BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

O.A. No. 327 OF 2023

In ref: News item published in India Today dated 30.04.2023 titled "3 minors among 11 dead in Ludhiana gas leak, Punjab govt. announces Rs 2 lakh ex-gratia".

Reply in the form of Affidavit by Surabhi Malik, IAS, Deputy Commissioner, Ludhiana

RESPECTFULLY SHOWETH:-

1. That undersigned is posted as District Magistrate, Ludhiana and thus filing the reply as Respondent.
2. That Hon'ble Green Tribunal has passed the order dated 02.05.2023 by relying upon O.A. No. 327/2023, in the light of media report of death of 11 persons, including three minors, at Ludhiana on account of gas leak in Giaspura area of the city on April 30, 2023. Further media report dated 02.05.2023 in The Hindu Daily titled "5- members SIT to look into 11 deaths due to gas leak in Ludhiana" suggests that hydrogen sulphide could have led to the incident. The said gas could be from industrial waste dumped in the sewerage line. And then Hon'ble Tribunal passed order that:

" National Green Tribunal constituted an eight member fact-finding joint Committee to be headed by Chairman, Punjab State PCB. Other members of the Committee will be Regional Director (North), CPCB, Industrial Toxicology Research Centre (ITRC), Lucknow, nominee of Director, PGI Chandigarh, nominee of NDRF, State PCB, District Magistrate, Ludhiana and Commissioner, Municipal

Corporation, Ludhiana. State PCB will act as nodal agency for coordination and compliance. The Committee may meet within one week from today and complete its task preferably within one month. It will be free to interact with any other department, institution or individual and undertaking visit to concerned sites. The Committee will be free to function online or offline as the situation may warrant. The Committee may give its report to this Tribunal on or before 30.06.2023 by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image PDF. If any violators are identified, they may also be given a copy of the report for their response, if any, before the next date. .

In the meanwhile, the District Magistrate, Ludhiana may ensure payment of compensation @ Rs. 20 lakhs each to the heirs of 11 persons who have died, deducting the amounts, if any, already paid within one month. The Committee may mention the details of persons who have died and persons injured with extent of injuries suffered by them. It may also recommend measures to be taken in future to prevent such incidents.

3. It is submitted that Gas Leak Incident happened on 30.04.2023. In this regard a multi-level Magisterial Inquiry was instituted by undersigned vide letter No 5318-5321/M.A Dated:-30.04.2023, with Sub Divisional Magistrate, Ludhiana (West) being the chairperson. Sub Divisional Magistrate, Ludhiana (West) vide letter no: 2886 dated: 29.06.2023 submitted the Magisterial Inquiry Report for above-mentioned case. This office has accepted above mentioned Magisterial Inquiry Report and have forwarded the same to Fact Finding Joint Committee vide this

office letter no.8952/M.A dated 29.06.2023 for consideration. **(Attached at Annexure - A)**

4. It is submitted that as per directions received from Hon'ble National Green Tribunal in reference of Original Application No 327 of 2023, that District Magistrate, Ludhiana may ensure payment of compensation @ Rs. 20 lakhs each to the heirs of 11 persons who have died, deducting the amounts, if any, already paid within one month. This office has appointed Sub Divisional Magistrate, Ludhiana (West) as Nodal Officer for disbursment of compensation amount.As per report received from Sub Divisional Magistrate, Ludhiana (west) vide letter No- 3237 dated- 12.07.2023 that the compensation to the next kin of the 8 deceased persons of Rs. 20 lacs has been disbursed and compensation of Rs. 1 lakh has been paid to the 4 injured persons in the tragedy. The details of compensation to next of kin of 3 deceased are mentioned in Para 5.The detail of 4 injured person, 11 deceased persons and their next kin and breakup of amount of compensation and is attached herewith **(Attached at Annexure - B)**

5. As per report received from Sub Divisional Magistrate, Ludhiana (west) vide letter No. 3237 dated- 12.07.2023, it is also submitted that after the death of Sourav Goyal and his wife Preeti Goyal their son Yug is the only heir, so the amount of Compensation of Rs 40 Lac (20 Lac each) has to be disbursed to their son Yug in the shape of F.D.R as he is of 5 years age i.e minor. Besides, after the death of Kamlesh Goyal Wife of Ashok Goyal both the sons namely Sourav Goyal (Deceased) and Gourav Goyal were the heirs of deceased Kamlesh Goyal and the amount of compensation in the lieu of the deceased Kamlesh Goyal is to be

disbursed amongst her both sons in the equal share i.e Rs 10 Lac each since her son Sourav Goyal and daughter in law Preeti Goyal W/o Sourav Goyal expired in the tragedy, Yug son of Sourav Goyal and Preeti Goyal becomes heir of Kamlesh Goyal so the amount of compensation @10 lac is liable to be paid to Gourav Goyal (Son) and Rs 10 lac to be paid to Yug(Grandson). Thus Rs 50 Lac (Rs 40 lac on account of death of his parents Sourav goyal and Preeti Goyal and Rs 10 lac on account of death of his Grandmother Kamlesh Goyal) is to be paid to Yug. As Yug is minor (age 5 year only), the case of legal guardian of Yug is yet to be decided and is under process.**It is submitted that the procedure for payment of compensation to Yug will be completed at earliest. Hence as requested by Sub Divisional Magistrate, Ludhiana (West) time of two months be granted to decide the case of payment of compensation.**

6. The Punjab Government and undersigned has followed the instruction passed earlier by Hon'ble National Green Tribunal. In view of the submissions made herein above, necessary instructions may be passed and original application no 327 of 2023 may be disposed of accordingly by this Hon'ble Tribunal. That any instruction passed by this Hon'ble Tribunal to the undersigned shall be complied with in letter and spirit.

It is, therefore, prayed that the Original Application No. 327 of 2023 may kindly be disposed of with appropriate orders.

Submitted by

(Surabhi Malik, IAS)

District Magistrate,
Ludhiana

Verification:-

Verified that the contents of para no.1 to 6 of the above reply are true and correct to my knowledge as derived from the official record. No part of the above reply is false and nothing material has been kept concealed therein.

Dated:-

Place:-

(Surabhi Malik, IAS)
District Magistrate, Ludhiana

Annexure-A

ਦਫ਼ਤਰ ਡਿਪਟੀ ਕਮਿਸ਼ਨਰ – ਕਮ - ਜ਼ਿਲ੍ਹਾ ਮੈਜਿਸਟਰੇਟ, ਲੁਧਿਆਣਾ

OFFICE OF THE DEPUTY COMMISSIONER – CUM - DISTRICT MAGISTRATE, LUDHIANA

To

The Chairman,
Fact Finding Joint Committee (FFJC)
Chandigarh.

No:- 8952/M.A Dated:- 29.06.2023

Subject- Inquiry report regarding Original Application No 327 of 2023 in the news item published in India today on 30.04.2023 titled " 3 minors among 11 dead in Ludhiana gas leak

In reference of Original Application No 327 of 2023 in the news item published in India today on 30.04.2023 titled **"3 minors among 11 dead in Ludhiana gas leak"** a Fact Finding Joint Committee (FFJC) was constituted vide NGT directions/orders. In reference to above-mentioned incident a multi-level Magisterial inquiry was instituted by undersigned vide letter No 5318-5321/M.A Dated:- 30.04.2023, under the Chairmanship of SDM, Ludhiana (West).

Sub Divisional Magistrate, Ludhiana (West) vide letter no:- 2886 dated:- 29.06.2023 submitted the magisterial inquiry report for above-mentioned case. This office accepts above mentioned magisterial inquiry report and forward the same to Fact Finding Joint Committee for consideration and necessary action please.

Deputy Commissioner,
Ludhiana

From

Sub Divisional Magistrate,
Ludhiana (West).

To

The Deputy Commissioner,
Ludhiana.

Memo No :- ३८८६ Dated :- 29/06/2023

Sub.:- Magisterial enquiry report of in Giaspura gas leak incident on 30.4.2023 at Giaspura, Ludhiana.

Ref .:- Your office letter (Endst.) No. 5318-5321 dated 30/4/2023, on the subject cited above.

Vide letter under reference, the undersigned was entrusted the magisterial enquiry into the gas leak incident, which occurred in Giaspura, Ludhiana on 30/04/2023. The enquiry has been completed on the basis of the reports of various concerned departments. The detailed enquiry report is attached alongwith for your kind perusal and further necessary action.

Sub Divisional Magistrate,
Ludhiana (West).

Report of Magisterial Enquiry in Giaspura gas leak incident on 30.4.2023 at Giaspura, Ludhiana

Chronology of the Incident (Endst No. 5367-5371/M.A. dated 02.05.2023)

An alleged gas leak incident was reported by a PCR of PS Sahnewal, Ludhiana Police Commissionerate in Sua Road, Giaspura in the eastern part of Ludhiana City at approx. 7:30 AM today i.e. on 30/04/2023 (Sunday) to the SHO, PS Sahnewal.

Following this, police team along with Ambulance reached the site and found two people lying unconscious by the roadside at Sua Road, Giaspura, who were immediately sent to the Civil Hospital, Ludhiana. The police team further found that the residents of a house at a distance of around 30-40 yards from a sewerage manhole had collapsed. Further, three (03) persons were found lying unconscious outside one local clinic namely Aarti Clinic and two (02) persons were found lying unconscious outside a local karyana shop viz. Goel Confectionery. The Sahnewal Police informed the District Administration, Municipal Corporation (MC), Ludhiana, medical teams and forensic experts, as well as the 13th NDRF battalion stationed at Ladhowal, Ludhiana, all of who rushed to the spot.

ADC, Khanna, SDM, Ludhiana (West), Joint Commissioner, MC, Ludhiana, and senior police officials also rushed to the spot, followed by District Magistrate and Commissioner of Police, Ludhiana and Commissioner, Municipal Corporation (MC), Ludhiana, for organizing immediate rescue and relief operations, and for cordoning off the affected area. The 7th Battalion of NDRF, which is stationed at Bathinda, joined the rescue & relief efforts at 11:15 AM.

The affected areas was evacuated and cordoned off. It took some time for the NDRF teams to identify the area of leakage. NDRF teams, with the help of specialized equipment/kits, collected samples from affected sewerage manholes and handed over to the teams of PPCB for lab testing & further investigation. With the help of hand-held gas detection kits, the NDRF teams detected unsafe levels of Hydrogen Sulphide (H_2S) in the general area. Coordination was also established with the Advisor (Operations)-cum-Joint Secretary (Mitigation), MHA, GoI and Joint Secretary (DM), MHA, GoI, for effective mitigation and response. **Dr. Anjan Roy, Former Director, Indian Institute of Petroleum (IIP), Dehradun** and an expert through video conference, suggested the next course of action for decontamination with diluted caustic soda which was started in the evening of 30.04.2023. Detection was done regularly at various points in the suspected/ affected area to check the levels of contamination at different hours from 4.00 am to 4.00 pm on 01.05.2023. Furthermore, a Sr. Scientist of CSIO, Chandigarh reached the spot in the evening with more gas detection sensors to detect the levels of Hydrogen Sulphide (H_2S) in this incident. Mitigation & response measures have been undertaken by all concerned agencies as suggested by the expert and subsequently, H_2S levels significantly declined in the area. Also, in coordination with JS (Mitigation), MHA, GoI, two (02) Army teams viz. the Engineers Brigade from Zirakpur and a team from 11 Corps, Jalandhar also arrived and. The Army teams were stationed at 48 Armoured Regiment, Dholewal, Ludhiana.

The NDRF teams monitor H_2S level across the stretch at subsequent time intervals and after considerable improvement in situation on the ground, the police cordon, which was imposed on 30.04.2023 just after the incidence at 250 metre radius around the affected area was subsequently reduced to 25 metre from the affected area on 01.05.2023 as per the report of three members technical committee homed on 30.04.2023 (according to letter **Endst. No. 5373/MA dated 01.05.2023)**. The cordon was subsequently called off after two days.

1. The details of the deceased and injured persons is as below:- **(Memo No. 435/5A/ACP South dated 22.06.2023, Annexure-'C'** and **Civil Surgeon Office Report Letter No. Special/23/01 dated 24.06.2023) Annexure-'C'**

Sr No.	Name of the deceased	Age	Gender
1.	Sourav Goyal S/o Ashok Goyal R/o Lal Chakki, Sua Road, Giaspura, Ludhiana	35	Male
2.	Preety W/o Sourav Goyal R/o Lal Chakki, Sua Road, Giaspura, Ludhiana	31	Female
3.	Kamlesh Goyal W/o Ashok Goyal R/o Lal Chakki, Sua Road, Giaspura, Ludhiana	60	Female
4.	Kavilash S/o Chalak Dev Yadav R/o Sua Road, Giaspura, Ludhiana	40	Male
5.	Varsha W/o Kavilash R/o Sua Road, Giaspura, Ludhiana	35	Female
6.	Kalpna D/o Kavilash R/o Sua Road, Giaspura, Ludhiana	16	Female
7.	Abhay Narayan S/o Kavilash R/o Sua Road, Giaspura, Ludhiana	13	Male
8.	Aryan Narayan S/o Kavilash R/o Sua Road, Giaspura, Ludhiana	10	Male
9.	Amit Gupta S/o Hariom R/o Giaspura, Ludhiana	25	Male
10.	Navneet Kumar S/o Kumod Kumar Singh R/o 458/4/247, Ward No. 72, Near Masjid, Samrat Colony, Giaspura, Ludhiana	39	Male
11.	Neetu Devi W/o Navneet Kumar R/o 458/4/247, Ward No. 72, Near Masjid, Samrat Colony, Giaspura, Ludhiana	39	Female

List of injured persons:

There was no physical injury but history of inhalation of unknown gaseous substance as per report of CMO Office, Ludhiana

(Letter No. Special/23/01 dated 24.06.2023) Annexure-C

Sr No.	Name	Age	Gender
1.	Nitin S/o Kumod Kumar R/o 458/4/247, Ward No. 72, Near Masjid, Samrat Colony, Giaspura, Ludhiana	40	Male
2.	Gourav S/o Unknown R/o Giaspura, Ludhiana	50	Male
3.	Rajesh Kumar S/o Sagar Jaiswal R/o No. 01, Near Sitara Cinema, Sua Road, Giaspura, Ludhiana	28	Male
4.	Rubi Devi W/o Hari Chander Shah R/o Kundan Lal Property Dealer Makkar Colony, Sua Road, Giaspura, Ludhiana	29	Female

2. On the spot, statements of Sh. Davinder Yadav s/o Jamun Yadav, Sh. Rajesh Kumar s/o Sagar Prasad, Sh. Hari Chander Shah s/o Ram Parkash Shah, Smt. Rubi Devi w/o Hari Chander Shah, Sh. Jatinder s/o Kishan Rai, Sh. Sushil s/o Ram Parvesh were recorded, which are attached as **Annexure-A1**

A. Activities just after the incidence

NDRF Authorities:- (Letter No. 11011/11/Ops/NDRF/2023/1563 dated 20 May, 2023), Annexure-B : The team reached at incidence site at 0940 hrs. The entire area was immediately cordoned off completely by the NDRF teams after the tragic incident. After evacuation and decontamination exercise, the cordon was gradually reduced after due diligence and was completely removed after 2 days.

Police Authorities:- (Memo No. 435/5A/ACP South dated 22.06.2023), Annexure-C : It was informed by the police authorities that the CCTV cameras of the area were scanned and no suspicious activity was observed near the incident area upstream upto about 1 KM (Eastman Chowk) discharging any unethical effluent/ chemical etc. directly into sewer by any unsocial element.

Punjab Pollution Control Board:- (Letter No. 1849 dated 04.05.2023) Annexure-H1 : On 01.05.2023 and further upto 4.5.2023, the joint teams of Punjab Pollution Control Board and M.C. Ludhiana were constituted to scan the nearby area on the upstream and downstream of point of incident. Joint teams scanned 500m on upstream and up to 200m on downstream.

Municipal Corporation Ludhiana :- (Report Letter No. 166/PS/D Dated 23.06.2023) Annexure-G : The sewer line was stabilized by using diluted caustic soda in the evening of the incident on the advise of Dr. Anjan Ray (CSIR-IIP). Road gullies were constructed near the manholes to provide road Jalis for effective dissipation of sewer gases (If any) generated from the sewer lines after the incident.

B. Technical Committee Constituted *(Annexure-A2)*

Deputy Commissioner, Ludhiana vide **Letter No. 5362-5366/M.A. dated 1/5/2023** constituted a technical committee comprising of XEN, Water supply & Sanitation, XEN PWSSB & XEN (O&M Cell), M.C. Ludhiana. The committee was entrusted with the task of physically checking the area within 25 meter radius from the affected and to give immediate suggestions for ensuring the safety of public and submit its

report thereof to ADC Khanna by 1/5/2023and measures to be taken to lift the cordon imposed immediately after the incident.

Pursuant to above order, the committee officials visited the affected area and inspected three buildings where the incident had happened on 30/4/2023. The committee in its report dated 1/5/2023 observed that these buildings have very less or no provisions of cross-ventilation. The washroom neither had vent pipes nor exhaust fans. One drainage vent was found inside the residential room of the building of Aarti Clinic, which should not have been there. Furthermore, these buildings are very congested. In view of the above observations, the committee made following recommendations to prevent occurrence of such incidents in future:-

1. The Buildings should have provisions for proper cross ventilation so there is no possibility of any suffocation.
2. Washrooms should have exhaust fans and vent pipes so that the gases may be discharged.
3. With regards to the main sewer, the Committee suggested that all the manholes in the affected area should be provided with road gulleys or vent shafts so that sewer gases, which are formed inside sewer pipes, are discharged via these road gullies.

The findings of the committee are attached as ***Annexure-A3***

C. Magisterial Enquiry Ordered *(Annexure-A4)*

Deputy Commissioner, Ludhiana vide **Letter No. 5318-5321 dated 30.04.2023** constituted a committee for conducting Magisterial Inquiry into the incident of gas leakage with following members:

- SDM (West), Ludhiana
- PCS, Joint Commissioner, MC, Ludhiana.
- ACP, Ludhiana
- SEE, PPCB, Zonal Office-2, Ludhiana
- SEE, PPCB, Zonal Office-1, Ludhiana
- Deputy Director of Factories, Ludhiana

Deputy Commissioner during this time submitted three reports on Gas Leak incident at Giaspura, Ludhiana to ACS-cum-FCR, Deptt. of Revenue, Rehabilitation & Disaster Management, Govt. of Punjab, Chandigarh with reference no. as follows:- **(Annexure-A5)**

(i) First report sent vide No. 5331/MA dated 30.04.2023

(ii) Second report sent vide No. 5357/MA dated 01.05.2023

(iii) Third report sent vide No. 5372/MA dated 02.05.2023

In these reports Deputy Commissioner reported about immediate steps taken after the gas leak incidence at around 7.30 am on 03.04.2023. After that orders

about constitution of three members Technical Committee and constitution of six members Multi Sectoral Inquiry Committee. Finally in third report Deputy Commissioner provided detailed report of deceased and injured persons to ACS-cum-FCR (Revenue), Deptt. of Revenue, Rehabilitation & Disaster Management, Govt. of Punjab, Chandigarh.

Flow chart of incidence response and action taken was is attached as **Annexure-M**

D. <u>Reports of Various Departments taken as per the directions of Deputy Commissioner, Ludhiana</u>

d1 <u>National Disaster Response Force (NDRF) Annexure-B</u>

(Reported as Letter No. 11011/11/Ops/NDRF/2023/1563 dated 20 May 2023)

1. On 30 Apr 2023 at 0820 hours information received through Sh. Sameer Verma, SP Ludhiana (Punjab) by Sh. Uttam Chand, Commandant 13 Bn. NDRF about Gas leakage incident which happened in Giaspura, Sua Road, Ludhiana (Punjab) in which 04 persons found spot dead and 02 were seriously affected. SP asked for NDRF assistance immediately and he also told that told of gas and source of leakage is not known till now.

2. Accordingly, a team consisting of strength 03 SOs and 28 Rescuers led by Inspector Lal Singh Sukhwal (Mob- 7005890727) under the supervision of Sh. Dev Raj, Deputy Commandant with 04 x vehicles and all available CBRN equipments left from Bn HQ at 0.900 hours. The distance of incident site from Bn HQ is approx 30 Kms. Team reached at incident site at 0.940 hours.

3. Sh. Dev Raj, Deputy Commandant met with DC Mrs. Surbhi Malik, Commissioner Sh. Mandip Singh and took the stock of present situation and assessed the situation. He advised the civil administration to vacate and seal 500 mtrs surrounding areas of the incident site immediately so that further damage could be prevented. After assessing the situation NDRF team established the operation base/ command post at a safer distance as per rescuers and also advised Police, civil administration, public and media to maintain safe distance from the incident site. Team planned to execute operational tasks in 03 phases as under:-

(a) Phase-I. To search incident site to find out victim/unconscious person.

(b) Phase-II. To find out the source of gas leakage and plug it.

(c) Phase-III. To search nearby houses and lastly to carry out confirmatory search.

4. A sub team entered into the incident area under supervision of Sh. Dev Raj, Deputy Commandant. Initially the sub team tried to find out live victims in the area but no one was found at first sight. On further search the team observed that the contaminated gas was passing through three manholes of sewage pipe line passing along the road. They successfully plug two of them as the lid of third

manhole was broken NDRF team advised Municipal Committee employees to replace the broken lid and which replaced by them. The leakage was reduced to some extent. The sub team further searched the two buildings in which 04 victims were found dead and found a pet dog which was tied with chain on roof and was still alive, team rescued it and handed over to civil authority.

5. After half an hour, sub team was replaced by other sub team and team started confirmatory search of first floor of affected buildings. The team found that a door was latched from inside and it was also revealed that some people was suspected to be inside the room. Matter was informed to team commander and they tried to open the door but even after continuous knocking no one opened the door. The sub team made a lot of efforts to encourage and convinced them and thereafter finally door was opened from inside. After entering the room one male, one female and their 05 children aged approximately 07 years to 17 years were found hiding inside the room due to fear of incident.

All of them were rescued and evacuated safely from incident site and handed over to civil administration. Another team under Insp (GD) Lal Singh Sukhwal assisted civil administration in evacuating the persons of nearby houses to safer areas. Details of rescued persons:-

S.No.	Name of rescued persons	Age	Sex	
			Male	Female
(a)	Raushan Ali	48	Male	-
(b)	Imran Ali	17	Male	-
(c)	Trannum Khatun	15	-	Female
(d)	Araju Khatun	14	-	Female
(e)	Shabnam Khatun	11	-	Female
(f)	Sabana Khatun	10	-	Female
(g)	Sabina Khatun	07	-	Female

6. Commandant 13th Bn NDRF also reached at incident site at around 1200 hours and took the stock of situation. He discussed with Commissioner Sh. Mandip Singh Commissioner Ludhiana, DC Mrs. Surbhi Malik, IAS and DC Corporation Mrs. Shena Aggarwal, who were present at the incident site and supervised the operation further.

7. Meanwhile as per directions of HQ DG NFRF, a team of 7th Bn NDRF strength 01 GO, 04 SOs and 25 Rescuers also reached incident site at 1330 hours under supervision of Sh. Santosh Singh, Commandant 7th Bn NDRF alongwith Gas Alert Micro - V detector. On testing through Gas Alert Micro - V detector, it was revealed that Hydrogen Sulphide gas (H_2S) has contaminated the air and caused the incident. Initially the level of air contamination was found 190-200 PPM. Then the state medical authority used Caustic Soda in sewage and flushed out with water to get the level of contamination down. Thereafter the air contamination level came down between 02-15 PPM. Further civil administration called up experts from CSIO (Central Scientific Instrument Organization) Chandigarh who had taken the sample for further investigation.

8. Teams of 13 Bn NDRF and 7th Bn NDRF stayed at incident site for two days, checked air contamination on next day. The situation was found normal by evening on 1st May 2023. Operation was called off with consent of civil authorities on 01 May 2023 at 2200 hours and teams left for their respective locations.

9. Some photographs of operation are attached as Annexure-K.

d2 **Health Department through *Letter No. Special/23/01 dated 24.06.2023 Annexure-C***

Day of incident, 30/04/2023, Emergency response team performance, Department of Health, Ludhiana

On receiving the information about the disaster at Giaspura with the incidence of alleged toxic gas leakage at 8:00 AM. Emergency disaster teams were activated immediately. Civil surgeon Ludhiana personally monitored the teams and led the way by ordering the Senior Medical Officer of the Civil Hospital, Ludhiana, to be equipped to handle the emergency.

Emergency disaster response is divided into four zones.

1. The visit to the disaster scene:

Officers deputed were:-

1. Dr. Charan Kamal, Medical officer, Forensic medicine and toxicology expert, Civil Hospital Ludhiana.
2. Dr. Vishal deep Chopra, Medical Officer, Emergency, Civil Hospital, Ludhiana.
3. Dr. Manju, Medical officer, Civil Surgeon, Office, Ludhiana.

Ambulances were equipped with necessary emergency treatment kits, three fixed oxygen cylinders, two patients' portability capacities, and three portable oxygen cylinders.

All three teams consisted of one doctor, one class four, and one pilot.

108 Ambulances/ NGO/ private ambulances and even private vehicles transferred the patients to the Civil/ District Hospital Ludhiana and nearby hospitals like SPS Apollo/ Oswal Hospital. There was no hassle reported in transferring the victims to healthcare facilities.

Dr. Charan Kamal and his team stayed there till 12.30 PM to analyze the situation, being a toxicology expert gave his input to evacuate the area, and assisted the administration to take steps to limit further damage by advising the practical inputs such as using the masks, a practical tour of the affected area helped to analyze the site of leakage, a probable diagnosis of the type of the gas and it's toxic nature. Kept a constant touch with the team no. 2, the team of multi-specialist doctors for the treatment of the victims established back at the base that is District/Civil Hospital Ludhiana and gave valuable inputs to analyze the

signs and symptoms of the victims and findings of the dead bodies. **Our team drew a hypothesis of Hydrogen sulfate poisoning and toxicity of methane, etc., by 9.30 AM only.**

Dr. Vishal stayed along with the team up to 2.00 PM, Dr. Manju along with her team stayed up tuntil4 PM.

Treatment for the Minor toxicity effects in the form of headache and confusion were seen in the local population. Medicines and consultations were provided by the teams.

Team No. 02. Emergency treatment team.

Officers deputed were

Dr. Harinder Singh Sood, MD, Medicine, Senior Medical Officer, ART, Civil Hospital Ludhiana,

Dr. Sukhdeep Kaur, MD, Medicine, medical officer, Civil Hospital Ludhiana, Dr. Amandeep Kaur, MD, Medicine, medical officer, CHC Dehlon and

Dr. Harleen Kaur, MD Ophthalmology,

Dr. Harpreet Singh, Medical Officer, emergency, Civil Hospital Ludhiana. They were present at the district hospital in Ludhiana.

They received two victims and nine dead bodies during the emergency.

The signs and symptoms are suggestive are acute inhalation poisoning and acute reversal was done successfully.

This team along with consultation with Dr. Charan Kamal is present at the site and keeping in view the signs/ Symptoms of the victims decoded the probable cause very quickly. The vast experience of our medical specialists and other paramedical staff helped these patients/victims to come out of the toxic effects of toxicity of gases.

Team No. 3. The Medicolegal team:

Under the direct supervision of:

Dr. Vivek Kataria, MS General Surgery, Assistant Civil Surgeon, Ludhiana. Our Medicolegal team was constituted and put into action for the necessary examination. As soon as police officials produced Inquest papers regarding the deaths of the ten people for the postmortem examination. A board of doctors consisting of Dr. Charan Kamal, MD Forensic Medicine, and Toxicology, Medical Officer, civil hospital Ludhiana, Dr. Saurav Singla, MS. Orthopedics, medical officer Civil Hospital Ludhiana, Dr Geetanjali Kalyan, an Emergency medical officer was framed. This team observed that all the deceased have almost similar findings of asphyxia due to inhalation poisoning. As they were having pale faces, congested conjunctivae of the eyes, hemorrhagic mucosal membranes, discolored brains, discolored lungs of greenish purple color, and generalized cyanosis on the dead

bodies. They also kept the Organs (viscera) preserved appropriately for the chemical analysis at State Chemical Laboratory Kharar for the type of gas/ poison for the Histopathology examination from the Government Medical College Rajindra Hospital Patiala.

The rotten eggs smell at the locality, the constant irritation to the eyes, mild headache, and mind confusion in the people, who were present at the scene were suggestive of hydrogen sulfide and the symptoms described by the patients/ victims at the hospital in the form of headache, irritation in eyes, confusion, irritation in the oral mucosa, falling saturation, breathlessness (and even unconsciousness in one patient were also suggestive of hydrogen sulfide and methane toxicity.

The performance of all team was beyond words. These teams were in constant discussion with higher officials of the health department, the department of medical education and research, the head of the departments of various specialist departments of Government Medical colleges of Patiala/ Amritsar, etc.

The collective efforts of these three emergency teams of the health department led to the saving of two precious lives and the completion of the emergency disaster response. The response from the General administration, higher officials of the health department, the Department of Police, and other paramedical staff was helpful. This board did a detailed postmortem examination of the dead bodies of ten bodies from 04:00 PM to 10.00 PM.

Team No. 4

Other treating physicians and other paramedic staff of Civil Hospital, Ludhiana did a commendable job by taking care of patients for 24 hours.

In total 9 dead bodies were received at the civil hospital Ludhiana and 2 dead bodies were brought by police from SPS Apollo hospital. A postmortem examination on all 11 bodies was done at civil hospital Ludhiana and dead bodies were handed over to the police with due respect.

And made reversion of toxicity of two victims successfully.

Post-mortem examination of 10 dead bodies was conducted on 30/04/2023, by board of doctors and cause of death was declared **"THE CAUSE OF DEATH, IN THIS CASE, IS POISONING DUE TO TOXIC GAS INHALATION HOWEVER TYPE OF POISONING WILL BE DECLARED AFTER RECEIVING."**

It is humbly submitted that only two reports amongst eleven have been received till date from GMC, Patiala. (Reports already sent) via email. All eleven chemical analysis reports are pending from Chemical Laboratory Kharar. It is further submitted that the cause of death was already given and viscera was kept for ascertaining the type of intoxicant only. The histopathology examination received in above said two cases are showing acute tubular necrosis and intense congestion of lungs which are again suggestive of inhalational poisoning.

The report of chemical analysis is always dispatched to the concerned police station and all eleven chemical analysis reports are pending from Chemical Laboratory Kharar. (Report is attached as *Annexure-1*).

d3 Police Authorities Report *(Memo No. 435/5A/ACP South dated 22.06.2023)* Reports are attached as Annexure-C

A Special investigation Team has been constituted to probe the incident. The CCTV cameras within radius of 1 km of the place of occurrence were minutely examined and certain enquiries were also conducted from nearby residents. It was informed by the police authorities that samples of 3 cans of suspicious material were taken at around 500 metres downstream from the point of incident at a vacant plot and also one can of unknown chemical was recovered from the premises of M/s Aarti Clinic (one of the houses in which the tragic incident has happened). The sample obtained from M/s Aarti Clinic have not been analyzed by either CFSL/FSL or PBTI Labs, Mohali. It is further submitted that the post-mortem examinations of the all the deceased persons were conducted by Board of Doctors and further various visceras taken out from the dead bodies were sent to the chemical examiner Kharar. Reports of which are still awaited. Further investigation is underway.

d4 Joint Commissioner, Municipal Corporation, Zone-C, Ludhiana Report

(Letter No. 35/JCK/D dated 22.05.2023) Annexure-D

Report about

(i) Record of water and sewerage connection of the person there as per Letter No. 106/XEN-C/OM dated 19.05.2023

(ii) No record of building plan of Aarti Clinic, Goyal Confectionary/Goyal Cold Drink in Municipal Corporation, Ludhiana. (Letter No. 119/ZS/R dated 18.05.2023)

- *Building plans of Goyal Confectionery /Goyal Cold Drink and Aarti Clinic Situated at Sua road Giaspura Ludhiana (Tragedy sites).*

As per reports neither of the buildings i.e. M/s Goyal Cold Drinks and M/s Aarti Clinic have got the building plans approved as per the records in the Municipal Corporation Zone-C nor has any of the affected site has deposited regular fees of building under regularization policy notified by Government has been deposited. Report attached as ***Annexure-E***

- *Sewer connection of Goyal Confectionery/Goyal Cold Drink and Aarti Clinic Situated at Sua road Giaspura Ludhiana.*

As per Municipal Corporation records, Sewer connection of building Goyal Confectionery/Goyal Cold Drink is in the name of Ashok Goyal and Aarti Clinic is in the name of Sh. Kamlesh Kumar but there was no record connection of adjoining house in which the incident occurred. Report attached as ***Annexure-F***

Municipal Corporation, Ludhiana Report *(Annexure-G)*

(Letter No. 166/PS/D dated 23.06.2023)

The report submitted by MCL regarding its observations and findings is as under:-

Occurrence of events

Mr. Swaran Chand, ADFO, stated that on 30-04-2023 at 8:15 am, the control room of the Fire Brigade, Municipal Corporation Ludhiana received information about a gas leak on Giaspura Sua Road. After receiving the information, the fire brigade personnel reached the spot around 08:40 hrs and found some individuals lying unconscious in front of the Amul Milk shop. The individuals were immediately taken to the hospital by ambulance (Annexure-'A' attached with photo). Subsequently, the higher officials of the Municipal Corporation were informed about the incident.

The Hon'ble Deputy Commissioner and Commissioner of Municipal Corporation arrived at the site, and other officers from the Municipal Corporation O&M Department, District Government officials, NDRF team, Punjab Pollution Control Board team, etc. joined them. The Deputy Commissioner, Commissioner of Municipal Corporation, and all the teams jointly inspected the site and found that it had a strong smell of rotten eggs. When the teams approached the site, the smell of gas became stronger. All the maintenance holes/haudis in the area were mapped (Annexure-B). It was seen that some dead bodies found next to the personal haudi of Goyal Cold drink. Also a maintenance hole near transformer was covered with a broken cover, which appeared to have been recently broken, and the malba (debris) of that cover was lying nearby on the site (attached at Annexure-'C'). The visible steel reinforcement of the broken maintenance holes cover was not rusted. Additionally, the team observed that the private haudi of Amul Milk/Goyal Cold Drink shop was blue in color from the inside, whereas the haudi of nearby houses did not have this blue shade. The team also noted that there was no bad smell beyond the broken maintenance hole cover.

Meanwhile, the NDRF team, along with the Municipal Corporation team and PPCB team, wearing safety kits, took samples of water from maintenance hole chambers and sent for testing as per the details below:

Maintenance hole opp. Sitara Cinema (E) (S4), ii) Maintenance hole of main sua road opp. st. no. 4 near transformer (B) (S1), iii) Maintenance hole of main sua road opp. st. no. 5 near Jasbir Building material (A) (S3), iv) Maintenance hole of st. no. 4 (Sample) gali (B1) (A1), v) Gaar of personal haudi of Goyal Cold Drink (D1) & also a sample was taken from sewer Maintenance hole in Giaspura park (in the different area, to act as a control sample). The samples have later been sent to PBTI lab for testing. The indicating map of the site is attached for reference (Annexure-B1).

After consultation with Director CSIR, the NDRF team started checking of gas limits in the area using gas detection kits, from around 1.30 PM onwards. The

concentration of gases was measured inside the maintenance hole and in the surrounding air. Later in the evening, the NDRF team was joined by Dr. Surjeet, a representative of the CSIR Department, Chandigarh, for the same, and this continued throughout the night. A copy of the readings showed that the concentration of Hydrogen Sulphide (H_2S) and Carbon monoxide (CO) gases was very high inside these maintenance holes as detailed below.

Thus it was observed that concentration of H_2S was quite high (in the range of 174 to 195) in maintenance holes A, B, C, D & Haudi D1, D2. In the others, the H_2S concentration was in the range of 10-15 (E/B1). Also, the concentration of CO was high in B1, D1, D2. **These were discussed telephonically with Dr. Anjan Ray, Director CSIR, who verbally suggested defusing/neutralizing the acidic gases with the help of a diluted caustic soda solution to prevent the further spread of poisonous gases through the sewer line.** As per the verbal instructions from Director CSIR, the teams of the Municipal Corporation prepared caustic soda solutions and started pouring the solution into the maintenance hole chambers at around 6:30 pm. The exercise continued throughout the night & the readings of gas concentration were repeated every 2 hours jointly by NDRF & MC teams. Wherever the gas concentration was high, caustic soda solution was then used to dilute it. The Municipal Corporation team added Caustic soda solution to the maintenance hole chambers as per requirement even during the night hours with the help of sewer jetting-cum-suction machine and washed the effected chambers with the help of fire tender. It was seen that the gas levels were steadily declining after 10 PM & came within permissible levels after that. These were continued to be measured till around 11.00 AM the next day, when the levels were found to be within permissible limits. The remedial action is to make more road gullies and disconnect illegal sewer connections (Details at Annexure-'D')

The sewer near the incident site was laid 20 years ago by Punjab Water Supply and Sewerage Board. The design statement showing gradient, slope, discharge etc. was received from the record of PWSSB along with map is attached at Annexure-'E'. As per the record, the total length of the sewer line from Eastman chowk to Giaspura chowk is 1800 mtr. approx.

- The sewer in the area is 30" id is designed to take discharge of 3.56 cusec and designed discharge of this sewer is 7.02 cusec from Node no. N/10/1 to N/1.
- It is submitted that one no. of tube well exist in this area, upstream of this site, which is having approximately 0.208 cusec water generation per day.
- No. of water supply and sewer connections Domestic in the area are approximately 400 nos. and having 0.104 cusec waste water generation. 66 nos. of disposal connections having approximately 0.197 cusec say 0.2 cusec.

From the above it is evident that the total waste water discharge in the area (Tube well and Disposal) is 0.405 cusec. So it is clear that the capacity of main sewer is much more than the waste water flowing in the sewer system, so the sewer system is not over loaded.

The direction of sewer is from Ashirwad Kanda towards Giaspura Chowk and this sewer is flowing by the gravity as shown in the design statement that the gradient of the sewer is 1/2500.

The level of the chambers near incident site is mentioned in designed statement annexed at Annexure-'F'.

It is also submitted that cleaning and desilting of sewer lines is done through mechanised means regularly in the entire city. Almost all the major sewer lines are cleaned once every 3-5 years as per the norms. It is further submitted that this main sewer line was cleaned with super suction machines in March 2019, the photographs for the same have been attached for reference at Annexure-'G'.

Further, in case of any problem or blockage in any particular sewer line, the cleaning of that line is taken as per the requirement. It was informed by the SDO-O&M, MCL of the area that cleaning of sewer lines on the downstream side of the affected area had been done recently in the month of April, 2023.

This was also evident from the fact that the levels of sewerage flow in sewer maintenance hole was much below the sewer capacity & no overflowing or blockage was visible.

Also, the residents of the area had mentioned that there was no issue of blockage or problem in the sewer flow. (Annexure-'H').

The sewer length in the area was examined and it was seen that 06 nos. of road gullies exist along with the maintenance hole chambers in that stretch having 150 mtr. from Jasbir Building material store to Sitara Cinema. And 19 nos. of road gullies already exists in the street opposite transformer in Street no. 04, Makkar colony. It is also mentioned that two additional road gully chambers were constructed from Jasbir Building material store to Sitara Cinema as remedial measure after the recommendation of the joint committee of MCL, PWSSB & Water and Sanitation Department constituted by Deputy Commissioner Ludhiana (Annexure- I). Issues discussed in the meeting of the joint committee constituted by NGT.

i. A fact-finding committee has also been constituted in this regarding of NGT. A meeting of this committee was held on 08-05-2023. Various issues as detailed below were discussed there: i. **Sh. Sheelendra Pratap Singh from Indian Institute of Toxicology research, Lucknow gave his observation that H2S is natural occurring gas in sewer but such high amount of concentration is not usually heard of & could be due to anaerobic digestion of sewer waste along with high amount of acid/ metal.**

ii. It was pointed out by Dr. Lakshmi, Epidemiologist from PGI Chandigarh that no such report of H_2S death in open space have been reported anywhere in the world.

iii. SE, PPCB informed that industries were checked within 50 mtr, 100 mtr & 500 mtr of the site & it was found that out of total 113 industries checked, 17 were

found to be water polluting. **Out of these 17 industries, 4 industries were at the downstream of the incident out of which 3 were acid consuming and 13 industries were found at the upstream out of which 11 was acid consuming.**

iv. SE, PPCB also informed that they had checked unauthorised industrial units running from houses/ residential units in the area. On checking, it was found that 23 industries were running from 64 residential premises checked. Out of these 4 industries were water polluting & pickling/ electroplating units, which were acid & metal consuming (3 upstream & 1 downstream).

v. SE PPCB also presented samples reports of waste water collected from the maintenance hole chambers as attached at Annexure-'J'. From these reports, it was observed that the pH value of sewer water content of three maintenance holes mentioned at sr. no. B, C & D is between 2 to 3.

NGT committee then visited the area along with the team from MCL and interviewed survivors and victims' family members. The interview transcripts are attached at Annexure-'H'. The people interviewed informed cohesively that there was no report of sewer block in fast few days or months. Further, all the members told committee that this is a peculiar smell which they had never smelled in past. Further, it was pointed out that there are large no. of electroplating and chemical industries running in this area and they are discharging their liquid in the sewer.

The issue of discharge of electroplating industry in the city was also discussed. It was informed that a common CETP, operated by JBR technologies is responsible for collecting the wastewater from more than 1000 electroplating industry in the region, treating it and then ensuring discharge as per the norms. It was also suggested by member CPCB that audit of various electroplating industries and JBR technologies should be conducted by Punjab Pollution Control Board to check the generation of water by the industry, the treatment of the wastewater and the mode of disposal of waste water generated after treatment.

Checking of organic discharge from meat shops into the sewer in the area. It is submitted that the special drives were conducted by the teams of O&M cell and Health branch of MCL on Sua Road, near Goyal Cold Drinks, Giaspura, on 8th June, 2023, and 22nd June, 2023. It was found that there are 06 nos. of meat shops in the vicinity of the area up stream of this site in approx. 150 mtr. stretch. Only one of the shops had a sewer connection with the possibility of its discharge into the sewer system. The approx. discharge from this shop is assessed to be approx 200 litres per day. It is submitted that though this discharge is negligible and itself could not lead to such high concentrations of H_2S in the sewer in the area. 16. It is further stated that on 8th June, 2023, the Health branch issued 8 challans to meat shops, and 20 kgs of meat recovered during the drive was destroyed. Continuing this effort, another special drive was conducted on 22nd June, 2023, by the teams of MCL. During this drive, 13 challans were issued to meat shops, and 50 kgs of meat were destroyed by the Health branch. Only one of those meat shops had a sewer connection, which could had caused discharge into sewer system. This

sewer connection has now been disconnected by O&M cell MCL. Pictures of this special drive and the copies of the challans have been attached at Annexure-K.

The sample reports of water collected from various maintenance hole chambers & sent for testing by MCL has also been received and annexed at Annexure-'L'.

Expert opinions/ reports

It is further submitted that the officials from CPCB visited site of accident Giaspura, Ludhiana on 03.05.2023, namely Mr. G. Rambabu, Scientist D, Dr. Narender Sharma, Scientist E, Mr. Kamlesh Singh, Scientist E and Mr. Nazimuddin, Scientist F and have submitted their report in the matter. Some of the key points are reproduced as below: (Annexure- M) "Presence of sulphide in sewer water as H2S is due to biochemical reduction of the sulphate present in water. The ratio of Sulphur (S). Hydrosulphide (H2S) and H2S in sewer water at any point of time depends on the pH of sewer water at that time. Intermittent discharge of acidic effluents from industries in mixed sewers acts as an agent for shifting the equilibrium. Acidic effluents are also a source of sulphate (due to sulphuric acid), which ultimately forms sulphide.

Further, if industrial effluents containing metals and heavy metals are discharged in the sewers, the metals are precipitated as metal sulphides in the sewer lines. These metal sulphides, in the presence of acids/acid effluents containing H2SO4 and/or HCl, end up generating hydrogen sulphide (H2S) gas.

Therefore, it can be concluded that intermittent discharge of acidic and metallic industrial effluent/waste into mixed sewers can be a source of sudden release of H_2S gas in very high concentration from such sewers.

It is relevant to mention that H2S is a diprotic weak acid and even a saturated solution of H_2S is not expected to have a pH less than 4.0. Therefore, it may be concluded that pH level of 2.5-2.6 as reported in main sewer water near the houses where deaths occurred is a result of acidic industrial effluent discharge.

The above facts strongly point towards the discharge of industrial effluent as the cause of highly acidic water in the main sewer in the area and the also the cause of release of H_2S in the sewer line in high concentration, leading to immediate collapse and death of eleven persons.

As per recent media reports and the discussion held with Chief Environmental Engineer, PPCB, the industries in Ludhiana use both Hydrochloric acid and Sulphuric acid. It was also reported that few industries in Giaspura area have acid pickling step in their manufacturing process. The chloride content in the main sewer water near the accident was found higher in comparison to distant points (both upstream and downstream) which may be due to use of hydrochloric acid in the area. These facts also indicate that industrial discharge is a key factor in releasing of H2S in high concentrations."

A report has also been received from Dr. Anjan Ray, Director CSIR through his email dt 1.5.2023, which is as follows: (ANNEXURE- N)

"In continuation of our discussions throughout the day today in the aftermath of the Ludhiana Gas Leak, I have summarized my initial hypotheses and recommendations for the consideration of the local administration and of NDMA as follows:

i. Evidence from the medical examiner and his preliminary forensic assessment suggests that the gas released contained hydrogen sulphide (H2S) as the primary causal agent. This correlates with the foul smell noted by some affected residents and the symptoms outlined by the medical specialist.

ii. We cannot rule out carbon monoxide as a secondary causal agent. CO is colorless and is often found in sewer gas compositions. An authoritative recent review of sewer gas compositions can be found at https://www.sciencedirect.com/science/article/pii/S2772416622000808.

iii. Based on the hypothesis that H2S is the primary causal agent, a frontline response of neutralizing the H2S with appropriately diluted caustic soda has been advised. This appears to be working based on feedback from the team on the ground, as ambient H2S levels have fallen sharply after the caustic treatment.

iv. It may be noted that sudden acidification of sewer contents (for instance, through the shock discharge of acidic effluent from any electroplating unit in the area) could cause a surge in H2S levels. To determine if this might have been the cause, ICP analysis of trace elements and metals in the sewage samples may be carried out.

v. Unlike H2S, there is no way as such of neutralizing CO. However, its vapour density (~14) is close to that of air (~14.7) and it should disperse naturally at a rate quicker than H2S (V.D ~ 17), which is heavier than air.

vi. H2S readings will, therefore, vary across a vertical axis at ground level, 1.5 feet above ground (typical level of a person lying on a bed), and at 4.5 feet above ground (typical nostril level of a standing person), with the maximum concentration of the toxic gas being at the ground level. While CO will not show much variation. I remain at your service for additional questions, if any."

Further, a study of the literature and scientific data points out that the role of these metals in formation and acidification is as follows: (ANNEXURE- O) Nickel (Ni): Nickel can act as a catalyst in certain chemical reactions that lead to the formation of H2S. It can enhance the conversion of sulphur-containing compounds into H2S. Additionally, nickel compounds may contribute to the acidification of certain environments.

- Zinc (Zn): Zinc play a role in acidification processes, particularly in the presence of acidic substances. It can react with acids, forming zinc salts and

releasing hydrogen gas, thereby contributing to the overall acidification of a system.

- Chromium (Cr): Chromium compounds can contribute to acidification when they dissolve in water, forming acidic solutions.
- Iron (Fe): Iron is an essential component in various chemical reactions that lead to the production of H2S. Iron sulphide minerals, such as pyrite (FeS2), can release H_2S when they come in contact with water and undergo chemical weathering or microbial activity. Iron can also participate in acidification processes, particularly through the formation of acidic solutions when iron compounds dissolve in water.

Conclusion

The sewer system had sufficient capacity and as per the visible scenario, the cleaning reports of O&M branch of MCL and the feedback from the people interviewed, there was no report of sewer block in fast few days or months in the area.

- Sufficient number of Road gullies were constructed with the main and branch sewer line which act as vent for escaping of sewer gases. Hence the possibility of accumulation of gases in large quantity is minimal.
- Though there were some meat shops in the area, but only one of them was found to have a sewer connection. Though this could have led to some discharge of the organic matter in the sewer, but this could have lead to increase in the production of H_2S gas inside the sewer only. In the current case, there is abnormally low pH, with the release of very high concentration of H_2S gas from a particular outlet for a very short span of time, which does not seem possible merely due to a little increase in the organic load in the sewer.
- Reports of PPCB point out the existence of a number of industrial units in the vicinity (both authorised and illegal), which have been discharging the metals and acid into the sewer lines.
- An audit is also required into the treatment and discharge of wastewater of the more than 1000 electroplating units in the city through the CETP operated by JBR technologies. Without this information, it cannot be ruled out that there has been no illegal discharge of untreated waste of the electroplating industry (containing heavy metals as well) into the sewer lines of Ludhiana.
- Also, the interviews and discussion with the people of the locality show that there are a lot of electroplating & other industrial units nearby, some of which could have been dumping its waste illegally.
- It seems that the incident might have occurred due to some chemical reaction of some acids/ metals with naturally occurring sewer gases (H_2S)/ sewage, which could have led to a sudden release of very high concentration of H_2S gas for a short period of time leading to the death of the people instantaneously. This seems likely based on reports of high

concentration of metals & very low pH (showing acidification of the sample).

- Further, it is observed that H_2S gas had been released into the air from a limited area in extremely high quantity for a very limited span of time, even leading to breakage of manhole covers and blackening of the cover, which does not seem possible as a part of natural sewer gas formation, and indicates occurrence of some sort of chemical reaction.
- Thus after taking to victims and local residents, visiting field and taking comments from experts in subject matter, committee is of view that this sudden release of very high concentration of H_2S is due to releasing of chemicals in sewer from various industrial units. However, the exact source is not known & is a matter of investigation.

d5 Punjab Pollution Control Board

Punjab Pollution Control Board has submitted 3 interim reports:

Letter No. 1849 dated 4.5.2023 (Annexure-H1) in which they submitted about the joint survey conducted around the place of incidence to identify the cause under which joint survey was conducted by officer of PPCB and MC, Ludhiana and they mention that no acid consuming industry was found within 100 metre distance from place of incidence.

Letter No. 1898 dated 6.5.2023 (Annexure-H2) in which PPCB has given its findings on visit reports of 22 industries on 01.05.2023 and 04.05.2023. PPCB reported that Board of monitoring and taking action against violating industry, no sewer vents were observed near the point of incident.

Letter No. 2216 dated 19.5.2023 (Annexure-H3) according to which on 01.05.2023 samples from the branch lines of the sewer in nearby vicinity collected by the Joint team of PPCB and Municipal Corporation, Ludhiana were collected and sent to Central Lab to PPCB at Patiala. The reports submitted by the department are attached as Annexure-A

The abstract of visits is as under: **(PPCB First Interim report No. 1849 dated 04.05.2023 (Annexuer-H1)**

Total No. of industries visited	Distance from point of incidence					
	Upstream & downstream Upto 50m		Upstream & downstream 50-100m		Upstream up to 500m& downstream upto 200 m	
	Total water polluting industries found	Pickling / electroplating etc. industries	Total water polluting industries found	Pickling / electroplating etc. industries	Total water polluting industries found	Pickling / electroplating etc. industries
113	0	0	2	0	15	14

Out of the total 113 industries, 17 were found water polluting by the joint team. Out of these 17 industries, 4 industries were at the downstream of the incident. out of which, 3 were acid consuming. 13 water polluting industries were found at the upstream out of which 11 were acid consuming.

None of these 13 industries was observed to be discharging any acidic effluent into sewer line by the joint team of PPCB / MCL at the time of visit. No acid consuming industry was found within 100 mtr distance from the place of incident.

As per the decision of District Administration, joint teams of MCL and PPCB continued door to door survey on 3.5.2023 and 4.5.2023 for checking the residential buildings/premises and 66 establishments were visited.

Initial discussions with experts revealed that in case, waste water stream in a sewer line remains in running condition with proper ventilation of sewage network, the generation of H_2S at such a lethal concentration is not possible as there would be no anaerobic conditions developed in sewer line, which is a pre-requisite for generation of H_2S gas. However, in case there is a built up of organic matter due to blockage/stagnation in sewer /slow velocities of sewage/ ill designed sewer, there is possibility of sludge/slime formation, only then Bio-chemical degradation of organic matter would lead to the generation of gases like methane and H_2S. Inadequate vents to the sewer lines accompanied by no or poor ventilation in the residences of affected houses might have aggravated the problem resulting in the accumulation of H_2S gas in the affected pocket.

No sewer vents have been observed near the point of incident. Non availability of ventilation pipes in the affected stretch might have led to heavy accumulation of sewer gases such as H_2S, CO, etc. This gas is also a cause of sewer men deaths across the country as tiny proportions are also considered lethal.

Jetting and super suction machine at the night of incidence were operated late night. This incident occurred in a very short span of sewage network. The manholes at non-uniform interval were observed near the incident site.

The sewer opening/ WC opening/ wash basin drains may have acted as a reverse ventilation pipeline dissipation of H_2S in the affected premises as the sewer connections have not been provided scientifically by the affected households. Poor ventilation system may have affected the dissipation of H_2S gas and have aggravated the situation. H_2S gas is the inherent component of sewage network and formed due to anaerobic digestion of organic matter. The vicinity in and around the incident is densely populated and several commercial establishments discharging heavy organic and acidic effluent such as dhabas, meat shops / slaughter houses etc. are located in the area. It is required to be checked as to whether the sewer connection of the affected premises have been approved by the Municipal Corporation or have been connected by the owner of the premises against the sewer designs in un-authorized manner.

Considering the poor ventilation of the houses, building plans are required to be assessed.

The Government of Punjab, Department of Science, Technology and Environment has issued directions vide memo no. 10/228/2019/STE-5/594066/1 dated 10.10.2019 u/s 5 of Environment (Protection) Act, 1986 to various departments and Municipal Corporation, Ludhiana. One of the direction is reproduced below:

> No new connection or enhancement of existing connection by MC, Ludhiana.
>
> MC, Ludhiana shall not grant any new connection or enhancement of existing connection to municipal sewer for discharging industrial effluents.

Final report by Punjab Pollution Control Board

(Letter No. 2936 dated 21.06.2023) Annexure-I

In continuation to the earlier reports submitted, the Punjab Pollution Control Board has examined this incident through various scientific interventions and has also taken Expert opinions. The Board has also examined the literature published in various international Journals/papers for understanding the cause of the incident. Following findings have been observed:-

1. Formation of Hydrogen Sulphide (H_2S) in Sewers

Hydrogen Sulphide is commonly known as sewer gas and is formed under anaerobic conditions through microbial biochemical degradation of organic matter including human excreta, kitchen refuse, detergents, animal waste, Oil & Grease, etc. which are usually present in the waste streams. Hydrogen Sulphide is generated in relatively stagnant waste water systems or at low velocities of sewer streams. Higher Organic load leads to more generation of H2S gas in sewer lines.

Mechanisms for the creation and release of H2S gas also occur when sulphate or oxygen is used/depleted to produce Sulphide. Sulphate reducing bacteria acts as a major source for microbial biochemical degradation of organic matter and release of H2S gas. Sulphates are present in great abundance in municipal wastewater systems and primarily stems from household cleaning detergents. Once the anaerobic conditions reduce Sulphates to Sulphides, it reacts with hydrogen to produce Hydrogen Sulphide.

$$SO42\text{-} + \text{organic matter} + \text{anaerobic Bacteria} \rightarrow S2\text{-} + H2O + CO2$$

$$S2\text{-} + 2H+ = H2S.$$

2. Factors affecting the formation of H_2S gas in sewer

Formation of H2S gas in sewers depend on Flow (Velocity) of Sewage in pipes, Slope of the pipe, Ratio of wetted perimeter of the pipe wall to surface width of the stream, Temperature of the Sewage, Biochemical Oxygen Demand, Presence of Sulphates, Available Oxygen and Retention Time in the System.

3. Reasons for H_2S gas accumulation in sewers

Blocked Air Vents, Clogged Drains, ill Designed Sewers, Blockage/Stagnation, Slow Velocities of Sewage and Sludge/Slime Formation etc are the possible reasons for accumulation of H2S gas in sewer lines.

4. Optimum pH for H2S generation

Nearly 90 % of Sulphide will be present as H2S at pH 6 as depicted in graph attached as Annexure-A *(Source:- Journal Presented by Jason Kane at Queensland Water industry operation conference and exhibition, USA)*. This graph further depict that even at pH 5, 100% of Sulphides get converted to H2S. This implies that majority of the Sulphides are converted to H2S at pH 6 and there is no special requirement of very low pH for generating high concentration of H2S as all the H2S exist at pH of 5

5. Development of anaerobic conditions and generation of Sulphuric acid in septic conditions in sewers through Bio-chemical Oxidation as reflected from analysis results.

Hydrogen Sulphide is Biochemically oxidized in presence of moisture to form Biogenic Sulphuric Acid. Colonisation by aggressive acidophilic bacteria is capable of generating enough sulphuric acid to reduce the surface pH to 1-2, whereas Thiobacilli is capable of generating sufficient sulphuric acid to further reduce the pH to 1. Higher concentration of H2S in sewer lines leads to increased bio-chemical oxidation of Sulphides to Sulphuric Acid.

Further, the **Sulphuric acid is also generated in the Municipal Sewers through Chemical Oxidation of H2S in presence in aqueous medium.** The rate of chemical Sulphide oxidation increases exponentially with Hydrogen Sulphide concentrations and chemical sulphide oxidation is resultant into the formation of Sulphuric Acid. Hence, with the increase in the concentration of H2S, there is increase in Sulphuric Acid generation

As per analysis report, the low pH between 2.51-2.59 is observed at manholes close to incident site (Affected stretch) . Whereas, it is 4.41 at Upstream and 5.74 at Downstream of incident point. **Had there been any acidic industrial discharge from upstream in the sewer line , the pH levels at upstream and downstream of the incident point should have been equivalent to pH levels in the affected stretch and all the parameters should have shown a uniform trend in the samples drawn from all the manholes.**

Low pH in the affected stretch and relatively high pH at the upstream and downstream of the incident site clearly shows the built up of anaerobic conditions and after affects of H2S generation leading to biochemical formation of sulphuric acid thereby lowering of pH in the affected stretch and sustaining in the adjoining pockets

(Source:- Paper published by Jason Kane in Queensland Water industry operations conference, Paper published by Concrete pipe Association of Australasia, Paper

published by Mr. Brecht Donckels, Research and Product Development Division, Aquafin N.V. Belgium)

6. Effects of Iron and other metals in H2S generation

There are number of units engaged in machining processes (non-water polluting) operating in Ludhiana and particularly in this area. These units are covered under White Category and exempted by the CPCB from consent management in the notification for categorization of industries. Iron in particle form from such industries may have entered into sewers and got accumulated due to sludge settling and converted to dissolved solids due to low pH in the affected pocket. Iron concentration in the range of 300 mg/l on upstream and downstream comparing to high concentration of Iron (1000-1500 mg/l) in the affected pocket substantiates the above hypothesis. Further, the results in the branch sewer suggests relatively low iron content (Maximum 9 ppm), which suggest that accumulation of iron content happens only in the affected pocket and not due to discharge from any adjoining units.

The concentration of other metals is not significant comparing to iron and the general standards prescribed by the ministry for such discharges into the Municipal Sewer. As far as presence of metals especially Iron, Zinc, Nickel, Chrome or any other heavy metal in the sewerage sample is concerned, these cannot lead to the generation of H2S. On the contrary, iron and other metals in the aqueous medium or iron salts would combine with sulphide ions (from H2S or any other source of sulphide) to immediately convert to highly stable iron/metal sulphide through an irreversible reaction leading to the formation of respective metal sulphides. Hence, due to above property of metals, iron, nickel, zinc, chromium etc. would never be a source of H2S generation, rather are used as H2S scavengers to remove sulphide from various streams likely to contain H2S.

Further, Dosing of Ferrous or Ferric iron as either a chloride or a sulphate has been a proven mechanism for hydrogen sulphide control applications. Iron salts bind with Hydrogen sulphide leading to production of Iron sulphides in stable forms through an irreversible reaction. Dosing of Ferrous or Ferric iron as either a chloride or a sulphate has been able to control Hydrogen Sulphide levels in Bio gas digesters. Iron salts are used in Biogas digesters to suppress H2S generation. These iron sulphides are very fine particles having very low sedimentation properties and are generally carried along with the sewer stream.

7. Susceptibility of industrial discharge at incident site.

A detailed survey of the upstream and downstream of the point of incident was jointly conducted by teams of PPCB and MCL from 01.05.2023 to 04.05.2023. The joint teams have scanned the area physically upto 500 mtr on upstream & upto 200 mtr on downstream of point of incidence.

During the visits, 179 establishments including residential and commercial were inspected. Out of these 179 establishments, 22 industries were found water

polluting. These are tiny electroplating/pickling/barrelling units. The observation and findings w.r.t the visits conducted is as under:-

1. There is no large or medium industry in the area surveyed. All the industries are of tiny/small scale.

2. Out of 22 water polluting industries, 15 industries were located at the upstream (13 acid consuming/electroplating and 2 caustic barrelling). Amongst 13, 6 are acid pickling and 7 are electroplating. **There is no acid consuming industry within 100mtr radius of the incident.**

3. Two caustic barrelling units have no role in discharge of acidic effluent. Whereas, 6 tiny pickling units have total effluent generation of 17.5 KLM (Average 0.7 KLD). All of these tiny units are member of one or other re-processors. In case, if assumed that any discharge have been made from these units, it will not be as concentrated as fresh acid but must be spent acid. It will not be possible for an inert acid with such a low volume to travel more than 100mtrs and sustain low pH around 2.5 in affected stretch despite high dilution available in the public sewer from domestic and other sources. Further to add that on the previous evening, there was heavy rain in the affected area and lot of rain water was carried out by the sewerage stream leading to further dilution of industrial effluent if any available in the sewerage network. Further, on 30.4.2023, when the sampling of main sewer line were collected from the affected area, no industry in the vicinity was in operation being Sunday, gas leak tragedy and forced power cut due to gas leak. This implies that the low pH at the incident site was not due to any industrial discharge but it was some localized reason that contributed to the low pH.

4. Above findings are supported by the analysis report as low pH between 2.51-2.59 is observed at manholes close to incident site, whereas, it is 4.41 at Upstream and 5.74 at Downstream of incident point. Had there been any acidic industrial discharge from upstream in the sewer line , the pH levels at upstream and downstream of the incident point should have been the same as that of the affected stretch and all the parameters should have shown a uniform trend in the samples drawn from all the manholes.

5. Further, samples from 9 locations of the branch sewer lines in the adjoining streets in the periphery of 500 m u/s and 200 m d/s were collected to check the sources of different parameters when all the water polluting industries were in operation on 1.5.2023. pH of these points has been observed to be near to neutral except at one point q(5.7). Therefore, contribution of the industries from nearby vicinity, seems not possible.

6. <u>Comments on the analysis results of the samples collected by Punjab Pollution Control Board as per **final report dated 21.06.2023 Letter No. 2963**</u>

   On the day of incident i.e. 30.4.2023, samples were collected from 6 manholes of sewer line immediate near to the affected site and thereafter

the samples were also collected from branch sewer lines. The details are as under:-

Ref. No.	Sampling Location	Reference w.r.t zero point (incident point)	Time	Sample no.
A	From Manhole Opp. Jasbir Building Material Store	Upstream near to incident point	01:00 PM	S-3
B	From Manhole Near Transformer, Outside Saroj Beauty Parlour	Immediate Upstream the incident point	11:30 AM	S-1
			12:20 PM	A-1
C	From Manhole in the front of Nitco Logistics (P) Ltd, Near Transformer	Immediate u/s the incident point	04:30 PM	S-5
D	From Manhole Opp. Aarti Clinic	Opp. to the incident point.	12:40 PM	S-2
E	From Manhole Opposite Dharam Kanda near Punjab Emporium)	Immediate d/s the incident point	01:40 PM	S-4

The analysis results are examined and Final observations are as under:

From the perusal of above results collected on 30.4.2023 from the main sewer line and on 1.5.2023 from the branch sewer lines, it is observed that the pocket in the affected stretch is not behaving in unison with the rest of the sewer line of the area. High accumulation of various pollutants is observed in this pocket indicating some abnormality in the flow of sewer or some blockage in that particular stretch only. The parameters reflected in the samples collected from the branch sewer lines near the water polluting industries supports the hypothesis of no contribution from these industries and rather built of anaerobic/septic conditions in the affected stretch.

7. <u>Sources responsible for High Organic load at the site</u>

a) Densely Populated Vicinity:- The Area is a house to crowded habitats mainly made by migrant labours who work in the industries. There are several vehras in which migrant labours are living in congested areas and other commercial establishments contributing to huge organic load. The vicinity in and around the incident site is densely populated

b) Cluster of Meat and Fish processing shops and dhabas:- There is a Cluster of nearly 10 fish/Meat shops located in the upstream of the incident point which are discharging the washing water with high Organic loads into sewers. Besides, There are around 6-7 dhabas opposite to the point of incident which are also a source of high organic load. They neither have any adequate disposal for highly organic effluent nor any adequate solid waste disposal arrangements. Broken manhole near the Meat shops indicate that the solid waste might be dumped in municipal sewer which leads to choking and heavy accumulation of organic matter.

8. Sources responsible for accumulation of H2S in affected pocket

Initial discussions with experts revealed that in case, waste water stream in a sewer line remains in running condition with proper ventilation of sewage network, the generation of H2S at such a lethal concentration is not possible as there would be no anaerobic conditions developed in sewer line, which is a pre-requisite for generation of H2S gas. However, in case there is a built up of organic matter due to blockage/stagnation in sewer/ slow velocities of sewage/ ill designed sewer, there is possibility of sludge/slime formation, only then Bio-chemical degradation of organic matter would lead to the generation of gases like methane and H_2S. Even if, the H_2S generates and proper vents are available, the chances of accumulation of H_2S at such high concentrations is not possible. Inadequate vents to the sewer lines accompanied by no or poor ventilation in the residences of affected houses might have aggravated the problem resulting in the accumulation of H_2S gas in the affected pocket.

As such, following might have been the main reasons for accumulation and reverse dissipation of H_2S gas:-

a. Requirement of Sewer Vents

Sewer vents need to be provided to prevent sewer gases from entering the home and allows wastewater gases and odors to escape through the plumbing vent stack. Non availability of ventilation pipes in the affected stretch might have led to heavy accumulation of sewer gases such as H2S, CH4, CO etc. This gas is also a cause of sewer men deaths across the country as concentrations about 200 -250 ppm are also considered lethal. Further, the H2S levels at the night of incident even after caustic dosing were also measured to be very high (around 200 PPM) by NDRF teams which clearly shows that the H2S built up was there even after caustic dosing in the evening. This clearly shows development of anaerobic conditions due to deposition of organic matter and inadequate slime stripping in the affected stretch. Dr. Charan Kamal, District Forensic Officer, Ludhiana told the Fact-Finding Joint Committee on 8.5.2023 that in the past, he has experienced 6-7 incidents from H2S gas and all the incidents were happened due to sewer gases.

b. Reverse Ventilation of H2S Gas and Unscientific sewer connections by affected households.

The sewer connection made by M/s Goyal Karyana Store was unscientific which lead to reverse ventilation of H2S gas in their residence. The sewer opening / WC opening / wash basin drains may have acted as a reverse ventilation pipeline dissipation of H2S in the affected premises. Poor ventilation system particularly in the affected houses might have affected the dissipation of H2S gas and have aggravated the situation. No fatality was observed due to any dissipation of H2S in the main sewer line which was near to other end of the road. The incident occurred in a very small stretch at the opposite end of the main sewer line. As the sewer line of the 3 affected houses are interconnected, the possibility of hitting of the inspection chamber by someone with some stick/chemical thereby

disturbance of the traps and leading to sudden dissipation of gas can not be ruled out.

c. Slime deposition in the sewer line near to the affected stretch

Inadequate slime stripping and slime deposition in the sewer line is one of the main reasons for accumulation of H2S at the affected stretch. The slime deposition was removed at night at around 1:00 AM using jetter and supersuction machines which clearly shows that thick sludge was deposited at bottom of the sewer line and clubbed with all the factors stated above has lead to heavy accumulation only in the affected stretch and reverse dissipation in the affected households. Further even if H2S is formed, the same would have not been reversely dissipated had there been the presence of sewer vents and provisions of scientific sewer connections with adequate ventilation arrangements by the affected households.

9. Scientific and Technical Views of the Experts

A. The Preliminary Report along with Findings and recommendations from Dr. Anoop Grover, Professor, Department of Chemical Engineering, Thapar Institute of Engineering and Technology (TIET) is attached alongwith the report.

B. The report on the visit of Expert Committee comprising of Professor Sushil Mittal, Vice Chancellor, Sardar Beant Singh State University, Gurdaspur (Now Vice Chancellor, Punjab Technical University) and Professor Raj Kumar Gupta, Department of Chemical Engineering, Thapar Institute of Technology is attached alongwith the report.

C. The copies of literature obtained from various Journals/papers published internationally supporting the above hypothesis is also attached alongwith the report.

Thus, in view of the literature and Expert views, the Punjab Pollution Control Board is of the view that the formation and accumulation of H_2S gas at the point of incident is due to the anaerobic biochemical degradation of Organic matter and not due to discharge of industrial chemical effluent as described above.

d6 Central Pollution Control Board Report

***(Through mail from RD CPCB Chandigarh June 22, 2023)* Annexure-J**

It is submitted that at the accident site, it was observed that there are branch sewer lines/ sewer connections from the two nearby houses where the death occurred that join the main sewer line that runs below the main road in front of these houses. The analysis report of the main sewer water collected by PPCB few hours after the accident from the manhole near the point of accident indicated pH of the sewer as highly acidic and ranging between 2.5 and 2.6. It was also reported that main sewer line near the point where this incident happened was found filled/choked.

Presence of sulphide in sewer water as H_2S is due to biochemical reduction of the sulphate present in water. The ratio of Sulphur (S). Hydrosulphide (HS) and H_2S in sewer water at any point of time depends on the pH of sewer water at that time. Intermittent discharge of acidic effluents from industries in mixed sewers acts as an agent for shifting the equilibrium. Acidic effluents are also a source of sulphate (due to sulphuric acid), which ultimately forms sulphide.

Further, if industrial effluents containing metals and heavy metals are discharged in the sewers, the metals are precipitated as metal sulphides in the sewer lines. These metal sulphides, in the presence of acids/acid effluents containing H_2SO_4 and/or HCl, end up generating hydrogen sulphide (H_2S) gas.

Therefore, it can be concluded that intermittent discharge of acidic and metallic industrial effluent/waste into mixed sewers can be a source of sudden release of H_2S gas in very high concentration from such sewers.

It is relevant to mention that H_2S is a diprotic weak acid and even a saturated solution of H_2S is not expected to have a pH less than 4.0. Therefore, it may be concluded that level of 2.5-2.6 as reported in main sewer water near the houses where deaths occurred is a result of acidic industrial effluent discharge.

The above facts strongly point towards the discharge of industrial effluent as the cause of highly acidic water in the main sewer in the area.

As per recent media reports and the discussion held with Chief Environmental Engineer, PPCB, the industries in Ludhiana use both Hydrochloric acid and Sulphuric acid. It was also reported that few industries in Giaspura area have acid pickling step in their manufacturing process. **The chloride content in the main sewer water near the accident as found higher in comparison to distant points (both upstream and downstream) which may be due to use of hydrochloric acid in the area. These facts also indicate that industrial discharge is a key factor in releasing of H_2S in high concentrations.**

The details of sewer network of Giaspura area were not available with officers of Municipal Corporation, who were present at the site during the visit. All the industries located along the sewer network are required to be surveyed by local authorities to identify the possible sources of acidic and metals, heavy metals and sulphide containing industrial effluent/waste.

Further, Hon'ble NGT, Principal Bench has constituted a Joint Committee with members from various agencies including CPCB to investigate the matter, arrive at a conclusion and take remedial measures to prevent such accidents in the future.

d7 <u>Central Scientific Institute of Research (CSIR)- Indian Institute of Toxicology Research (IIT-R) Report</u>

<u>(through mail on June 23, 2023) Annexure-K</u>

- Hydrogen sulfide (H_2S) is a dangerous and colorless gas that can be produced

when organic matter decomposes, such as in rotting vegetation or waste water in a sewer system. It is highly toxic, ranking second in workplace fatalities due to gas inhalation after carbon monoxide and is often recognized by its foul smell, similar to rotten eggs.

- In the case of domestic wastewater, the main process responsible for the formation of hydrogen sulfide is the microbial reduction of sulfate ions. When there is a lack of dissolved oxygen and the presence of soluble Biological Oxygen Demand (BOD), bacteria like Desulfovibrio desulfuricans (SRB) and other sulfate--reducing bacteria (SRBs) convert sulfate ions into sulfide. This occurs in the absence of oxygen and the presence of organic matter, such as sludges.

- Hydrogen sulfide tends to accumulate in confined and poorly ventilated areas where there are sewage holding tanks or other parts of sewage systems. If the system is damaged, malfunctioning, or there are loose connections, gas cane scape. This can happen when organic matter or sludges are disturbed, such as during the addition or discharge of effluent material into a compromised system. Sewage holding tanks that receive galley waste on vessels are particularly prone to the formation of a greasy sludge film, which further promotes the production of hydrogen sulfide. Additionally, blockages in ventilation components increase the risk of hydrogen sulfide back--venting, allowing the gas to escape into toilet and other confined spaces through the sewerage pipe network.

- A sewer main can contain significant amounts of undetected dissolved H_2S in the waste water. When the water is disturbed, such as when pumps are activated, this dissolved gas can rapidly turn into toxic gas clouds due to the "**soda--can effect.**" This effect occurs when the disturbed water releases the dissolved gas, resulting in sudden and dangerous concentrations of hydrogen sulfide.

- Due to its density, hydrogen sulfide is slightly heavier than air, causing it to accumulate in sub surfaces paces such as basements, underground chambers, or sewer systems. This makes these areas particularly susceptible to high concentrations of hydrogen sulfide gas.

- During heavy rainfall, organic matter such as decaying vegetation, animal waste, and other debris can be washed into the sewer system. This influx of organic material provides a rich food source for bacteria, including SRBs. As the organic matter decomposes, SRBs metabolize sulfate ions present in the waste water, resulting in the production of H_2S.

- Heavy rainfall can cause turbulent flow in sewer systems, leading to the disturbance of settled sediments. Sewer sediments often contain accumulated organic matter and sludges that serve as a nutrient source for SRBs. When these sediments are stirred up, it can promote increased bacterial activity and H_2S production.

- The increased H_2S production during heavy rainfall can raise the likelihood of H_2S leakage and exposure in sewer systems. If the sewer infrastructure is damaged, malfunctioning, or not properly sealed, the H_2S gas cane scape in to confined spaces, nearby buildings, or even the atmosphere. This poses significant health risks to workers and the public due to the toxic and potentially lethal effects of H_2S inhalation.

- Meat shops often generate a significant amount of organic waste, including trimmings, blood, and other byproducts. These organic materials are rich in proteins and can contribute to the production of H_2S when they undergo decomposition. If a meat shop is located in close proximity to a sewer system, the organic waste from the shop can enter the sewer lines, providing a readily available food source for sulfur--reducing bacteria. This can enhance the microbial activity responsible for the conversion of sulfate ions to sulfide, thereby increasing the potential for H_2S formation.

- When heavy rainfall combines with the organic waste from a nearby meat shop, it can result in increased organic loading and nutrient availability within the sewer system.

- The combined effect of heavy rainfall and the presence of a nearby meat shop can lead to an elevated risk of H2S formation in the sewer system. It is important to monitor and manage these factors effectively to prevent the accumulation of H_2S gas, which can pose significant health hazards to workers and the surrounding environment. Implementing proper waste management practices, ensuring proper ventilation, and conducting regular maintenance and inspections can help mitigate the risks associated with H_2S in such scenario.

d8 Director of Factories

(through Letter No. Spl 1 dated 01.05.2023) Annexure-L

The Director of Factories has submitted its report vide no. Spl. 1 dated 1.5.2023 which states that the Giaspura gas leak incident has not happened in the premises of any factory and as such is not covered under the purview of its department.

ANALYSIS ON REPORTS SUBMITTED BY VARIOUS STAKEHOLDERS AND INSTITUTIONS

The undersigned has thoroughly examined the various reports received from all the stakeholders and members of multi-sectoral committee. Tallying these with the first-hand observations, made at the site on the day of the incident, I find it imperative to address certain incongruencies in these reports on certain points.

It is pertinent to mention here that deductions drawn/scientific explanations proffered by various agencies and the undersigned are limited by the scale & scope of the samples collected by various agencies at different sites at various times on that day. The fact finding committee would also be constrained from being able to access those bio-chemical conditions created on that particular day by virtue of visiting the site ex-poste fact after the decontamination drive had been successfully executed. This means that the exact ambient conditions in the sewers which were not tested for on the day of the tragedy cannot be recreated today.

However, this does not mean that no deductions could be drawn from the facts already furnished based on existing test reports. The undersigned would hereby like to point out certain incongruencies in interpretations by various stakeholders on the salient questions to be answered and then present a set of its own inferences. This shall be followed by certain recommendations the undersigned would like to make for remedial action.

A. <u>Salient Observations by various stakeholders at the tragedy points on the day of the incident</u>

- There was no blockage in sewers reported by the residents of the village in the receipt past, visibly also no blockage detected.
- There were no vents in place in the manholes.
- The buildings were highly congested and cross-ventilation was negligible.
- In the residential building of Arti Clinic, it was observed that there was a dry drainage vent (no P-trap/ water closet) which would have been the most likely source of regurgitation of sewer gas into the houses, where five members of the family had been found tragically deceased.
- There was heavy rainfall on the previous day.
- Persistent trace of rotten-eggs smell noticed in the windward direction of the road. Video footages sowed pedestrians walking back and forth the tragedy points without being affected by the gas an hour after the incident was reported. **This showed that the propounded 'gas blanket' had vanished after a short spell.**

- Bodily reactions of the victims have been varied. As a case in point, the first person to collapse from the gas, Mr. Gaurav Goyal survived while his relatives who rushed to help him tragically passed away.

- **H_2S poisoning was corroborated by medical, forensics evidence and by gas detectors. It was noted that there was a dead cat on the ground floor but a dog in the same building upstairs survived. This adds on to the theory of formation of a deadly gas blanket with highest concentrations at ground level as H_2S gas is typically denser and heavier than air. Amongst the sewer gases, H_2S fits these characteristics the best.**

- Certain suspicious items in containers were seized by police. The test results regarding their composition are awaited.

- All eleven chemical analysis reports are pending from Chemical Laboratory, Kharar.

- Test results received from Punjab Biotechnology Incubator Lab in Mohali showed, unnaturally high amounts of iron were detected in sewers at 2 particular manhole points in proximity to tragedy points (718 and 899 mg/l as opposed to general standards as per Environment Protection Rules of 3 mg/l).

B. <u>Points of incongruence in reports received and observations of the Committee</u>

Q.1 What was the condition of the sewers on the day of the incident?

PPCB strongly claims in its third report that the key chemical reaction that triggered this event occurred under anaerobic conditions that resulted from choking/blockages in the sewer.

MC on the other hand, attaches interviews with local residents on the reporting of blockages and claims no such incident was reported in the recent past. It also claims that periodic cleaning was done in these sewers, which does not add up to the claim of PPCB that there was blockage and sludge.

Observations of the District Administration: The Administration had inspected the sewers on the fateful day and found that levels of sewerage flow in sewer maintenance hole was below the sewer capacity and no overflowing or blockage was visible, as indeed claimed by the MC. This must be read in tandem with the fact that there was heavy rain on the previous day, which would have resulted in overflow, had there been a blockage. However, the status of last cleaning of the sewers is not very evident as sludge was indeed detected from the manholes (as claimed by PPCB).

It is true that particular stretch of road reported no blockages in the drains. However, it is also true that there was a lack of ventilation in the sewers. Other

physical attributes of the sewer systems may be further examined. The gradient and slope of the sewers must be more thoroughly studied. This is because if there is a kink over irregularity in the structures, it may have facilitated sedimentation and subsequent underflow of discharge (rather than overflow) which could set in motion a set of deadly set of reactions. Local sedimentation of particles could have occurred in and around the incident site, aided by anaerobic conditions (due to lack of sufficient vents). Such conditions developed in lower sediments could have generated H_2S gas.

Q.2 What were the chemical ambient conditions that precipitated this deadly event?

A series of chemical theories has been quoted by **PPCB** in the annexures to their final report.

(i) Anaerobic conditions reduce Sulphates (present abundantly in sewers) to Sulphides, it reacts with hydrogen to produce Hydrogen Sulphide.

SO42-+ organic matter + anaerobic Bacteria $\rightarrow$ S2-+H@) + CO2

S2-+2H+ = H_2S

The claim is that Sulfate Reducing Bacteria (SRBs) convert sulfate ions into sulfide in the absence of oxygen and the presence of organic matter, such as sludges.

(ii) "Dosing of Ferrous or Ferric iron as either a chloride or a sulphate has been able to control Hydrogen Sulphide levels in Bio gas digesters. Iron salts are used in Biogas digesters to suppress H_2S generation. These iron sulphides are very fine particles having very low sedimentation properties and are generally carried along with the sewer stream." This theory is used by PPCB to make the argument that the peculiarly high quantities of iron detected in 2 manholes would not aid in the proliferation of H_2S, but would rather aid in its abatement.

(iii) Contrasting this with MC's comments based on expert advice received, "Intermittent discharge of acidic effluents from industries in mixed sewers acts as an agent for shifting the equilibrium. Acidic effluents are also a source of sulphate (due to sulphuric acid), which ultimately forms sulphide.

Further, if industrial effluents containing metals and heavy metals are discharged in the sewers, the metals are precipitated as metal sulphides in the sewer lines. These metal sulphides, in the presence of acids/acid effluents containing H2SO4 and/or HCl, end up generating hydrogen sulphide (H_2S) gas.

Therefore, it can be concluded that intermittent discharge of acidic and metallic industrial effluent/waste into mixed sewers can be a source of sudden release of H_2S gas in very high concentration from such sewers."

Here, the claim is that heavy metals such as iron, when released consistently even in low volumes would lead to an exacerbation of the rate of H2SO4 formation and subsequent release of H_2S.

As evident, the above theories have a mismatch in terms of their claimed outcome. However, it cannot be denied from reports that excess generation of H_2S has likely happened at the very manholes where excess iron levels were detected, even if the science behind this is not conclusive as per above reports.

This could have been due to multiple precipitative factors- possible sedimentation of sludge (organic or metal) as evidenced by higher levels of Iron & organic sludge on that day.

(iv) On pH levels: CPCB in its report, claims that H_2S is a diprotic weak acid and even a saturated solution of H_2S is not expected to have a pH less than 4.0. Therefore, it may be concluded that pH level of 2.5-2.6 as reported in main sewer water near the houses where deaths occurred is a result of acidic industrial effluent discharge.

Meanwhile, PPCB comments of pH that : low pH between 2.51-2.59 is observed at manholes close to incident site, whereas it is 4.41 at Upstream and 5.74 at Downstream of incident point. Had there been any acidic industrial discharge from upstream in the sewer line, the pH levels at upstream and downstream of the incident point should have been the same as that of the affected stretch.

These theories also have a mismatch in interpretations. However, the PPCB report seems to inch towards a casual fallacy that because pH is higher upstream and downstream, this causally means no effluent discharge occurred at these stretches. A more prudent analysis, in the opinion the undersigned would be why such abetting ambient conditions were not present upstream and downstream, which led to the tragedy to occur where it did. Thus, no definitive influences can be drawn, except that the possibility of multiple collective causal factors cannot be ruled out.

Overall Observations: It is evident that different stakeholders have varied interpretations of the implications of same facts. It would be fit to deduce some conclusions on this aspect as to *what cannot be ruled out*, rather than using conjectures to arrive at irrefutable conclusions.

It is a fact that sewer water at tragedy points was more acidic than in upstream and downstream samples. It is also true that unnaturally high iron content has been observed in near the tragedy point manholes. Hence, this does not negate the possibility that there were industrial effluents that have accumulated over time in these sewers (may be on account of the structural peculiarities of these points). The crux of the scientific studies quoted by PPCB is also that in natural sewer conditions with free-flowing water, there should not have been an

aberration in the natural of such surge of sewer gas as a natural equilibrium would be maintained. This is noted to be a widely supported theory. The conclusion thereby is that - first, there was an anomaly in the equilibrium conditions of the sewer on the day of the incident. There is no reliable proof to determine whether this was on account of structural incongruencies of sewer lines at those locations or on account of a sudden unnatural industrial discharge. It is understood that all of the chemical reactions mentioned above are plausible, even simultaneously with the right ambient conditions. Determining which of these effects would have dominated at that point would be largely speculative & probable in nature.

Q.3 Was there is a role of any human interference/ externality that led to this event?

a. Meat shops

CSIR's Toxicology Reports say that: "When heavy rainfall combines with the organic waste from a nearby meat shop, it can result in increased organic loading and nutrient availability within the sewer system leading to an elevated risk of H_2S formation in the sewer system."

MC's report also mentions that: "One meat shop had a illegal sewer connection which has been disconnected by O&M cell MCL."

Observations of the Undersigned: These facts seem to imply that meat shops are a source of contamination of sewers. However, the day of the incident was an unremarkable day in terms of meat demand, suggesting no specific surge of animal waste disposal to explain this unnatural accident. Moreover, no build-up of animal waste was specifically reported by any agency on the day of the incident. The conclusion is that though meat shops with illegal connections are a threat to environmental sanctity of the area and must be strongly dealt with, they do not seem to be a strong factor to have caused a tragedy of such massive scale without any aiding externality. However, since they have the potential to be disruptive to normal sewer conditions, MC must keep a strong check on those disposing animal waste into sewers.

b. Industrial Discharge

The PPCB reports very strongly support the conjecture that effluents could not have been a reason for the event. The perusal of the facts could suggest a different interpretation: There exists no strong evidence to reliably rule out sporadic discharge of effluents by electroplating and acid pickling factories in the vicinity. In fact, PPCB in its 2nd interim report has listed a set of water-polluting industries beyond 100 meters of the site which have engaged in some violations in the past. The CPCB report and MC report mention the strong possibility of acidic effluents possibly leading to generation of H_2S.

Such plausible sporadic discharge, leading to sedimentation/build up over time, combined with the peculiar sewer conditions, lack of sewer vents and past rainfall

vents could have jointly led to the creation of a set of conditions that facilitated a deadly chemical reaction that precipitated in the sudden release of gas.

Q.4 What was peculiar about this day and stretch of sewerage?

It is evident from the facts furnished by multiple agencies (PPCB, CPCB, CSIR, MC) that the particular stretch of the sewer was behaving quite unnaturally compared to upstream and downstream points. This is both on account of the chemical composition of sewer water (pH, iron levels) and on the absence of choking after a heavy rainfall despite presence of sludge.

This report hereby posits that there seem to have been both a build-up of abetting conditions over time and a sudden trigger event which could have led to this tragedy. The ruling out of either set of these factors cannot satisfactorily help explain the abnormal outcome. The factors that have built up over time may include sporadic industrial discharges, meat residue discharges, insufficient ventilation and sludge formation. The "sudden" trigger cannot be accurately determined. The rain of the previous day may have aided in exacerbating the built up factors. However, acknowledging the collaborative factors that could have led to this incident is relevant in terms of enhancing preparedness for the future and for taking remedial steps to prevent future occurrences. Hence our findings focus on suggestive steps based on lessons learnt from this catastrophe.

None of the above deductions negate the immediate need for certain remedial actions. The MC has already inspected and shut down connections of errant meat shops in the vicinity. Extra sewer vents have also been provided as a precaution. PPCB has issued notices of closure to some industrial violators in the vicinity of the event and show causes have been issued. This tragedy was a lesson on how quantifiably insignificant everyday violations and delays in maintenance can mutate into an irreversible catastrophe that no monetary compensation and future preparedness can assuage.

<u>Suggested remedial measures :-</u>

From CSIR-IITR, Lucknow

(i) *Ventilation:* Adequate ventilation is crucial in areas where H_2S may accumulate, such as confined spaces, sewer systems, or wastewater treatment plants. Properly designed and functioning ventilation systems should be installed to ensure the continuous exchange of air, preventing the buildup of H_2S gas.

(ii) *Monitoring:* Implement a comprehensive monitoring system to continuously measure H_2S levels in relevant areas. This can invoice the use of gas detectors or sensors that provide real-time data on gas concentrations. Regular monitoring allows for the early detection of H_2S leaks and timely response to mitigate risks.

(iii) *Maintenance and Inspection:* Regular maintenance and inspection of sewer systems, wastewater treatment facilities, and associated equipment are critical to identify and address potential sources of H_2S leakage. This includes checking for damage, loose connections, or blockages that can contribute to gas escape.

(iv) *Proper Waste Management:* Effective waste management practices can help minimize H_2S formation. This includes preventing the buildup of organic matter, controlling BOD and COD levels, and implementing strategies to reduce the entry of organic waste into sewer systems.

From Punjab Pollution Control Board:

1. No new connection or enhancement of existing connection by MC, Ludhiana.
2. MC, Ludhiana shall not grant any new connection or enhancement of existing connection to municipal sewer for discharging industrial effluents.

From Municipal Corporation, Ludhiana

1. A special disaster management team should be set up in the municipal corporation to handle various chemical and gas leakage disasters.
2. A detailed audit of water consumption & waste water treatment various types of industries should be conducted at the level of Punjab Pollution Control Board jointly by MCL & PPCB and regulatory action ensured wherever warranted.
3. Proper plumbing systems should be adopted in households/buildings, i.e., proper sewer connections should be taken with proper water seal traps. The water inside the trap serves as a liquid seal that helps keep sewer gas smells from getting out of the drains. The depth of the water seal inside a trap should be enough to keep sewer gas away while not obstructing drainage from the system. Proper vent pipes/exhaust fans should be installed for a proper ventilation system.

Other important suggestions by inquiry magistrate:

1. **A sewer gas audit** at various vulnerable locations across the city may be carried out by Municipal Authorities using Hi-tech sensors and regular check for any presence of heavy metals in areas with high concentration of industries.
2. First responders training for handling gas leak disasters should be done, provision of adequate supporting equipment like gas masks, oxygen cylinders, kits for gas detection must be ensured.
3. A public advisory on understanding/detecting the symptoms of presence of bodily toxins and adequate emergency response training must be taken up.

4. Unauthorized and illegal sewer connections must be immediately snapped to allow proper and adequate flow in sewers as per the design standards and prevent blockage/deposition of any kind of matter in the sewer lines.

5. PPCB should keep a close watch on proliferation of illegal industries operating without requisite approvals and take action in a timely manner.

It is further submitted that the Hon'ble National Green Tribunal has constituted a Fact-Finding Committee to suggest the requisite remedial measures for prevention of such incidents in future. The above facts have been hereby furnished for the kind consideration of the said committee.

Harjinder Singh, IAS
Sub Divisional Magistrate,
Ludhiana (West)

ANNEXURE 'A-1'

ਮੈਂ ਵਿਆਨ ਕਰਦਾ ਹਾਂ ਕਿ ਮੈਂ ਦਰਿੰਦਰ ਕੁਮਾਰ ਪੁੱਤਰ ਸ਼੍ਰੀ ਮਾਸਟਰ ਹਰਦੇਵ ਸਿੰਘ 50 ਸਾਲ ਆਧਾਰ ਕਾਰਡ ਨੰਬਰ 8422 8775 7440 ਦਾਸੀ ਸ਼ੁਮਾ ਹੈਂ ਜਿਹੜਾ ਕਾਮ ਤਰਨ ਦੀਤਾਲੀ ਕਲਾਂ ਨਹਿਆਲਾ ਦਾ ਅਹਿਦ ਕਰਕ ਹਾਂ ਮੈਂ ਮੌਜਾ ਕਾਂ ਪਿਛੇ ਜਿਲਾਸਪੁਰ ਮਿਤੀ: 30-04-2023 ਦਿਨ ਐਤਵਾਰ ਸਮਾਂ ਤਕਰੀਬਨ ਸਵੇਰ 7:00 ਵਜੇ ਦਾਖਲਿਆ ਸੀ। ਉਸ ਵਕਤ ਮੈਨੂੰ ਕਿਸੇ ਨੇ ਦੱਸਿਆ ਕਿ ਸ਼ੁਮਾ ਹੈਂ ਤੇ ਤਕਰਨ ਕਬੀਲਾਕਾ ਯਾਰਦ ਕਰ ਕੋਈ ਘਟਨਾ ਹਾਪ ਗਈ ਹੈ, ਜਦ ਮੈਂ ਮੌਕੇ ਪਰ ਆਇਆ ਤਾਂ ਤਾਕਰਨ ਸਿੰਘ ਅਤੇ ਉਹਦੇ ਦੀ ਪੁਲੀ ਫੱਸਕੀ ਅਤੇ ਸਾਂਤ-ਭੁਮਾਰ ਕਿਤ ਸਹਿਤ ਹਾਰੇ ਵਿਅਕਤੀ ਚਾਰੇਂਨ ਤੇ ਕ ਕੁਰਬ ਤ ਤਿੰਨਾਂ ਪੈਰ ਸਨ ਅਤੇ ਕੋਈ ਆਦੀਕ ਕਿਤੀ ਵਾਦਰ ਸਾਂ ਹਾਂ ਮੀ ਸਿਸ ਕਰਨ ਮੈਨੂੰ ਵੀ ਚੱਕਰ ਆਉਣ ਵੱਲ ਪਏ, ਮੈਨੂੰ ਕੁੱਝਿਆ ਕਿ ਕਿਤੇ ਮੈਂ ਵੀ ਚਾਰੇਂਨ ਨਾ ਤੋਂ ਨਾਲਾਂ ਕਿਸ ਕਰਕੇ ਮੈਂ ਉਥੋਂ ਖੁੱਲ ਕ ਸਾਂਪਥੀ ਥਾਨ ਚਲਾਈ, ਕਿਸ ਤੋਂ ਕੁਝ ਟਾਈਮ ਬਾਅਦ ਮੈਂ ਵਿਹ ਘਟਨਾ ਬਾਰੇ ਤਕਰਨ ਤੋਂ ਜਾਣਿਆ ਤਾਂ ਮੈਨੂੰ ਪਤਾ ਲੱਗਿਆ ਕਿ ਤਾਕਰਨ ਕਬੀਲਾਕਾ ਉਸਦਾ ਪੁਰਾ ਪਰਿਵਾਰ ਕਿਸੇ ਸਰਿਮਨੀ ਗੱਲ ਬਾਰ ਗਰ ਚੁਕੇ ਹਨ ਅਤੇ ਸਾਰੇ ਸ਼ੁਮਾਰੇ ਕਿਤ ਸਹਿਤ ਵਰੀ ਵਿਅਕਤੀਆਂ ਦੀ ਸੱਤ ਤੇ ਚੁੱਕੀ ਹੈ।

ਦਰਿੰਦਰ ਕੁਮਾਰ

Mb. No:- 98786-46807

ATTESTED

Executive Magistrate
LUDHIANA (SOUTH)

ਮੈਂ ਤਾਜੇਸ਼ ਕੁਮਾਰ ਪੁੱਤਰ ਸ਼ਕਤੀ ਰਾਮ ਉਮਰ 50, ਸੱਯਦ ਹਸੇਲੀ
ਮਾਰਗ ਤੇਜ਼ ਵਿਸਾਖਾਪੱਤਨਮ ਦਾ ਰਹਿਣ ਵਾਲਾ ਹਾਂ।
ਮੇਰਾ ਸਥਾਈ ਫੋਨ ਨੰਬਰ 6038509648 ਹੈ।

ਮੈਂ ਮਿਤੀ 30-4-23 ਨੂੰ ਵਿਸਾਖਾਪੱਤਨਮ ਵਿਖੇ ਆਪਣੇ
ਘਰ ਵਿਚ ਸੀ ਕਿ ਮੇਰੇ ਫੋਨ ਤੇ ਲਗਭਗ 7:00 ਵਜੇ ਇੱਕ
ਕਾਲ ਆਈ। ਉਸ ਵਿਅਕਤੀ ਨੇ ਆਪਣਾ ਨਾਮ ਸੋਹਿਲ ਕੋਹਲੀ ਦੱਸਿਆ
ਜੋ ਕਿ ਮੇਰੀ ਜਾਣਕਾਰੀ ਵਿਚ ਨਹੀਂ ਸੀ। ਸ਼ੁਰੂਆਤ ਵਿਚ ਉਸਨੇ ਮੈਨੂੰ
ਕਿਹਾ ਕਿ ਉਹ ਮੇਰਾ ਦੋਸਤ ਹੈ ਅਤੇ ਮੈਨੂੰ ਯਾਦ ਕਰਵਾਇਆ
ਕਿ ਅਸੀਂ ਕਿਸੇ ਸਮੇਂ ਇਕੱਠੇ ਪੜ੍ਹਦੇ ਸੀ। ਮੈਂ ਉਸਨੂੰ ਕਿਹਾ ਕਿ ਮੈਨੂੰ
ਯਾਦ ਨਹੀਂ ਆ ਰਿਹਾ ਕਿ ਅਸੀਂ ਕਦੋਂ ਮਿਲੇ ਸੀ। ਫਿਰ ਉਸਨੇ ਮੈਨੂੰ
ਕਿਹਾ ਕਿ ਉਹ ਮੇਰੇ ਨਾਲ ਮਿਲਣ ਆਵੇਗਾ। ਮੈਂ ਉਸਨੂੰ ਕਿਹਾ ਕਿ ਉਹ
ਮੈਨੂੰ ਆਪਣੇ ਆਉਣ ਦੀ ਜਾਣਕਾਰੀ ਦੇਵੇ ਤਾਂ ਜੋ ਮੈਂ ਉਸਨੂੰ ਲੈਣ ਆ
ਸਕਾਂ। ਉਸ ਦਿਨ ਮੈਂ ਆਪਣੀ ਦੁਕਾਨ ਤੇ ਕੰਮ ਵਿਚ ਰੁੱਝਾ ਹੋਇਆ
ਸੀ ਕਿ ਮੈਨੂੰ ਉਸਦਾ ਫੋਨ ਆਇਆ ਕਿ ਉਹ ਮੇਰੀ ਦੁਕਾਨ ਦੇ ਬਾਹਰ
ਖੜ੍ਹਾ ਹੈ। ਮੈਂ ਉਸਨੂੰ ਦੁਕਾਨ ਦੇ ਅੰਦਰ ਆਉਣ ਲਈ ਕਿਹਾ। ਉਹ
ਅੰਦਰ ਆਇਆ ਅਤੇ ਮੈਨੂੰ ਜੱਫੀ ਪਾ ਲਈ। ਉਸਨੇ ਮੈਨੂੰ ਕਿਹਾ ਕਿ
ਉਹ ਮੈਨੂੰ ਮਿਲਣ ਲਈ ਬਹੁਤ ਉਤਸੁਕ ਸੀ। ਮੈਂ ਉਸਨੂੰ ਕਿਹਾ ਕਿ
ਉਹ ਮੈਨੂੰ ਆਪਣੇ ਬਾਰੇ ਕੁਝ ਦੱਸੇ ਤਾਂ ਜੋ ਮੈਨੂੰ ਯਾਦ ਆ ਸਕੇ।
ਉਸਨੇ ਮੈਨੂੰ ਦੱਸਿਆ ਕਿ ਉਹ ਦਿੱਲੀ ਵਿਚ ਰਹਿੰਦਾ ਹੈ ਅਤੇ
ਉਸਦਾ ਆਪਣਾ ਕਾਰੋਬਾਰ ਹੈ। ਉਸਨੇ ਮੈਨੂੰ ਕਿਹਾ ਕਿ ਉਹ
ਕਾਰੋਬਾਰ ਦੇ ਸਿਲਸਿਲੇ ਵਿਚ ਵਿਸਾਖਾਪੱਤਨਮ ਆਇਆ ਹੈ ਅਤੇ
ਉਸਨੇ ਮੈਨੂੰ ਆਪਣੇ ਹੋਟਲ ਦਾ ਨਾਮ ਵੀ ਦੱਸਿਆ। ਉਸਨੇ ਮੈਨੂੰ
ਕਿਹਾ ਕਿ ਉਹ ਮੈਨੂੰ ਮਿਲਣ ਲਈ ਬਹੁਤ ਉਤਸੁਕ ਹੈ ਅਤੇ ਮੈਨੂੰ ਉਸਨੂੰ
ਮਿਲਣ ਲਈ ਆਉਣਾ ਪਵੇਗਾ। ਮੈਂ ਉਸਨੂੰ ਕਿਹਾ ਕਿ ਮੈਂ ਆਪਣੇ
ਕੰਮ ਵਿਚ ਰੁੱਝਾ ਹੋਇਆ ਹਾਂ ਅਤੇ ਮੈਂ ਉਸਨੂੰ ਮਿਲਣ ਲਈ ਆਵਾਂਗਾ।
ਉਸਨੇ ਮੈਨੂੰ ਕਿਹਾ ਕਿ ਉਹ ਮੈਨੂੰ ਮਿਲਣ ਲਈ ਬਹੁਤ ਉਤਸੁਕ ਹੈ ਅਤੇ
ਉਹ ਮੈਨੂੰ ਮਿਲਣ ਲਈ ਆਵੇਗਾ। ਮੈਂ ਉਸਨੂੰ ਕਿਹਾ ਕਿ ਮੈਂ ਆਪਣੇ
ਕੰਮ ਵਿਚ ਰੁੱਝਾ ਹੋਇਆ ਹਾਂ ਅਤੇ ਮੈਂ ਉਸਨੂੰ ਮਿਲਣ ਲਈ ਆਵਾਂਗਾ।
ਉਸਨੇ ਮੈਨੂੰ ਕਿਹਾ ਕਿ ਉਹ ਮੈਨੂੰ ਮਿਲਣ ਲਈ ਬਹੁਤ ਉਤਸੁਕ ਹੈ ਅਤੇ
ਉਹ ਮੈਨੂੰ ਮਿਲਣ ਲਈ ਆਵੇਗਾ। ਮੈਂ ਉਸਨੂੰ ਕਿਹਾ ਕਿ ਮੈਂ ਆਪਣੇ
ਕੰਮ ਵਿਚ ਰੁੱਝਾ ਹੋਇਆ ਹਾਂ ਅਤੇ ਮੈਂ ਉਸਨੂੰ ਮਿਲਣ ਲਈ ਆਵਾਂਗਾ।

ਵਿਸਾਖਾਪੱਤਨਮ

ਰਾਜੇਸ਼ ਕੁਮਾਰ
8699808113

ATTESTED
Executive Magistrate
LUDHIANA (South)

ਮੈਂ ਤਸੀਲਦਾਰ ਪਾਸ ਪੇਸ਼ ਹੋਇਆ ਪਰ ਉਸ ਵੱਲੋਂ ਕੋਈ ਸੁਣਵਾਈ ਨਹੀਂ ਕੀਤੀ ਗਈ ਅਤੇ ਮੈਨੂੰ ਵਾਪਸ ਭੇਜ ਦਿੱਤਾ ਗਿਆ। ਮੈਂ ਤਸੀਲਦਾਰ ਦੇ ਰੀਡਰ ਨਾਲ ਵੀ ਸੰਪਰਕ ਕੀਤਾ ਪਰ ਉਸ ਵੱਲੋਂ ਵੀ ਕੋਈ ਸੁਣਵਾਈ ਨਹੀਂ ਕੀਤੀ ਗਈ। ਮੈਂ ਤਸੀਲਦਾਰ ਦੇ ਰੀਡਰ ਦਾ ਮੋਬਾਇਲ ਨੰਬਰ 8684865198 ਹੈ।

ਮੈਂ ਮਹਿਰਾ ਸਟੋਨ ਕਰੱਸ਼ਰ ਵਿਰੁੱਧ ਮਿਤੀ 30-4-2023 ਨੂੰ ਸਵੇਰੇ 7:00 ਵਜੇ ਦਾਖਲ ਹੋਇਆ ਤਾਂ ਮੈਨੂੰ ਉਥੇ ਕੰਮ ਕਰਦੇ ਮਜ਼ਦੂਰਾਂ ਨੇ ਦੱਸਿਆ ਕਿ ਉਹ ਕੰਮ ਬੰਦ ਕਰਕੇ ਜਾ ਚੁੱਕੇ ਹਨ। ਮੈਂ ਉਥੇ ਮੌਜੂਦ ਕਰੱਸ਼ਰ ਮਾਲਕਾਂ ਨਾਲ ਗੱਲਬਾਤ ਕੀਤੀ ਤਾਂ ਉਹਨਾਂ ਨੇ ਮੈਨੂੰ ਦੱਸਿਆ ਕਿ ਉਹ ਕੰਮ ਬੰਦ ਕਰਕੇ ਜਾ ਚੁੱਕੇ ਹਨ। ਮੈਂ ਵੇਖਿਆ ਕਿ ਉਹ ਤਰਪਾਲ ਦੇ ਸ਼ੈਡ ਹੇਠਾਂ ਬੈਠੇ ਸਨ ਜਿਨ੍ਹਾਂ ਕੋਲ ਕੋਈ ਹਥਿਆਰ ਨਹੀਂ ਸੀ। ਮੈਂ ਉਹਨਾਂ ਨੂੰ ਕੋਈ ਹੁਕਮ ਨਹੀਂ ਦੀ ਕੋਈ ਕਾਰਵਾਈ ਨਹੀਂ ਕੀਤੀ। ਮੈਂ ਵਾਪਸ ਆ ਕੇ ਆਪਣੇ ਦਫਤਰ ਵਿਚ ਬੈਠ ਗਿਆ। ਉਸ ਤੋਂ ਬਾਅਦ ਮੈਂ ਕੋਈ ਕਾਰਵਾਈ ਨਹੀਂ ਕੀਤੀ। ਮੈਂ ਵੇਖਿਆ ਕਿ ਉਹ ਤਰਪਾਲ ਦੇ ਸ਼ੈਡ ਹੇਠਾਂ ਬੈਠੇ ਸਨ ਜਿਨ੍ਹਾਂ ਕੋਲ ਕੋਈ ਹਥਿਆਰ ਨਹੀਂ ਸੀ। ਮੈਂ ਉਹਨਾਂ ਨੂੰ ਕੋਈ ਹੁਕਮ ਨਹੀਂ ਦੀ ਕੋਈ ਕਾਰਵਾਈ ਨਹੀਂ ਕੀਤੀ। ਮੈਂ ਵਾਪਸ ਆ ਕੇ ਆਪਣੇ ਦਫਤਰ ਵਿਚ ਬੈਠ ਗਿਆ। ਉਸ ਤੋਂ ਬਾਅਦ ਮੈਂ ਕੋਈ ਕਾਰਵਾਈ ਨਹੀਂ ਕੀਤੀ।

ATTESTED

Executive Magistrate
LUDHIANA (South)

ਮੈਂ ਰੂਬੀ ਦੇਵੀ ਪਤਨੀ ਰਾਜਿੰਦਰ ਸਾਹ ਵਾਸੀ ਵਾਰਡ ਨੰਬਰ 13 ਗਏਪੁਰ ਪ੍ਰਕਾਸ਼ ਸਮਸਤੀਪੁਰ ਬਿਹਾਰ (ਹਾਲ ਵਾਸੀ ਸੂਆ ਰੋਡ ਨੇੜੇ ਗੋਇਲ ਕੋਲਡ ਤ੍ਰਿਵੇਣੀ ਲੁਧਿਆਣਾ) ਦੇ ਬਿਆਨ ਦਰਜ ਕਰਦੀ ਹਾਂ। ਮੇਰਾ ਮੋਬਾਇਲ ਨੰਬਰ ਨੰਬਰ 7284 1947224 ਹੈ।

ਮੈਂ ਪਰਿਵਾਰ ਸਮੇਤ ਉਪਰੋਕਤ ਪਤੇ ਤੇ ਕਿਰਾਏਦਾਰ ਵਿਚ ਮਿਤੀ 30-4-2023 ਨੂੰ ਸਵੇਰੇ ਤਕਰੀਬਨ 7:00 ਕੁ ਵਜੇ ਵਾਪਰੀ ਉਸ ਵਕਤ ਮੈਂ ਮਾਰਕੀਟ ਵਿਚ ਪ੍ਰੋਵੀਜ਼ਨ ਦੁਕਾਨ ਵਿਚ ਸਾਹ ਪੀਣ ਵਾਸਤੇ ਗਈ ਸੀ। ਉਸ ਵਕਤ ਵਿਚ ਮਾਰਕੀਟ ਵਿਚ ਕਾਫੀ ਭੀੜ ਮਾਰਕੀਟ ਸ਼ੁਰੂ ਹੋ ਰਹੀ ਸੀ। ਮੈਂ ਦੇਖਿਆ ਕਿ ਗੋਇਲ ਕੋਲਡ ਡ੍ਰਿੰਕ ਦੇ ਸਾਹਮਣੇ ਤਕਰੀਬਨ 4 5 ਵਿਅਕਤੀ ਡਿੱਗੇ ਪਏ ਸਨ ਅਤੇ ਤੜਫ ਰਹੇ ਸਨ। ਫਿਰ ਮੈਂ ਮੇਰੇ ਗੁਆਂਢ ਵਿਚ ਕੰਮ ਕਰਦੀ ਮੇਰੀ ਪਛਾਣ ਵਾਲੀ ਨੂੰ ਜੋ ਤੜਫ ਰਹੀ ਸੀ ਉਸਨੂੰ ਬਚਾਉਣ ਲਈ ਗਈ ਅਤੇ ਜਿਵੇਂ ਹੀ ਮੈਂ ਉਸਨੂੰ ਉਠਾਉਣ ਦੀ ਕੋਸ਼ਿਸ਼ ਕੀਤੀ ਮੇਰਾ ਸਾਹ ਰੁਕਣ ਲੱਗ ਗਿਆ ਚੱਕਰ ਆਉਣ ਲੱਗ ਪਏ ਅਤੇ ਫਿਰ ਮੈਂ ਬੇਹੋਸ਼ ਹੋ ਗਈ। ਉਸ ਤੋਂ ਬਾਅਦ ਮੈਨੂੰ ਮੋਹਨਦਈ ਓਸਵਾਲ ਹਸਪਤਾਲ ਵਿਚ ਜਾ ਕੇ ਤਕਰੀਬਨ ਪੰਜ ਘੰਟੇ ਬਾਅਦ ਹੋਸ਼ ਆਈ ਅਤੇ ਮੈਨੂੰ ਪਤਾ ਲੱਗਿਆ ਕਿ ਮੇਰੀ ਗੁਆਂਢ ਵਿਚ ਰਹਿਣ ਵਾਲੇ ਕਈ ਲੋਕਾਂ ਦੀ ਮੌਤ ਹੋ ਚੁੱਕੀ ਸੀ।

ਬਿਆਨ ਕਰਤਾ
रूबी देवी
7087540074

ATTESTED
Executive Magistrate
LUDHIANA (South)

ਜੋ ਸਿਮਰਨ ਪੁੱਤਰ ਕਿਸ਼ਨ ਚੰਦ ਵਾਸੀ ਨੂਰਵਾਲਾ ਰੋਡ ਆਰ ਵੈਲੀ ਦੇ ਘਰ ਕਿਰਾਏਦਾਰ
ਵਿਚ ਕਿਰਾਏ ਤੇ ਰਹਿ ਰਿਹਾ, ਜਿਸਦਾ ਕਰੀਬ 05 ਕੁ ਦਿਨ ਪਹਿਲਾਂ ਹੋਈ ਇਕ ਬੇਟੀ
ਜਿਸਦੀ ਦੇਖਭਾਲ ਕਰਨ ਸਿਮਰਨ ਦੀ ਮਾਤਾ ਵੀ ਸਿਮਰਨ ਦੇ ਕਮਰੇ ਚ ਸੀ। ਜੋ ਪਰਸੋਂ
ਮਿਤੀ 30-4-2023 ਦਿਨ ਐਤਵਾਰ ਨੂੰ ਸਵੇਰੇ ਤਕਰੀਬਨ 7:00 ਵਜੇ ਦੇ
ਕਰੀਬ ਤੋਂ ਸੀ ਉਸ ਵਕਤ ਮੈਂ ਆਪਣੀ ਦੁਕਾਨ ਖੋਲ ਕੇ ਝਾੜੂ ਲਗਾ ਰਿਹਾ
ਸੀ। ਜਦ ਮੈਂ ਤਕਰੀਬਨ ਅੱਧਾ ਘੰਟਾ ਬਾਅਦ ਬਾਹਰ ਆਇਆ ਤਾਂ
ਦੇਖਿਆ ਕਿ ਮੇਰੀ ਦੁਕਾਨ ਵਾਲੀ ਦੁਕਾਨ ਦੇ ਬਾਹਰ ਸਿਮਰਨ ਦਾ ਪਰਿਵਾਰ
ਖੜ੍ਹਾ ਸੀ ਅਤੇ ਇਕ ਔਰਤ ਰੋ ਰਹੀਆਂ ਸੀ ਜਦ ਉੱਥੇ ਜਾ ਕੇ ਪਤਾ ਕੀਤਾ
ਕਰਨ ਲੱਗਾ ਕੀ ਸੀ, ਬਾਅਦ ਪਤਾ ਲੱਗਾ ਕਿ ਗੈਸ ਚੜ੍ਹਨ ਕਰਕੇ ਮੌਤ ਵੀ
ਖਰਾਬ ਹੋ ਗਈ ਸੀ, ਜਿਸ ਕਰਕੇ ਮੈਂ ਆਪਣੀ ਦੁਕਾਨ ਬੰਦ ਕਰਕੇ ਉੱਥੇ
ਚਲਾ ਗਿਆ।

ਬਾਕੀ ਇਸ ਬਾਰੇ ਪਤਾ ਲੱਗਿਆ ਕਿ ਕਿਸੇ ਵਿਅਕਤੀ
ਗੈਸ ਕਾਰਨ ਮੌਤ ਆਦਿ ਹੋਣ ਕਰਕੇ ਸਾਰੇ ਲੋਕਾਂ ਦੀ ਮੌਤ
ਤੇ ਦੁੱਖੀ ਸੀ।

ਬਿਆਨ ਕਰਤਾ

[illegible signature]

ATTESTED
Executive Magistrate
LUDHIANA (South)

M. No-
99157-
39068

ਮੈਂ ਵਿਆਨ ਕਰਦਾ ਹਾਂ ਕਿ ਮੈਂ ਸੁਸ਼ੀਲ ਪੁੱਤਰ ਰਾਮ ਪ੍ਰਕਾਸ਼ ਉਮਰ 26 ਸਾਲ ਆਧਾਰ ਕਾਰਡ ਨੰਬਰ: 629583366020 ਵਾਸੀ H.No.B-XXIX 458/12/22/A-Street No.2 ਅੱਬਲ ਕਲੋਨੀ ਵਾਰਡ ਨੰ. 74 ਸ਼ਿਮਲਾਪੁਰੀ ਦਾ ਰਹਿਣ ਵਾਲਾ ਹਾਂ। ਕਿ ਮੈਂ ਅੱਜ ਕਾਰ ਪਿੱਛੇ ਸ਼ਿਮਲਾਪੁਰੀ ਵਿਚ ਮਿਤੀ: 30-4-2023 ਸਮਾ ਤਕਰੀਬਨ ਸਵੇ 7:00 ਵਜੇ ਸਤਿਸੰਗੀ ਅੱਬਲ ਕਲਾਨ ਨਾਲ ਮੋਟਰ ਟੱਕਰ ਕੀਤੀ, ਉਸ ਵਕਤ ਮੈਂ ਹੁਣੇ ਹੀ ਤਰਾ ਦਾਖੀਕਲ ਪਾਸ ਹੋਈ ਸੀ ਜਦ ਮੈਂ ਹਾਦਸਾ ਕੀਤਾ, ਮਦ ਮੈਂ ਹਾਦਸਾ ਕਰਕੇ ਤੇ ਮੈਂ ਰੌਲਾ ਪਾ ਦਿਤਾ ਕਿ ਮੋਟਰ ਵਾਲੀ ਦੌਲਤੀ ਚਲੀਜ਼ ਤੇ ਕਿ ਹਾਦਸਾ ਕਿਸ ਤਰਾ ਹੋਇਆ ਤਾਂ ਜੋ ਮੋਟਰ ਵਾਲਾ ਮੋਟਰ ਸਾਈਕਲ ਦੌਲਤੀ ਨੂੰ ਕਾਬੂ ਕਰ ਲਿਆ। ਜੋ ਕਿ ਮੋਟਰ ਵੀ ਦੌਲਤੀ ਸੀ ਉਹ ਵੀ ਮੌਕਾ ਵੀ ਹਾਜ਼ਰ ਹੋ ਗਏ ਸਨ, ਤੇ ਉਹ ਵੀ ਹਾਦਸਾ ਚਸ਼ਮਦੀਦ ਹੋ ਕਿਸੇ ਪਾਸ ਸਨ। ਉਸ ਵਕਤ ਹਾਦਸਾ ਸਥਲੀ ਵੀ ਹਾਜ਼ਰ ਪਰਾਚ ਤੋਂ ਫੋਟੋ ਕੀਤੀ। ਮੌਕੇ ਉਸ ਵਕਤ ਚੱਕਰ ਆ ਗਿਆ ਸੀ ਤੇ ਮੈਂ ਉੱਥੇ ਤੋਂ ਸਾਇਕਲ ਸਮੇਤ ਚਲਾਈ, ਮੈਂ ਕਿਥੇ ਜਾ ਰਿਹਾ ਸੀ, ਤੇ ਵਾਪਸ ਵਿਚ ਪਤਾ ਲੱਗਾ ਕਿ ਮੋਟਰ ਦੌਲਤੀ ਤੇ ਤਕਰੀਬ ਕਾਫੀ ਵੀ ਦੌਲਤੀ ਵੀ ਨੌਤ

ਦਸਖੀ ਮੈਂ

03/05/23

ATTESTED

Executive Magistrate
LUDHIANA (South)

M.No. 98036
36237

ANNEXU

ਦਫ਼ਤਰ ਡਿਪਟੀ ਕਮਿਸ਼ਨਰ – ਕਮ - ਜ਼ਿਲ੍ਹਾ ਮੈਜਿਸਟਰੇਟ, ਲੁਧਿਆਣਾ

OFFICE OF THE DEPUTY COMMISSIONER – CUM - DISTRICT MAGISTRATE, LUDHIANA

ORDER:

Immediately after the gas leak incident was reported at around 7:30AM on 30.04.2023, senior officials of District Administration, Police Commissionerate, Municipal Corporation (MC), Ludhiana, medical teams and forensic experts, as well as the 13th NDRF battalion stationed at Ladowal, Ludhiana and 7th Battalion, NDRF stationed at Bathinda rushed to the spot. The affected area was evacuated and cordoned off.

1. The NDRF teams began taking readings in the affected area with the help of hand-held gas detectors, especially near the seven (07) manholes from 1pm onwards on 30.04.2023 (Sunday). At 1pm on 30.04.2023, the level of H_2S at surface of one of the manhole was 15 ppm. While the reading of H_2S on the surface was between 10-15 ppm, it varied between 100-200 ppm inside the manholes. Subsequently, on the advice of Dr. Anjan Ray, former Director, Indian Institute of Petroleum (IIP) and an expert, the decontamination of the area with diluted caustic soda was started in the evening of 30.04.2023. NDRF teams informed that, on 01.05.2023, from 4AM till 4PM, readings were taken. As per the latest reading taken by NDRF at 4PM, the level of H_2S inside the one (01) manhole near Aarti Clinic, Giaspura, was 2 PPM, while CO level was Zero. Inside the other remaining six (06) manholes, both the H_2S and CO was Zero. As per the report of NDRF, after this, the H_2S levels in the ambient air were recorded as Zero.

2. Keeping in view that the levels of H_2S and CO have fallen to Zero in six (06) manholes and 2 PPM in the 7th manhole at 4PM on 01.05.2023, an Order constituting three (03)-member Technical Committee comprising of XEN, Water Supply & Sanitation (WSS), Ludhiana; XEN, PWSSB, Ludhiana, and XEN (O&M Cell), MC, Ludhiana was issued vide this Office Endst. No. 5362-5366/MA dated 01.05.2023. This Committee was entrusted with the task of physically checking the area still cordoned off by the Police i.e. 25 metre radius from the affected area for other factors affecting the safety of residents, give suggestions, if any, to ensure the safety of public, and submit its report thereof to ADC, Khanna by 01.05.2023.

Pursuant to the issuance of the above Order, the Committee officials visited the affected area on 01.05.2023 and inspected the three (03) buildings where the incident had happened on 30.04.2023. The Committee, in its report submitted on 01.05.2023, observed that these buildings have very less or no provision of cross-ventilation. The washrooms neither have vent pipes nor exhaust fans. One drainage vent was found inside the residential room of the building of Aarti Clinic, which should not have been there. Furthermore, these buildings are very congested. In view of the above observations, the Committee made the following suggestions to prevent occurrence of such an incident in the future:

(i). The buildings should have provision for proper cross-ventilation so that there is no possibility of any suffocation.

(ii). Washrooms should have exhaust fans and vent pipes so that the gases may be discharged.

(iii). With regard to the main sewer, the Committee suggested that all the manholes in the affected area should be provided with road gulleys or vent shafts so that the sewer gases, which are formed inside the sewer pipes, are discharged via these road gulleys or vent pipes.

3. A report as to the law and order situation in the affected area was taken from the Office of Commissioner of Police, Ludhiana. ADCP (South), Ludhiana, in its report to this Office sent vide No. 309/5A/ADCP South Ludhiana dated 02.05.2023, has reported that an FIR No. 112 dated 30.04.2023 u/s 304 of IPC was registered at PS Sahnewal. Investigation in the case is ongoing and all possible angles are being probed. The situation in the area is peaceful.

Keeping in view the NDRF Report as per which the H_2S levels in the ambient air were recorded as Zero at 4PM on 01.05.2023 and the report of the police today mentioning that the law & order situation in the affected area as peaceful, the cordon is, hereby, ordered to be removed in the affected area in Giaspura, Ludhiana with directions to the Municipal Corporation (MC), Ludhiana to carry out the tasks required for implementing the suggestions made by the three (03)-member Technical Committee detailed at Para 2 (iii) above.

Furthermore, the residents of the area are advised to carry out the tasks suggested by the Technical Committee at para 2 (i) and 2 (ii) before occupying their houses.

Deputy Commissioner,
Ludhiana

Endst. No. 5367 - 5371 / MA, Dated: 02.05.2023

A copy of the above is forwarded to the following for information and necessary action:

1. Commissioner of Police, Ludhiana
2. Commissioner, Municipal Corporation (MC), Ludhiana - for information, and with a request that Building Inspectors may kindly be directed to liaise with the residents of the affected area for implementation of the suggestions of the Technical Committee, as detailed at Para 2 (i) and 2 (ii) above.
3. Civil Surgeon, Ludhiana
4. ADC, Khanna
5. SDM, Ludhiana (West)

Deputy Commissioner,
Ludhiana

ANNEXURE P3

ਇਸਮਾ ਸਮਾ ਰੋਡ ਗਿਆਸਪੁਰਾ ਇਖੇ ਹਾਪਰੇ ਗੱਸ ਸ਼ੀਵ ਮਾਮਲੇ = ਸਥੈਯੀਫਿਪੋਰਟ ।

ਉਪਰੋਕਤ ਇਸਮੇ ਦੇ ਸਬੰਧ ਇਚ ਸੂਸਿਆ ਕਾਰਾ ਹੈ ਕਿ ਮਾਂਚ ਮਿਤੀ 01.05.2023 ਨੂੰ ਮੇਰੇ ਦੀ ਸਾਂਚ ਦੀਤੀ ਗਈ ਅਤੇ ਦੇਖਿਆ ਗਿਆ ਦੀ ਮਿਲਾਂ ਤਿਲ ਇਮਾਰਤਾਂ ਇਚ ਇਹ ਹਾਦਸਾ ਹਾਪਰ ਹੈ, ਉਨਾਂ ਦੀ ਸਥਿਤੀ ਸਗ-ਭਗ ਇਕੋ ਜਿਹੀ ਹੈ। ਇਹਨਾਂ ਸਾਰੀਆਂ ਇਮਾਰਤਾਂ ਇਚ ਕਰੋਸ - ਵੈਂਟੀਲੇਸਨ ਦਾ ਪ੍ਰਬੰਧਨ ਬਹੁਤ ਘੱਟ ਹੈ ਜਾਂ ਬਿਲਕੁਲ ਨਹੀ ਹੈ। ਬਾਥਰੂਮਾਂ ਇਚ ਜਾ ਤਾਂ ਵੈਂਟ ਪਾਇਪ ਸਗੇ ਹੋਏ ਹਨ ਅਤੇ ਜਾ ਹੀ ਮੈਨਜਮੈਂਟ ਫੈਲ ਸਗੇ ਹੋਏ ਹਨ। ਸਮਾਰਤੀ ਫਲੀਲਿਟ ਵਾਲੀ ਇਮਾਰਤ ਇਚ ਰਿਸੈਪਸਨ ਕਮਰੇ ਇਚ ਵੈਂਟੀਲੇਸਨ ਵੈਂਟ ਬਣਾਇਆ ਗਿਆ ਹੈ। ਜੋ ਕਿ ਕਮਰੇ ਇਚ ਨਹੀ ਬਣਿਆ ਹੋਣਾ ਚਾਹੀਦਾ। ਇਹ ਇਮਾਰਤਾਂ ਬਹੁਤ ਪੁਰਾਣੀਆਂ ਹਨ।

ਇਹਨਾਂ ਗੱਲਾਂ ਦੇ ਧਿਆਨ ਇਚ ਰੱਖਦੇ ਹੋਏ ਇਹ ਸੁਝਾਅ ਦਿੱਤਾ ਜਾਂਦਾ ਹੈ ਕਿ "ਇਹਨਾਂ ਇਮਾਰਤਾਂ ਇਚ ਵੈਂਟੀਲੇਸਨ ਸਹੀ ਮੈਨਜਮੈਂਟ ਫੈਲ ਸਗਾਏ ਜਾਣ ਤਾਂ ਜੋ ਘੱਟਣ ਦੀ ਸਮੱਸਿਆ ਨਾ ਆਵੇ, ਅਤੇ ਬਾਥਰੂਮਾਂ ਇਚ ਵੀ ਮੈਨਜਮੈਂਟ ਫੈਲ ਅਤੇ ਵੈਂਟ ਪਾਇਪ ਸਗਾਏ ਜਾਣ, ਤਾਂ ਜੋ ਗੱਸ ਦੀ ਲਿਕਾਜੀ ਨੂੰ ਸਕੇ। ਜਿਥੇ ਤੱਕ ਸੀਵਰ ਰੋਡ ਤੇ ਸੀਵਰ ਲਾਈਨ ਦਾ ਸਵਾਲ ਹੈ, ਇਹ ਸੁਝਾਅ ਦਿੱਤਾ ਜਾਂਦਾ ਹੈ ਕਿਉਂਕਿ ਇਸ ਥਾਂ ਤੇ ਹਾਦਸਾ ਵਾਪਰਿਆ ਹੈ ਇਥੇ ਹਰ ਇਕ ਮੈਨਹੋਲ ਖੁਲ੍ਹਾ ਰੱਖੀ ਜਾਵੇ ਜਾਂ ਵੈਂਟ ਸਾਫਟ ਕਰ ਦਿੱਤੀ ਜਾਵੇ, ਤਾਂ ਜੋ ਜਹਰੀ ਗੱਸ ਕਢਦੀ ਹੀ ਹੈ ਤਾਂ ਉਸਦੀ ਲਿਕਾਜੀ ਖੁਲ੍ਹੇ ਖੁਲ੍ਹ ਨੂੰ ਸਕੇ ਅਤੇ ਭਵਿੱਖ ਇਚ ਇਸ ਤਰ੍ਹਾਂ ਦੇ ਹਾਦਸੇ ਤੋਂ ਬਚਿਆ ਜਾ ਸਕੇ।

ਰਿਪੋਰਟ ਸਾਥ ਭੀ ਦੀ ਜਾਣਕਾਰੀ ਹਿਤ ਭੇਜਿਆ ਹੈ।

1880 ਐਸ.ਡੀ.ਐਮ

Sub-Divisional Magistrate
Ludhiana (West)

(SDE)
(Public Health)

(SDE)
PWSSB
On Behalf of XEN, PWSSB

XEN (OEM)
MCL

Navdeep
JE (PWSSB)

(XEN)
(Public Health)

DC-ਜੀ

AY

CSIR-CSIO Chandigarh Tuesday 24

2022

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Date: 30-04-2023 DAY 144-221 WK 22

MEETINGS / APPOINTMENTS

⑤ Goyal ⑥
② Upstream LHS RHS

① Jasbir Building ③ Saroj Deaty ④ Aarti cling ⑦ Punjab emporium

CSIO sensor data:

location point			gas		
			H_2S	CO	
①	①		0	0	(surface)
			—	—	
②	②		0	0	(surface
			0	20 ppm	(innen)
③	③		0	0	(surface)
			12 ppm	92 ppm	(innen)
④	④		0	0	—
⑤	⑤	LHS	0	0	surface
			1.5	296	(innen
⑥		RHS	0	0	surface
			18	47 ppm	innen

25 Wednesday

MAY

WK 22 DAY 145-220

MAY

WK	M	T	W	T	F	S
18	30	31				
19	2	3	4	5	6	7	8
20	9	10	11	12	13	14	15
21	16	17	18	19	20	21	22
22	23	24	25	26	27	28	29

MEETINGS / APPOINTMENTS

Detected using Honeywell Max XT-II

9

Received by

10

11 Amarjit Bains

12 AO E, Khanna

Report by Sujit Kaman 30/4/23

Sujit Kaman
Sr. Scientist
CSIR-CSIO

1

2

3

4

5

6

IMPORTANT

Annexure-A5

ANNEXURE 'A'

ਦਫ਼ਤਰ ਡਿਪਟੀ ਕਮਿਸ਼ਨਰ – ਕਮ - ਜ਼ਿਲ੍ਹਾ ਮੈਜਿਸਟਰੇਟ, ਲੁਧਿਆਣਾ

OFFICE OF THE DEPUTY COMMISSIONER – CUM - DISTRICT MAGISTRATE, LUDHIANA

ORDER: **Constitution of Committee of Officers for conducting multi-sectoral Inquiry into the incident of Gas Leak at Giaspura, Ludhiana today morning i.e. on 30.04.2023**

In view of the gas leak incident that took place in Giaspura, Ludhiana at around 8.15 AM today morning i.e. on Sunday, 30.04.2023, a Committee of the following officers is, hereby, constituted, for conducting multi-sectoral inquiry into this incident:

1. Ms. Swati Tiwana, PCS, SDM, Ludhiana (West), Mobile No. 75081-61360
2. Mr. Kulpreet Singh, PCS, Joint Commissioner, Municipal Corporation (MC), Ludhiana (Mobile No. 98558-83389)
3. Mr. Vaibhav Sehgal, PPS, ACP (Zone-2), Ludhiana (Mobile No. 98150- 02180)
4. Mr. RK Ratra, Superintending Engineer, PPCB, Ludhiana (Mobile No 98789-50529)
5. Mr. Paramjit Singh, Superintending Engineer, PPCB, Ludhiana (Mobile No. 98789-50532)
6. Mr. Gaurav Puri, Dy. Director (Factories), Ludhiana (Mobile No. 96460- 15878)

The above-said Committee shall conduct thorough probe into the cause of the incident and submit its report by tomorrow i.e. by Monday, 01.05.2023.

ADC (General),
Ludhiana

Endst. No. 5318 - 5321 / MA, Dated: 30.04.2023

A copy of the above is forwarded to the following for information and necessary action:

1. Commissioner of Police, Ludhiana
2. Commissioner, Municipal Corporation, Ludhiana
3. Chief Engineer, PPCB, Ludhiana
4. To all the members of the above-said Committee, for information and necessary compliance

ADC (General),
Ludhiana

affected area on 01.05.2023 and inspected the [illegible]

ਦਫ਼ਤਰ ਡਿਪਟੀ ਕਮਿਸ਼ਨਰ – ਕਮ - ਜ਼ਿਲ੍ਹਾ ਮੈਜਿਸਟਰੇਟ, ਲੁਧਿਆਣਾ

OFFICE OF THE DEPUTY COMMISSIONER – CUM - DISTRICT MAGISTRATE, LUDHIANA

To,

ACS-cum-Financial Commissioner (Revenue),
Department of Revenue, Rehabilitation & Disaster Management,
Government of Punjab, Chandigarh

No. 5372 / MA, Dated: 02.05.2023

SUBJECT: Third & Final Report on the Gas Leak incident at Giaspura, Ludhiana (Punjab) at around 7:30 AM on 30.04.2023 (Sunday)

Reference: (i). First Report on the above incident, which was sent vide No. 5331/MA dated 30.04.2023

(ii). Second Report on the above incident, which was sent vide No. 5357/MA dated 01.05.2023

With reference to the above subject, it is submitted that the First Report on the above incident was sent to your Office vide this office letter bearing No. 5331/MA dated 30.04.2023 while the Second Report was sent vide letter bearing No. 5357/MA dated 01.05.2023.

1. As reported in the First Report, immediately after the gas leak incident was reported at around 7:30AM on 30.04.2023, senior officials of District Administration, Police Commissionerate, Municipal Corporation (MC), Ludhiana, medical teams and forensic experts, as well as the 13th NDRF battalion stationed at Ladowal, Ludhiana and 7th Battalion, NDRF stationed at Bathinda rushed to the spot. The affected area was evacuated and cordoned off.

2. The NDRF teams began taking readings in the affected area with the help of hand-held gas detectors, especially near the seven (07) manholes from 1pm onwards on 30.04.2023 (Sunday). At 1pm on 30.04.2023, the level of H_2S at surface of one of the manhole was 15 ppm. While the reading of H_2S on the surface was between 10-15 ppm, it varied between 100-200 ppm inside the manholes. Subsequently, on the advice of Dr. Anjan Ray, former Director, Indian Institute of Petroleum (IIP) and an expert, the decontamination of the area with diluted caustic soda was started in the evening of 30.04.2023. NDRF teams informed that, on 01.05.2023, from 4AM till 4PM, readings were taken. As per the latest reading taken by NDRF at 4PM, the level of H_2S inside the one (01) manhole near Aarti Clinic, Giaspura, was 2 PPM, while CO level was Zero. Inside the other remaining six (06) manholes, both the H_2S and CO was Zero. As per the report of NDRF, after this, the H_2S levels in the ambient air were recorded as Zero.

3. Keeping in view that the levels of H_2S and CO have fallen to Zero in six (06) manholes and 2 PPM in the 7th manhole at 4PM on 01.05.2023, an Order constituting three (03)-member Technical Committee comprising of XEN, Water Supply & Sanitation (WSS), Ludhiana; XEN, PWSSB, Ludhiana, and XEN (O&M Cell), MC, Ludhiana was issued vide this Office Endst. No. 5362-5366/MA dated 01.05.2023. This Committee was entrusted with the task of physically checking the area still cordoned off by the Police i.e. 25 metre radius from the affected area for other factors affecting the safety of residents, give suggestions, if any, to ensure the safety of public, and submit its report thereof to ADC, Khanna by 01.05.2023.

4. Pursuant to the issuance of the above Order, the Committee officials visited the affected area on 01.05.2023 and inspected the three (03) buildings where the incident had happened on 30.04.2023. The Committee, in its report submitted on 01.05.2023, observed that these buildings have very less or no provision of cross-ventilation. The washrooms neither have vent pipes nor exhaust fans. One drainage vent was found inside the residential room of the building of Aarti Clinic, which should not have been there. Furthermore, these buildings are very

congested. In view of the above observations, the Committee made the following suggestions to prevent occurrence of such an incident in the future:

(i). The buildings should have provision for proper cross-ventilation so that there is no possibility of any suffocation.

(ii). Washrooms should have exhaust fans and vent pipes so that the gases may be discharged.

(iii). With regard to the main sewer, the Committee suggested that all the manholes in the affected area should be provided with road gulleys or vent shafts so that the sewer gases, which are formed inside the sewer pipes, are discharged via these road gulleys or vent pipes.

5. A report as to the law and order situation in the affected area was taken from the Office of Commissioner of Police, Ludhiana. ADCP (South), Ludhiana, in its report to this Office sent vide No. 309/5A/ADCP South Ludhiana dated 02.05.2023, has reported that an FIR No. 112 dated 30.04.2023 u/s 304 of IPC was registered at PS Sahnewal. Investigation in the case is ongoing and all possible angles are being probed. The situation in the area is peaceful.

Keeping in view the NDRF Report as per which the H_2S levels in the ambient air were recorded as Zero at 4PM on 01.05.2023 and the report of the police today mentioning that the law & order situation in the affected area as peaceful, the police cordon - which, on the day of the incident i.e. on 30.04.2023, was of 250 metres radius from the affected area and was subsequently reduced to a radius of 25 metres from the affected area yesterday i.e. on 01.05.2023 - was removed with directions to the Municipal Corporation (MC), Ludhiana to carry out the tasks required for implementing the suggestions made by the three (03)-member Technical Committee detailed at Para 4 (iii) above. Furthermore, the residents of the area have been advised to carry out the tasks suggested by the Technical Committee at para 4 (i) and 4 (ii) before occupying their houses.

6. In the meanwhile, it is worthwhile to mention here that the Hon'ble National Green Tribunal (NGT) has taken suo-moto cognizance of the incident today from the news item published in India Today dated 30.04.2023, and issued an Order in Original Application No. 327/2023 dated 02.05.2023 wherein an eight-member fact-finding joint Committee to be headed by Chairman, Punjab State PCB, has been constituted with further directions that the Committee may meet within one week from the date of order and complete its task preferably within one (01) month. Also, the Hon'ble Tribunal has directed the undersigned to ensure payment of compensation @Rs. 20 lakhs each to the heirs of 11 persons who have died, deducting the amounts, if any, already paid within one (01) month. The Committee has also been directed to mention the details of persons who have died and persons injured with extent of injuries suffered by them, and further to recommend measures to be taken in future to prevent such incidents. A copy of the Order is enclosed herewith for your ready reference and perusal, please.

The report is submitted for your kind information, please.

Deputy Commissioner,
Ludhiana

Endst. No. 5373 / MA, Dated: 01.05.2023

A copy of the above is forwarded to the ACS to CM, Punjab, Chandigarh for kind information, please.

Deputy Commissioner,
Ludhiana

Email

ANNEXURE-8
Surabhi Malik

Fwd: submission of report

From : ngtgasleakffjc@gmail.com
Subject : Fwd: submission of report
To : gurnam <gurnamsingh.cpcb@nic.in>, rpbd@iitrindia.org, director@iitrindia.org, Sheelendra Pratap Singh <sheelendra@iitr.res.in>, PGIMER Chandigarh <pgimer@chd.nic.in>, pvm lakshmi <pvm_lakshmi@yahoo.com>, dg ndrf <dg.ndrf@nic.in>, uttamchand2115@gmail.com, Surabhi Malik <dc.ldh@punjab.gov.in>, commissionermcl@gmail.com, msppcb@gmail.com
Cc : ceeludhiana@yahoo.com, ppcbzo1ldh@gmail.com, seezo2ldhppcb@yahoo.com, chairmanppcb@yahoo.co.in

Thu, Jun 22, 2023 06:24 PM
4 attachments

ADC(G)
22/6/2023

The mail is forwarded in reference to Letter no. 14223-29 dated 20.06.2023 and email dated 22.06.2023
---------- Forwarded message ---------
From: **Chairman PPCB** <chairman.ptl.ppcb@punjab.gov.in>
Date: Thu, Jun 22, 2023 at 5:45 PM
Subject: Fwd: submission of report
To: ngtgasleakffjc <ngtgasleakffjc@gmail.com>

SDM West for consideration in magisterial inquiry

From: "SUNIL DUTT" <jk13.ndrf@gov.in>
To: "Chairman PPCB" <chairman.ptl.ppcb@punjab.gov.in>
Sent: Saturday, May 20, 2023 7:04:01 PM
Subject: submission of report

SIR,
PLEASE SEE THE ATTACHED FILE.

13TH BN NDRF
LADHOWAL, LUDHIANA
PUNJAB - 141005

सबका साथ
सबका विकास
सबका विश्वास
सबका प्रयास

Azadi Ka Amrit Mahotsav

THROUGH E-OFFICE

jk13.ndrf@gov.in

13th Bn NDRF
Ladhowal Camp
Ludhiana(Punjab)
PIN- 141008

11011/11/Ops/NDRF/2023/1563

20 May 2023

Chairman
Punjab Pollution Control Board
Email - chariman.ptl.ppcb@punjab.gov.in

SUBMISSION OF REPORTS /DOCUMENTS TO THE "FACT FINDING JOINT COMMITTEE" CONSTITUTED BY HON'BLE NGT IN O.A NO 327 OF 2023 IN LUDHIANA GAS LEAK INCIDENT

Inputs and findings of the incident alongwith photographs of gas leakage at Giaspura, Ludhiana (Punjab) on 30 Apr 2023 is enclosed herewith as per appendix attached as desired please.

(Uttam Chand)
Commandant
Commandant 13th Bn NDRF

Encl : As stated above.

All of them were rescued and evacuated safely from incident site and handed over to civil administration. Another team under Insp (GD) Lal Singh Sukhwal assisted civil administration in evacuating the persons of nearby houses to safer areas. Details of rescued persons:-

S/No	Name of rescued persons	Age	Sex	
			Male	Female
(a)	Raushan Ali	48	Male	-
(b)	Imran Ali	17	Male	-
(c)	Trannum Khatun	15	-	Female
(d)	Araju Khatun	14	-	Female
(e)	Shabnam Khatun	11	-	Female
(f)	Sabana Khatun	10	-	Female
(g)	Sabina Khatun	07	-	Female

6. Commandant 13th Bn NDRF also reached at incident site at around 1200 hours and took the stock of situation. He discussed with Commissioner Sh. Mandip Singh, Commissioner Ludhiana, DC Mrs Shurbhi Malik, IAS and DC Corporation Mrs Shena Aggarwal, who were present at the incident site and supervised the operation further.

7. Meanwhile as per directions of HQ DG NDRF, a team of 7th Bn NDRF strength 01 GO 04 SOs and 25 Rescuers also reached incident site at 1330 hours under supervision of Sh. Santosh Singh, Commandant 7th Bn NDRF alongwith Gas Alert Micro - V detector. On testing through Gas Alert Micro – V detector, it was revealed that Hydrogen Sulphid gas (H_2S) has contaminated the air and caused the incident. Initially the level of air contamination was found 190-200 PPM. Then the state medical authority used Caustic Soda in sewage and flushed out with water to get the level of contamination down. Thereafter the air contamination level came down between 02-15 PPM. Further civil administration called up experts from CSIO (Central Scientific Instrument Organization) Chandigarh who had taken the sample for further investigation.

8. Teams of 13 Bn NDRF and 7th Bn NDRF stayed at incident site for two days, checked air contamination on next day. The situation was found normal by evening on 1st May 2023. Operation was called off with consent of civil authorities on 01 May 2023 at 2200 hours and teams left for their respective locations.

9 Some photographs of operation are attached as **Annexure**.

(Uttam Chand)
Commandant
Commandant 13th Bn NDRF

Appendix

INPUTS AND FINDINGS OF THE INCIDENT ON GAS LEAKAGE AT GIASPURA, LUDHIANA (PUNJAB) ON 30 APR 2023

1. On 30 Apr 2023 at 0820 hours information received through Sh. Sameer Verma, SP Ludhiana (Punjab) by Sh. Uttam Chand, Commandant 13 Bn NDRF about Gas leakage incident which happened in Giaspura, Sua Road, Ludhiana (Punjab) in which 04 persons found spot dead and 02 were seriously affected. SP asked for NDRF assistance immediately and he also told that type of gas and source of leakage is not known till now.

2. Accordingly, a team consisting of strength 03 SOs and 28 Rescuers led by Insp Lal Singh Sukhwal (Mob-7005890727) under the supervision of Sh. Dev Raj, Deputy Commandant with 04 x vehicles and all available CBRN equipments left from Bn HQ at 0900 hours. The distance of incident site from Bn HQ is approx 30 Kms. Team reached at incident site at 0940 hours.

3. Sh. Dev Raj, Deputy Commandant met with DC Mrs Surbhi Malik, Commissioner Sh. Mandip Singh and took the stock of present situation and assessed the situation. He advised the civil administration to vacate and seal 500 mtrs surrounding areas of the incident site immediately so that further damage could be prevented. After assessing the situation NDRF team established the operation base/ command post at a safer distance as per protocol. Team Supervisor Sh. Dev Raj, Deputy Commandant passed safety instructions to all rescuers and also advised Police, civil administration, public and media to maintain safe distance from the incident site. Team planned to execute operational tasks in 03 phases as under :-

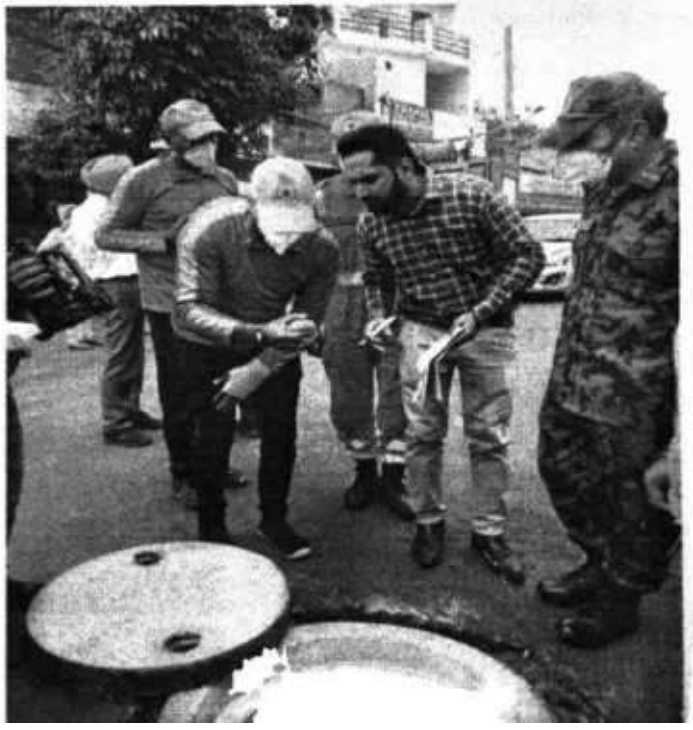
(a) Phase-I. To search incident site to find out victim/unconscious person.
(b) Phase-II. To find out the source of gas leakage and plug it.
(c) Phase-III. To search nearby houses and lastly to carry out confirmatory search.

4. A sub team entered into the incident area under supervision of Sh. Dev Raj, Deputy Commandant. Initially the sub team tried to find out live victims in the area but no one was found at first sight. On further search the team observed that the contaminated gas was passing through three manholes of sewage pipe line passing along the road. They successfully plug two of them as the lid of third manhole was broken NDRF team adviced Municipal Committee employees to replace the broken lid and which replaced by them. The leakage was reduced to some extent. The sub team further searched the two buildings in which 04 victims were found dead and found a pet dog which was tied with chain on roof and was still alive, team rescued it and handed over to civil authority.

5. After half an hour, sub team was replaced by other sub team and team started confirmatory search of first floor of affected buildings. The team found that a door was latched from inside and it was also revealed that some people were suspected to be inside the room. Matter was informed to team commander and they tried to open the door but even after continuous knocking no one opened the door. The sub team made a lot of efforts to encourage and convinced them and thereafter finally door was opened from inside. After entering the room one male, one female and their 05 children aged approx 07 years to 17 years were found hiding inside the room due to fear of incident.


CONFECTIONERY
GOYAL COLD DRINKS


Novelty



Annexure

PHOTOGRAPHS OF OPERATION GAS LEAKAGE INCIDENT AT GIASPURA, LUDHIANA (PUNJAB) ON 30 APR 2023 : 13TH BN NDRF

Annexure-C

ਨੰ. ਸਹੰਮਸ/23/01 ਮਿਤੀ 24/06/2023

ਵਲੋ

ਸਿਵਲ ਸਰਜਨ,

ਲੁਧਿਆਣਾ

ਵੱਲ

ਐਸ.ਡੀ.ਐਸ. (ਵੈਸਟ)

ਲੁਧਿਆਣਾ।

ਵਿਸ਼ਾ- ਲੁਧਿਆਣਾ ਗੈਸ ਲੀਕ ਘਟਨਾ ਦੀ ਰਿਪੋਰਟ ਭੇਜਣ ਸਬੰਧੀ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਦੇ ਸੰਬੰਧ ਵਿੱਚ ਲਿਖਿਆ ਜਾਂਦਾ ਹੈ ਕਿ ਲੁਧਿਆਣਾ ਗੈਸ ਲੀਕ ਘਟਨਾ ਨਾਲ ਸਬੰਧਤ ਰਿਪੋਰਟ ਇਸ ਪੱਤਰ

ਨਾਲ ਨੱਥੀ ਕਰਕੇ ਆਪ ਨੂੰ ਅਗਲੇਰੀ ਕਾਰਵਾਈ ਹਿੱਤ ਭੇਜੀ ਜਾਂਦੀ ਹੈ।

ਨੱਥੀ- ਉਕਤ ਅਨੁਸਾਰ

HRau 24/6/23

ਸਿਵਲ ਸਰਜਨ,

ਲੁਧਿਆਣਾ

Day of incident, 30/04/2023, Emergency response team performance, department of health, Ludhiana

On receiving the information about the disaster at Giaspura with the incidence of alleged toxic gas leakage at 8:00 AM. Emergency disaster teams were activated immediately. Civil surgeon Ludhiana personally monitored the teams and led the way by ordering the Senior Medical Officer of the Civil Hospital, Ludhiana, to be equipped to handle the emergency.

Emergency disaster response is divided into four zones.

1. The visit to the disaster scene:

Officers deputed were

1. Dr. Charan Kamal, Medical officer, Forensic medicine and toxicology expert, civil hospital Ludhiana.

2. Dr. Vishal deep Chopra, Medical Officer, Emergency, Civil Hospital, Ludhiana.

3. Dr. Manju, Medical officer, Civil Surgeon, office, Ludhiana.

Ambulances were equipped with necessary emergency treatment kits, three fixed oxygen cylinders, two patients' portability capacities, and three portable oxygen cylinders.

All three teams consisted of one doctor, one class four, and one pilot.

108 Ambulances/ NGO/ private ambulances and even private vehicles transferred the patients to the Civil/ District Hospital Ludhiana and nearby hospitals like SPS Apollo/ Oswal Hospital. There was no hassle reported in transferring the victims to healthcare facilities.

Dr. Charan Kamal and his team stayed there till 12.30 PM to analyze the situation, being a toxicology expert gave his input to evacuate the area, and assisted the administration to take steps to limit further damage by advising the practical inputs such as using the masks, a practical tour of the affected area helped to analyze the site of leakage, a probable diagnosis of the type of the gas and it's toxic nature. Kept a constant touch with the team no 2, the team of multi-specialist doctors for the treatment of the victims established back at the base that is District/Civil Hospital Ludhiana and gave valuable inputs to analyze the signs and symptoms of the victims and findings of the dead bodies. Our team drew a hypothesis of Hydrogen sulfate poisoning and toxicity of methane, etc., by 9.30 AM only.

Dr. Vishal stayed along with the team up to 2.00 PM,

Dr. Manju along with her team stayed up tuntil4 PM.

Treatment for the Minor toxicity effects in the form of headache and confusion were seen in the local population. Medicines and consultations were provided by the teams.

Team No. 02. Emergency treatment team.

Officers deputed were

Dr. Harinder Singh Sood, MD, Medicine, Senior Medical Officer, ART, Civil Hospital Ludhiana,

Dr. Sukhdeep Kaur, MD, Medicine, medical officer, Civil Hospital Ludhiana,

Dr. Amandeep Kaur, MD, Medicine, medical officer, CHC Dehlon and

Dr. Harleen Kaur, MD Ophthalmology,

Dr. Harpreet Singh, Medical Officer, emergency, Civil Hospital Ludhiana.

They were present at the district hospital in Ludhiana.

They received two victims and nine dead bodies during the emergency.

s.no	name	Presenting symptoms	Treatment	Investigations and results	Other
1.	Unknown later identified as Mr. Nitin Kumar S/o Parmod Kumar, 40/m, r/o Giaspura	08.10 AM- Suffocation due to gas leakage, irritation of eyes, blurring of vision, unresponsive, GCS 09/15, E2V2M5. BP 150/110 SPO2-98 % PULSE 99/MIN 09.15 AM- 120/80, SPO2- 100 %, PULSE 105, Now fully conscious, alert, responsive to commands, irritation in eyes minimal, 10.45 AM, GCS	Medicine/ eye/ Continuous oxygen inhalation, Steroids, Antibiotics and symptomatic treatment.	CBC- WNL LFT -WNL RFT –WNL ECG- SINUS TACHYCRDIA ABG- WNL S.ELECTROLYTES- WNL.	Date of admission 30/04/2023, 08.10 AM. CR 9881/23. Discharged 01/05/2023 in stable condition.

		12/15, alert. 12.30 AM- GCS 15/15, alert, better.			
2.	Unknown later identified as Gaurav s/o Ashok Kumar 45 years male, r/o giaspura	08.10 AM- Suffocation due to gas leakage, irritation of eyes, blurring of vision, unresponsive, GCS 09/15, E2V2M5, BP 142/98 SPO2-88 % PULSE 87/MIN Rbs 220 mmol, 09.10 AM- 132/103, SPO2- 100 %, PULSE 87, Now fully conscious, alert, responsive to commands, irritation in eyes minimal, 10.30 AM, GCS 09/15, alert. 12.30 AM- GCS 15/15, alert, better. 6.20 PM- stable.	Medicine/ eye/ Continuous oxygen inhalation, Steroids, Antibiotics and symptomatic treatment.	CBC- WNL LFT -WNL RFT –WNL ECG- SINUS TACHYCRDIA ABG- WNL S.ELECTROLYTES- WNL.	Date of admission 30/04/2023, 08.10 AM. CR 9881/23. Discharged 01/05/2023 in stable condition.

The signs and symptoms are suggestive are acute inhalation poisoning and acute reversal was done successfully.

This team along with consultation with Dr. Charan Kamal is present at the site and keeping in view the signs/ Symptoms of the victims decoded the probable cause very quickly. The vast experience of our medical specialists and other paramedical staff, helped these patients/victims to come out of the toxic effects of toxicity of gases.

Team no. 3. The Medicolegal team:

Under the direct supervision of:

Dr. Vivek Kataria, MS General Surgery, Assistant Civil Surgeon, Ludhiana. Our Medicolegal team was constituted and put into action for the necessary examination. As soon as police officials produced Inquest papers regarding the deaths of the ten people for the postmortem examination. A board of doctors consisting of Dr. Charan Kamal, MD Forensic Medicine, and Toxicology, Medical Officer, civil hospital Ludhiana, Dr. Saurav Singla, MS. Orthopedics, medical officer Civil Hospital Ludhiana, Dr Geetanjali Kalyan, an Emergency medical officer was framed.This team observed that all the deceased have almost similar findings of asphyxia due to inhalation poisoning. As they were having pale faces, congested conjunctivae of the eyes, hemorrhagic mucosal membranes, discolored brains, discolored lungs of greenish purple color, and generalized cyanosis on the dead bodies. They also kept the Organs (viscera) preserved appropriately for the chemical analysis at State Chemical Laboratory Kharar for the type of gas/ poison for the Histopathology examination from the Government Medical College Rajindra Hospital Patiala.

The rotten eggs smell at the locality, the constant irritation to the eyes, mild headache, and mind confusion in the people, who were present at the scene were suggestive of hydrogen sulfide and the symptoms described by the patients/ victims at the hospital in the form of headache, irritation in eyes, confusion, irritation in the oral mucosa, falling saturation, breathlessness (and even unconsciousness in one patient were also , suggestive of hydrogen sulfide and methane toxicity.

The performance of all team was beyond words. These teams were in constant discussion with higher officials of the health department, the department of medical education and research, the head of the departments of various specialist departments of Government Medical colleges of Patiala/ Amritsar, etc.

The collective efforts of these three emergency teams of the health department led to the saving of two precious lives and the completion of the emergency disaster response. The response from the General administration, higher officials of the health department, the Department of Police, and other paramedical staff was helpful . This board did a detailed postmortem examination of the dead bodies of ten bodies from 04.00 PM to 10.00 PM.

Other treating physicians and other paramedic staff of Civil Hospital, Ludhiana did a commendable job by taking care of patients for 24 hours.

In total 9 dead bodies were received at the civil hospital Ludhiana and 2 dead bodies were brought by police from SPS Apollo hospital. A postmortem examination on all 11 bodies was done at civil hospital Ludhiana and dead bodies were handed over to the police with due respect.

And made reversion of toxicity of two victims successfully.

Postmortem examination of 10 dead bodies was conducted on 30/04/2023, by board of doctors and cause of death was declared "THE CAUSE OF DEATH, IN THIS CASE, IS POISONING DUE TO TOXIC GAS INHALATION HOWEVER TYPE OF POISONING WILL BE DECLARED AFTER RECEIVING OF CE AND HPE." the list of cases were as follows,

PMR/CKL/202/23	Mrs. NEETU DEVI	Year(s)=36 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/201/23	Mr. NAVNEET KUMAR	Year(s)=39 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/200/23	Mrs. PREETI	Year(s)=31 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/199/23	Mr. SAURAV GOYAL	Year(s)=35 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/198/23	Mrs. KAMLESH GOYAL	Year(s)=60 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/197/23	Mr. ARYAN	Year(s)=12 Month(s)=--- Days(s)=--	SUA ROAD	Punjab Freeze	01 May 2023
PMR/CKL/196/23	Mrs. VARSHA DEVI	Year(s)=35 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/195/23	Mr. KAVILASH KUMAR	Year(s)=35 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/194/23	Ms. KALPNA YADAV	Year(s)=22 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023
PMR/CKL/193/23	Mr. ABHAY NARAYAN	Year(s)=16 Month(s)=--- Days(s)=--	SUA ROAD GIASPURA	Punjab Freeze	01 May 2023

Status report, 23/06/2023

It is humbly submitted that only two reports amongst eleven have been received till date from GMC, Patiala. (Reports already sent) via email. All eleven chemical analysis reports are pending from Chemical Laboratory Kharar. It is further submitted that the cause of death was already given and viscera was kept for ascertaining the type of intoxicant only. The histopathology examination received in above said two cases are showing acute tubular necrosis and intense congestion of lungs which are again suggestive of inhalational poisoning.

The report of chemical analysis is always dispatched to the concerned police station and all eleven chemical analysis reports are pending from Chemical Laboratory Kharar.

: Forwarded to Pes. Civil Surgeon Ludhiana, for necessary action

for SMO

Dr Charan Kamal
Medical Officer
L.M. Civil Hospital
Ludhiana.

Department of Pathology, Government Medical College, Patiala
MLC 140/23

Dispatch No. Path/ 534 **Dated** 15/5/23

To

Dr Charan Kamal,
Medical Officer.
LM Civil Hospital,
Ludhiana (Punjab)

Sub: Histopathological Report ofviscera

Case Deceased MrAbhay Narayan S/O Kavilash Kumar, age 16yr/M vide PM[illegible]MR/CKL/193/23 dated30/4/2023 conducted by Dr.Charan Kamal, PMC No. 38609, through Police [illegible]onstableDeepak 3879/LDH, PS Sahnewal, district Ludhiana, received on 5/5/23.

Received

1. One sealed jar with one seal containing
   a. Whole heart
   b. Part of both lungs
   c. Part of both kidneys
   d. Part of liver
   e. Part of spleen
2. One sealed envelope with sixseals containing
   a. Photostat police papers
   b. One Sample seal
   c. Request form HPE
   d. Post-mortem report

Observations

Heart: Received specimen of heart weighing 250 gm and measuring 11x8x4cm.
Thickness: Left Ventricle 1cm
Right Ventricle 0.3cm
M/E: Representative sections from the heart received showed mild myocyte hypertrophy along with mild interstitial fibrosis.All coronaries are unremarkable.

Part ofLungs: Received part of first Lung measuring 13x11x2cm.Weighs75gm. External and cut surface showed congestion. Received part of second Lung measuring 12x11x2cm. Weighs 50gm. External and cut surface showed congestion
M/E: revealed dilated and congested alveolar septa. Alveolar spaces as well as interstitium contain edematous fluid and fewinflammatory cells.

Part of both kidney: Received first and second part of kidney measuring 6x5x4cm and weighing25gm, 6.5x4x2 cm and weighing 25gms. External and cut surface unremarkable. Cortex and medulla appreciated.
M/S- showed congestion and featuresof focal acute tubular necrosis.

Part of Liver: Received part of Liver measuring 11x8x5cm.Weighs 125gm. External and cut surface unremarkable.
M/E: Showed mild congestion of portal tract and lymphocytic infiltration.
Features suggestive of changes of hepatitis.

art of spleen: Received part of spleen measuring9x6x3cm and weighing 75 gm. C/S: congested
M/S: showed expanded red pulp with congestion.

Dr.MonikaGarg
Associate Professor
Dept of Pathology
GMC Patiala

Dr. Monika Garg
MD
Associate Professor (Pathology)
Govt. Medical College &
Rajindra Hospital

Emergency response team performance, department of health, Ludhiana

On receiving the information about the disaster at Giaspura with the incidence of alleged toxic gas leakage at 8:00 AM. Emergency disaster teams were activated immediately. Civil surgeon Ludhiana personally monitored the teams and led the way by ordering the Senior Medical Officer of the Civil Hospital, Ludhiana, to be equipped to handle the emergency.

Emergency disaster response is divided into four zones.

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3. Dr. Manju, Medical officer, Civil Surgeon, office, Ludhiana.

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All three teams consisted of one doctor, one class four, and one pilot.

108 Ambulances/ NGO/ private ambulances and even private vehicles transferred the patients to the Civil/ District Hospital Ludhiana and nearby hospitals like SPS Apollo/ Oswal Hospital. There was no hassle reported in transferring the victims to healthcare facilities.

Dr. Charan Kamal and his team stayed there till 12.30 PM to analyze the situation, being a toxicology expert gave his input to evacuate the area, and assisted the administration to take steps to limit further damage by advising the practical inputs such as using the masks, a practical tour of the affected area helped to analyze the site of leakage, a probable diagnosis of the type of the gas and it's toxic nature. Kept a constant touch with the team no 2, the team of multi-specialist doctors for the treatment of the victims established back at the base that is District/Civil Hospital Ludhiana and gave valuable inputs to analyze the signs and symptoms of the victims and findings of

the dead bodies. Our team drew a hypothesis of Hydrogen sulfate poisoning and toxicity of methane, etc., by 9.30 AM only.

Dr. Vishal stayed along with the team up to 2.00 PM,

Dr. Manju along with her team stayed up tuntil4 PM.

Treatment for the Minor toxicity effects in the form of headache and confusion were seen in the local population. Medicines and consultations were provided by the teams.

Team No. 02. Emergency treatment team.

Officers deputed were

Dr. Harinder Singh Sood, MD, Medicine, Senior Medical Officer, ART, Civil Hospital Ludhiana,

Dr. Sukhdeep Kaur, MD, Medicine, medical officer, Civil Hospital Ludhiana,

Dr. Amandeep Kaur, MD, Medicine, medical officer, CHC Dehlon and

Dr. Harleen Kaur, MD Ophthalmology,

Dr. Harpreet Singh, Medical Officer, emergency, Civil Hospital Ludhiana.

They were present at the district hospital in Ludhiana.

They received two victims and nine dead bodies during the emergency.

This team along with consultation with Dr. Charan Kamal is present at the site and keeping in view the signs/ Symptoms of the victims decoded the probable cause very quickly. The vast experience of our medical specialists and other paramedical staff helped these patients/victims to come out of the toxic effects of toxicity of gases.

Team no. 3. The Medicolegal team:

Under the direct supervision of:

Dr. Vivek Kataria, MS General Surgery, Assistant Civil Surgeon, Ludhiana. Our Medicolegal team was constituted and put into action for the necessary examination. As soon as police officials produced Inquest papers regarding the deaths of the ten people for the postmortem examination. A board of doctors consisting of Dr. Charan Kamal, MD Forensic Medicine, and Toxicology, Medical Officer, civil hospital Ludhiana, Dr. Saurav Singla, MS. Orthopedics, medical officer Civil Hospital Ludhiana, Dr Geetanjali Kalyan, an Emergency medical officer was framed.This team observed that all the

deceased have almost similar findings of asphyxia due to inhalation poisoning. As they were having pale faces, congested conjunctivae of the eyes, hemorrhagic mucosal membranes, discolored brains, discolored lungs of greenish purple color, and generalized cyanosis on the dead bodies. They also kept the Organs (viscera) preserved appropriately for the chemical analysis at State Chemical Laboratory Kharar for the type of gas/ poison for the Histopathology examination from the Government Medical College Rajindra Hospital Patiala.

The rotten eggs smell at the locality, the constant irritation to the eyes, mild headache, and mind confusion in the people, who were present at the scene were suggestive of hydrogen sulfide and the symptoms described by the patients/ victims at the hospital in the form of headache, irritation in eyes, confusion, irritation in the oral mucosa, falling saturation, breathlessness (and even unconsciousness in one patient were also suggestive of hydrogen sulfide and methane toxicity.

The performance of all team was beyond words. These teams were in constant discussion with higher officials of the health department, the department of medical education and research, the head of the departments of various specialist departments of Government Medical colleges of Patiala/ Amritsar, etc.

The collective efforts of these three emergency teams of the health department led to the saving of two precious lives and the completion of the emergency disaster response. The response from the General administration, higher officials of the health department, the Department of Police, and other paramedical staff was helpful . This board did a detailed postmortem examination of the dead bodies of ten bodies from 04.00 PM to 10.00 PM.

Team No. 4

Other treating physicians and other paramedic staff of Civil Hospital, Ludhiana did a commendable job by taking care of patients for 24 hours.

In total 9 dead bodies were received at the civil hospital Ludhiana and 2 dead bodies were brought by police from SPS apollo hospital. A postmortem examination on all 11 bodies was done at civil hospital Ludhiana and dead bodies were handed over to the police with due respect.

And made reversion of toxicity of two victims successfully.

ANNEXURE 'A' (one)

Department of Pathology

Government Medical College, Patiala

MLC 144/23

Dispatch No. - 616 /23

Dated- 31 /05 /23

To, Dr.Saurav Singla/ Dr Geetanjali/ Dr Charan Kamal

MO, LMCH , Ludhiana

Subject: Histopathological Report of viscera (whole heart, part of both lungs, part of liver, part of spleen and part of each kidney)of deceased Aryan s/o Kavilash Kumar, vide PMR No. PMR/CKL/197/23 Dated 30/4/23 and brought in a sealed jar with 1 seal along with sealed envelope with 6 seals by SC Deepak/3879 and received by Dr Arpita JR Pathology in the department on 5/5/23.

GROSS EXAMINATION

Heart:- Weight -200 grams, Thickness of Left Ventricular Wall – 0.7 cm, Thickness of Right Ventricular Wall - 0.3 cm**Lung** :Received part of both lungs.1st part of lung - measuring 10 x 6 x 5 cm, weighing 50 gm.2nd part of lung -measuring 10 x 7 x 5 cm, weighing 50 gm.**Liver:** Part of liver measuring 9x 8x 5 cm, weighing 190 g. **Kidney** Received part of both kidneys.1st part of kidney measuring 4 x 3 x 2 cm, weighing 50 gm. 2nd part of kidney measuring 3.5 x 3x 1.5cm, weighing 20 gm. **Spleen:** Received part of spleen measuring 7 x 2 x 2cm , weighing 50 gm.

MICROSCOPIC EXAMINATION

Heart, Coronaries and Aorta: Representative sections are unremarkable. **Part of Lungs:** Representative sections from both parts show intense congestion of blood vessels and interstitial edema. **Part of Kidneys**: Representative sections from both parts of kidneys show focal acute tubular necrosis with congestion of blood vessels. **Part of Liver**: Unremakable. **Part of Spleen**: Unremarkable

Dr Aradhana

Assistant Professor

Deptt of Pathology

GMC Patiala

5:26 PM

Gmail - Re: regarding Giaspura incident

Annexure - 1 (2 pages) Received on 29/6/23 3:57 PM

Gmail

SDM LDH <sdmldhwest@gmail.com>

Re: regarding Giaspura incident

1 message

Dr Charan Kamal Ladhar <charankamalck@gmail.com>
To: sdmldhwest@gmail.com

Thu, Jun 29, 2023 at 3:57 PM

it is humbly submitted that in the continuation to my previous report, the details of one case, that is Mr Amit, was missed inadvertently. please consider this.

Victim_Name	Age	Address	State	cdTransactionID	cdManualTransaction	CreateDate	Userid	Status
11	Mr. AMIT GUPTA	Year(s)=33 Month(s)=— Days(s)=—	NARULA SURGICAL COMPANY GAISPURA	Punjab	M403000212300492	PMRAPK/06/23	01 May 2023	drarshpret44081	Not-Freeze

On Thu, Jun 22, 2023 at 5:10 PM Dr Charan Kamal Ladhar <charankamalck@gmail.com> wrote:

Good evening, sir, this is Dr. Charan Kamal, district forensic medicine expert Ludhiana.
It is humbly submitted that only two reports amongst eleven have been received till date from GMC, Patiala. (reports attached).
All eleven chemical analysis reports are pending from Chemical Laboratory Kharar.
It is further submitted that the cause of death was already given and viscera was kept for ascertaining the type of intoxicant only.
Regards.

ਨੰ:

ਮਿਤੀ

ਵੱਲੋਂ

ਸਿਵਲ ਸਰਜਨ,
ਲੁਧਿਆਣਾ।

ਸੇਵਾ ਵਿਖੇ,

ਉਪ ਮੰਡਲ ਮੈਜਿਸਟ੍ਰੇਟ (ਪੱਛਮੀ)
ਲੁਧਿਆਣਾ।

ਵਿਸ਼ਾ:- **Case report of Gas Leak Victims on DATED 30/04/2023**

ਹਵਾਲਾ:- ਆਪ ਜੀ ਦੇ ਟੈਲੀਫੋਨਿਕ ਸੰਦੇਸ਼ ਦੇ ਸਬੰਧ ਵਿੱਚ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਤੇ ਹਵਾਲੇ ਅਧੀਨ ਪੱਤਰ ਆਪ ਜੀ ਨੂੰ ਮਿਤੀ 30.04.2023 ਨੂੰ ਲੁਧਿਆਣਾ ਵਿਖੇ ਗੈਸ ਲੀਕ ਦੁਖਾਂਤ / ਦਰਘਟਨਾ ਸਬੰਧੀ ਜਿਹੜੀ ਰਿਪੋਰਟ ਸੀਨੀਅਰ ਮੈਡੀਕਲ ਅਫਸਰ, ਇੰ: ਸਿਵਲ ਹਸਪਤਾਲ, ਲੁਧਿਆਣਾ ਅਤੇ ਡਾਇਰੈਕਟਰ, ਮੈਡੀਕਲ ਸਰਵਿਸਜ਼ ਮੋਹਨਦਾਈ ਓਸਵਾਲ ਹਸਪਤਾਲ, ਲੁਧਿਆਣਾ ਵੱਲੋਂ ਪ੍ਰਾਪਤ ਹੋਈ ਹੈ, ਆਪ ਜੀ ਨੂੰ ਇਸ ਪੱਤਰ ਨਾਲ ਨੱਥੀ ਕਰਕੇ ਬਣਦੀ ਅਗੇਤਰੀ ਕਾਰਵਾਈ ਹਿੱਤ ਭੇਜੀ ਜਾਂਦੀ ਹੈ, ਜੀ।

ਸਹੀ/-

ਸਿਵਲ ਸਰਜਨ,
ਲੁਧਿਆਣਾ।

to be placed on file

ਲਾਰਡ ਮਹਾਵੀਰ, ਸਿਵਲ ਹਸਪਤਾਲ, ਲੁਧਿਆਣਾ

ਨੰ:ਸੀ.ਐਚ.ਲੁਧਿ:/23/..3279

ਮਿਤੀ: 26-06-2023

ਸੇਵਾ ਵਿਖੇ,

ਸਿਵਲ ਸਰਜਨ,

ਲੁਧਿਆਣਾ।

ਵਿਸ਼ਾ: **Case Report of Gas Leak Victims admitted at CH, Ludhiana on 30-04-2023**

ਹਵਾਲਾ: ਸਿਵਲ ਸਰਜਨ, ਲੁਧਿਆਣਾ ਜੀ ਦੇ ਜ਼ੁਬਾਨੀ ਆਦੇਸ਼ਾਂ ਸੰਬੰਧੀ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਤੇ ਹਵਾਲੇ ਅਧੀਨ ਆਪ ਜੀ ਦੇ ਵੱਲੋ ਉਕਤ ਮਰੀਜਾਂ ਦੀ ਕੇਸ ਰਿਪੋਰਟ ਤਿਆਰ ਕਰਨ ਲਈ ਕਿਹਾ ਗਿਆ ਸੀ। ਜਿਸ ਸਬੰਧੀ ਨਿਮਨਹਸਤਾਖਰ ਵੱਲੋ ਡਾ. ਅਮਨਪ੍ਰੀਤ ਕੋਰ (ਮੈਡੀਸਨ) ਦੀ ਡਿਊਟੀ ਲਗਾਈ ਗਈ ਸੀ। ਉਹਨਾਂ ਵੱਲੋ ਜੋ ਰਿਪੋਰਟ ਦਿੱਤੀ ਗਈ ਹੈ ਉਹ ਆਪ ਜੀ ਨੂੰ ਮੂਲ ਰੂਪ ਵਿੱਚ ਇਸ ਪੱਤਰ ਨਾਲ ਨੱਥੀ ਕਰਕੇ ਸੂਚਨਾ ਅਤੇ ਅਗੇਤਰੀ ਕਾਰਵਾਈ ਲਈ ਭੇਜੀ ਜਾਂਦੀ ਹੈ ਜੀ।

ਸੀਨੀਅਰ ਮੈਡੀਕਲ ਅਫਸਰ
ਇੰਚ, ਸਿਵਲ ਹਸਪਤਾਲ ਲੁਧਿਆਣਾ।

Case Report of Gas Leak Victims admitted at CH, Ludhiana on 30-04-2023

1. Gaurav, 45/ Male was admitted at CH Ludhiana vide Cr. No. 9880/23 on dated: 30-04-2023 with alleged H/o Toxic Gas Inhalation (Nature of gas not known). At the time of presentation he was in altered sensorium, irritable, non cooperative and was not oriented to time, place and person with no injury mark over his whole body. Treatment was given according to protocol after 3 hrs of treatment he was fully conscious and start taking orally, walking and talking. He has given the H/o inhalation of some pungent smell followed by dizziness. His all blood investigations X-Rays, ECGs all were normal and was discharged in stable condition with no residual disease or any permanent deformity on 01-05-2023 and called for follow up after 3 days. But patient did not came for follow up.
2. Nitin S/o Parmod Singh, R/o Sua Road, Giaspura, Ludhiana, 40/ Male was admitted at CH Ludhiana vide Cr. No. 9881/23 on dated: 30-04-2023 with alleged H/o Toxic Gas Inhalation (Nature of gas not known). At the time of presentation he was in altered sensorium, irritable, his Spo2 was 80% on room air, non cooperative and was not oriented to time, place and person with no injury mark over his whole body. Treatment was given according to protocol with 100% oxygen I.V fluids and after 4 hrs of treatment he was fully conscious and start taking orally, walking and talking but he felt a little weakness in his legs and arms during stay at hospital. He has given the H/o inhalation of some pungent smell followed by dizziness. His all blood investigations X-Rays, ECGs all were normal and was discharged in stable condition with no residual disease or any permanent deformity on 01-05-2023 and called for follow up after 3 days. But patient did not came for follow up.

Dr. AMANPREET KAUR
MD (Medicine)
MEDICAL OFFICER
Civil Hospital, Ludhiana (Pb.)
Reg. No.: 36529

MOH **MOHANDAI OSWAL HOSPITAL**

(Unit of Mohan Dai Oswal Cancer Treatment & Research Foundation)

(A CHARITABLE INSTITUTION)

G. T. ROAD, SHERPUR BYE PASS, LUDHIANA-141 009. PH. : 0161-2676100, 5224444, 5094538, 39, 40.

E-mail :- contact@moh.org.in • Website :- www.moh.org.in

To
Civil Surgeon Office
Ludhiana

Subject:-Medical Fitness of patients admitted with Gas inhalation at Mohandai Oswal Hospital, Ludhiana, who were discharged at stable condition with **NO PHYSICAL INJURY.**

This is to state that Patient-Ruby Devi, CR No-761475, Age-29/F, came to Mohandai Oswal Hospital emergency on 30/04/2023 at around 8:30 am with history of inhalation of unknown gaseous substance after gas leakage near Goyal Kiryana store. **At the time of admission, patient was not evidenced with any physical injury.** Patient came in MOH in drowsy state, on arrival patient GCS was E2V2M5, vitals were BP-110/70, PR-90/min, Temp-97.8, RR-14/min, SPO2- 96%. Patient conservatively managed and treatment incorporated accordingly. After 30 minutes patient GCS improved to E4V5M6. Patient UPT came out to be positive in view of that Gynae consult was taken and no active intervention was advised. Patient was managed with IV fluids, antibiotics, high flow o2 support, and other supportive measures. On 1/05/2023 patients vitals were stable , was conscious , oriented and being discharged in hemodynamically stable condition.

This is to state that Patient-Rajesh Kumar, CR No-761474, Age-28/M, came to Mohandai Oswal Hospital emergency on 30/04/2023 at around 7:20 am with history of inhalation of unknown gaseous substance after gas leakage at Goyal Kiryana store. **At the time of admission, patient was not evidenced with any physical injury.** Patient became unconscious, post inhalation, was agitated. On admission patient vitals were, BP-140/92 , PR-72/min , RR-20/min, SPO2-96%, Temp-97.2. Patient conservatively managed and treatment incorporated accordingly. Patient shifted to MICU at around 2:30pm on 30/04/2023, patient was managed with appropriate antibiotics and treatment. Patient gradually improved, conscious, oriented hemodynamically stable and was discharged on 01/05/2023.

At the time of Discharge there was no evidence of any physical injury or any impairment or disability, so both the patients were discharged at physically fit condition.

Regards
Dr Shally
Director- Medical Services
Mohandai Oswal Hospital
GT Road, Sherpur Bye Pass, Ludhiana - 141 009.
Mobile No – 9876234631
drshally@moh.org.in

Dr. Shally
Director-Medical Services
Mohandai Oswal Hospital
(Unit of Mohan Dai Oswal Cancer Treatment & Research Foundation)
G.T. Road Sherpur Bye Pass, Ludhiana

ANNEXURE – 'C'

From

Assistant Commissioner of Police
South, Ludhiana

To

Sub Divisional Magistrate (West),
Ludhiana

Subject: Status Report pertaining to the progress of investigation of case FIR no. 112 dated 30.04.2023 u/s 304 IPC was registered at PS Sahnewal, District Ludhiana related to the leakage of poisonous gas tragedy.

Memo no. 435/SA/Acp South dated 22-6-23

Sir,

It is respectfully submitted that in this connection a criminal case bearing FIR no. 112 dated 30.04.2023 u/s 304 IPC was registered at PS Sahnewal, District Ludhiana which is still under investigation. Unfortunately, due to this poisonous gas tragedy, 11 persons lost their lives. The details of those persons are as follows:

1) Navneet Kumar son of Kamodh Kumar resident of Mohalla Samrat Colony, Street No. 7, Sua Road, Giaspura, Ludhiana.
2) Neetu Devi wife of Navneet Kumar resident of Mohalla Samrat Colony, Street No. 7, Sua Road, Giaspura, Ludhiana.
3) Saurav Goyal son of Ashok Goyal resident of Sua Road, Giaspura, Ludhiana.
4) Preeti wife of Saurav Goyal resident of Sua Road, Giaspura, Ludhiana.

5) Kamlesh Goyal daughter of Ashok Goyal resident of Sua Road, Giaspura, Ludhiana.

6) Kavilash Kumar son of Janak Dev Yadav resident of Majiama, District Gaya,Bihar presently residing at Sua Road, Giaspura, Ludhiana.

7) Verma Devi wife of Kavilash Kumar son of Janak Dev Yadav resident of Majiama, District Gaya,Bihar presently residing at Sua Road, Giaspura, Ludhiana.

8) Abhay Narayan son of Kavilash Kumar son of Janak Dev Yadav resident of Majiama, District Gaya,Bihar presently residing at Sua Road, Giaspura, Ludhiana.

9) Kalpana Yadav daughter of Kavilash Kumar son of Janak Dev Yadav resident of Majiama, District Gaya,Bihar presently residing at Sua Road, Giaspura, Ludhiana.

10) Aryan son of Kavilash Kumar son of Janak Dev Yadav resident of Majiama, District Gaya,Bihar presently residing at Sua Road, Giaspura, Ludhiana.

11) Amit Gupta son of Hari Om Gupta resident of Sua Road, Giaspura, Ludhiana.

Apart from the aforementioned deceased persons, 4 persons were also injured after inhaling the poisonous gas, the details of those persons are as follows:

1) Nitin Kumar son of Kishori Kumar resident of House no. B-29/458/4/247 street no. 7, Samrat Colony, Guru TeghBahadar Nagar, Sua Road, Giaspura, Ludhiana

2) Gourav Goyal son of Ashok Goyal resident of 458/8B, Sua Road, Giaspura, Ludhiana

3) Ruby Devi wife of Chander Shah resident of Sua Road, Giaspura, Ludhiana

4) Rajesh Kumar son of Sagar Prasad resident of Street no. 1 Sua Road, Giaspura Ludhiana.

It is further submitted that in order to bring the true facts on record and to find out the truth, a judicial inquiry was ordered by the Deputy Commissioner Ludhiana which was earlier being conducted by Smt. ShivatiTiwana, PCS who has now been transferred and now this inquiry is being conducted by your goodself. It is further submitted that in order to conduct the investigation of the aforementioned criminal case in a fair, impartial and transparent manner and to dig out the truth behind the tragedy, a special investigation team under the supervision of Deputy Commissioner of Police (Investigation), Ludhiana was constituted by the the Commissioner of Police Ludhiana vide order bearing memo no. 1791-95/Reader dated 01.05.2023 and this team has been specifically directed to conduct the investigation after examining all the aspects, circumstances and the actual cause of this tragedy by minutely examining all the facts and the evidence produced by the witnesses and the scientific experts. It is further submitted that the post mortem examinations of the all the aforementioned deceased persons were conducted by the Board of Doctors and the videography of these post mortem examinations was also conducted and the various visceras taken out from the dead bodies were sent to the chemical examiner Kharar. The reports of which are still awaited. Best medical aid and treatment was also provided to the injured persons. The Special Investigation Team inspected the place of occurrence and the residential houses of the deceased as well as the injured. The main holes of the sewerage system of the locality were also examined and the

electroplating and other industries near the place of occurrence which used to consume/utilize various types of chemicals were also inspected and with the assistance of the technical teams, SHOs of various police stations and incharge CIA Staff, the footage of the CCTV cameras installed within the radius of 1 kilometer of the place of occurrence were also minutely examined and certain inquiries were conducted from the persons residing in the locality. The NDRF, PPCB and the FSL teams were also summoned at the spot and one Canny Plastic containing some chemical like liquid was taken into possession by the NDRF and Punjab Pollution Control Board Team from the house i.e. Aarti Clinic where 5 persons died due to this tragedy. The samples of the sewerage system were also taken by the officials of Punjab Pollution Control Board and the samples of the sewerage water were also collected by the Forensic teams which were separately taken into possession at the spot. Apart from this, 3 Cannies lying in a vacant plot containing some chemical like liquid were also taken into possession and the samples from these cannies were also collected by the officials of Punjab Pollution Control Board which have been sent to Chief Executive Officer, Punjab Biotechnology Incubator. Member Secretary of the Society for PBTI, C-134, Industrial Area, Phase-8, SAS Nagar, Mohali for testing, now the report of Punjab Biotechnology Incubator has been received which has been placed on the record and which is being examined by the Special Investigation Team from all the angles. The photocopy of this report is hereby annexed as Annexure R-1 for your kind perusal. Various persons namely Gaurav Goyal son of Ashok Goyal, Nand Kishore Shah son of Bhajana Shah, Phool Chand son of Chotte Lal, Raj Pat son of Bans Raj, Hari Ram son of Ram Sanehi, Urmila Devi wife of Raj Kumar, Guddu Kumar @ Guddu son of Davinder Prasad and Nitin Kumar

son of Santosh Kumar were joined in the investigation by the Special Investigation Team and certain inquiries regarding the real cause of the tragedy were conducted from them. Certain inquiries were also conducted from the officials of Punjab Pollution Control Board, JBR Company which used to lift the garbage, Department of Factories and Municipal Corporation Ludhiana. Various technical and scientific issues were also discussed with the aforementioned officials in order to detect the real cause of this tragedy by the members of the Special Investigation Team. It is further submitted that a team of the experts was also called from IIT Ropar at the spot by the Special Investigation Team and certain facts of the investigation pertaining to this tragedy were discussed with them and this team was also apprised regarding the various issues of this tragedy. Certain data based reports have now been submitted by the officials of Punjab Pollution Control Board, Municipal Corporation Ludhiana and the JBR Company which used to lift the garbage/waste which are being discussed and examined by the Special Investigation Team from all the angles.

The Special Investigation Team is conducting the investigation of the aforementioned criminal case in a fair, impartial and transparent manner and every dedicated and sincere effort is being made by this team within the ambit of law to find out the truth and to bring the real culprits to the book if any is there and to impart justice to the victims, as and when the investigation of the aforementioned criminal case pertaining to this poisonous gas tragedy is completed from all the angles, the final report under section 173 Cr.P.C. will be submitted in the Court of Learned Illaqa Magistrate Ludhiana.

Assistant Commissioner of Police,
South, Ludhiana.
22/6/23

ANNEXURE-H

ANNEXURE Q

ਦਫਤਰ ਜੁਆਇੰਟ ਕਮਿਸ਼ਨਰ, ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ, ਲੁਧਿਆਣਾ।

SDM-3/Guardian Investigation

Sub Divisional Magistrate
Ludhiana (West)

ਵੱਲ

ਦਫਤਰ ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ,
ਲੁਧਿਆਣਾ (ਪੱਛਮੀ)।

ਨੰ: 35/ਮ.ਮੀ.ਟ/ਨ੍ਹੀ ਮਿਤੀ: 22/5/2023

ਵਿਸ਼ਾ:- **ਮਿਤੀ 30-04-2023 ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੂਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ, ਗਿਆਸਪੁਰਾ ਵਿਖੇ ਹੋਈ ਗੈਸ ਲੀਕ ਦੇ ਹਾਦਸੇ ਸਬੰਧੀ।**

ਹਵਾਲਾ:- **ਪੱਤਰ ਨੰ: 1576 ਮਿਤੀ 17-05-2022 ਦੇ ਸਬੰਧ ਵਿੱਚ।**

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਅਤੇ ਹਵਾਲੇ ਅਧੀਨ ਆਪ ਵੱਲੋਂ ਮੰਗੀ ਗਈ ਸੂਚਨਾ ਇਸ ਪੱਤਰ ਨਾਲ ਨੱਥੀ ਕਰਕੇ ਭੇਜੀ ਜਾਂਦੀ ਹੈ।

22/05/23

ਜੁਆਇੰਟ ਕਮਿਸ਼ਨਰ, ਜੋਨ-ਸੀ,
ਨਗਰ ਨਿਗਮ, ਲੁਧਿਆਣਾ।

8337
26/5/23

124/ਪੱਤ-ਸੀ/ਮਾਰ
22/5/23

ਨੰ..106/XEN...G.ਕਸ਼ਾ ਮਿਤੀ ...19..5..23

ਵਿਸ਼ਾ:- **ਮਿਤੀ 30.04.2023 ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੁਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ , ਗਿਆਸਪੁਰਾ ਵਿਖੇ ਹੋਈ ਗੈਸ ਲੀਕ ਦੇ ਹਾਦਸੇ ਸਬੰਧੀ।**

ਹਵਾਲਾ:- ਪੱਤਰ ਨੰ. 1576 ਮਿਤੀ 17.05.2022 ਦੇ ਸਬੰਧ ਵਿੱਚ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਅਤੇ ਹਵਾਲੇ ਅਧੀਨ ਪ੍ਰਾਪਤ ਹੋਏ ਪੱਤਰ ਦੇ ਸਬੰਧ ਵਿੱਚ ਦੱਸਿਆ ਜਾਂਦਾ ਹੈ ਕਿ ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੁਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ, ਗਿਆਸਪੁਰਾ ਦੇ ਅਦਾਰਿਆਂ (ਆਰਤੀ ਕਲੀਨਿਕ, ਗੋਇਲ ਕਨਫੈਕਸ਼ਨਰੀ/ ਗੋਇਲ ਕੋਲਡ ਡਰਿੰਕਸ) ਦੇ ਨਗਰ ਨਿਗਮ ਲੁਧਿਆਣਾ ਦੇ ਰਿਕਾਰਡ ਅਨੁਸਾਰ ਪਾਣੀ/ਸੀਵਰੇਜ਼ ਦੇ ਕੁਨੈਕਸ਼ਨਾਂ ਦਾ ਵੇਰਵਾ ਹੇਠ ਲਿਖੇ ਅਨੁਸਾਰ ਹੈ:-

ਲੜੀ ਨੰ.	ਨਾਮ	ਪ੍ਰਾਪਰਟੀ ਨੰ.	ਆਈ.ਡੀ.ਨੰ.
1	ਕਵਿਲੇਸ਼ ਕੁਮਾਰ	ਨੇੜੇ 458/2-ਐਲ/8ਬੀ	185194
2	ਅਸ਼ੋਕ ਗੋਇਲ	458/2-ਐਲ/8ਬੀ	223094
3	ਨਵਨੀਤ ਕੁਮਾਰ	ਰਿਕਾਰਡ ਉਪਲੱਬਧ ਨਹੀ ਹੈ।	

ਰਿਪੋਰਟ ਆਪ ਜੀ ਦੀ ਜਾਣਕਾਰੀ ਹਿੱਤ ਪੇਸ਼ ਹੈ ਜੀ।

ਕਾਰਜਕਾਰੀ ਇੰਜੀਨੀਅਰ
ਜ਼ੋਨ-ਸੀ ਓਐਂਡਐਮ ਸੈੱਲ
ਨਗਰ ਨਿਗਮ ਲੁਧਿਆਣਾ।

Zonal Comm.(24) Pb.

SDM (West)

22/05/23.

ANNEXURE-F

119/ਮੁ.ਮੀ/ਅਮਰ
18/5/2023

ਵਿਸ਼ਾ:- ਮਿਤੀ 30/04/2023 ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੂਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ, ਗਿਆਸਪੁਰਾ ਵਿਖੇ ਹੋਈ ਗੈਸ ਲੀਕ ਦੇ ਹਾਦਸੇ ਸਬੰਧੀ।

ਹਵਾਲਾ:- ਪੱਤਰ ਨੰ: 1576 ਮਿਤੀ 17/05/2022 ਦੇ ਸਬੰਧ ਵਿੱਚ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਸਬੰਧੀ ਹਵਾਲੇ ਅਧੀਨ ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ ਲੁਧਿਆਣਾ (ਪੱਛਮੀ) ਵੱਲੋਂ ਆਏ ਪੱਤਰ ਦੇ ਸਬੰਧ ਵਿੱਚ ਦੱਸਿਆ ਜਾਂਦਾ ਹੈ ਕਿ (ਆਰਤੀ ਕਲੀਨਿਕ, ਗੋਇਲ ਕਨਫੈਕਸ਼ਨਰੀ / ਗੋਇਲ ਕੋਲਡ ਡਰਿੰਕਸ) ਬਿਲਡਿੰਗ ਦਾ ਨਕਸ਼ਾ ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ, ਲੁਧਿਆਣਾ ਦੀ ਬਿਲਡਿੰਗ / ਡਰਾਇੰਗ ਬ੍ਰਾਂਚ ਵੱਲੋਂ ਪ੍ਰਵਾਨ ਨਹੀ ਕੀਤਾ ਗਿਆ। ਇਹ ਰਿਪੋਰਟ ਮਾਨਯੋਗ ਜੁਆਇੰਟ ਕਮਿਸ਼ਨਰ(ਕੇ), ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ, ਲੁਧਿਆਣਾ ਜੀ ਨੂੰ ਭੇਜੀ ਜਾਵੇ ਤਾਂ ਜੋ ਓ.ਐਂਡ.ਐਮ ਸੈੱਲ ਬ੍ਰਾਂਚ ਦੀ ਰਿਪੋਰਟ ਨੂੰ ਇੱਕਠੀ ਕਰਕੇ ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ ਲੁਧਿਆਣਾ (ਪੱਛਮੀ) ਨੂੰ ਭੇਜੀ ਜਾਵੇ।

ZC (E) Smt.

19/5/23

18/5/23
18/5/2023

SDM
(West)

19/05/23

50/ATP-C/R
18-05-2023

ਦਫਤਰ ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ, ਲੁਧਿਆਣਾ (ਪੱਛਮੀ)।

ਸੇਵਾ ਵਿਖੇ

ਚੁਆਇੰਟ ਕਮਿਸ਼ਨਰ,
ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ, ਲੁਧਿਆਣਾ।
ਫੈਕਸ: 1576

ਵਿਸ਼ਾ:- ਮਿਤੀ 30/04/2023 ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸ਼ੁਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ ਗਿਆਸਪੁਰਾ ਵਿਖੇ ਹੋਈ ਗੈਸ ਲੀਕ ਦੇ ਹਾਦਸੇ ਸਬੰਧੀ।

ਵਿਸ਼ੇ ਸਬੰਧੀ ਆਪ ਨੂੰ ਬੇਨਤੀ ਕੀਤੀ ਜਾਂਦੀ ਹੈ ਕਿ ਹੇਠ ਲਿਖੇ ਤੱਥਾਂ ਬਾਰੇ ਆਪਣੀ ਰਿਪੋਰਟ ਭੇਜੀ ਜਾਵੇ।

1. ਮੌਕੇ ਤੇ ਘਰਾਂ ਦੇ (ਆਰਤੀ ਕਲੀਨਿਕ, ਗੋਇਲ ਕਨਫੈਕਸ਼ਨਰੀ/ਗੋਇਲ ਕੋਲਡ ਡਰਿੰਕਸ) ਬਿਲਡਿੰਗਾਂ ਦਾ ਨਕਸ਼ਾ ਨਗਰ ਨਿਗਮ ਵੱਲੋਂ ਪ੍ਰਵਾਨ ਕੀਤਾ ਗਿਆ ਹੈ ਜਾਂ ਨਹੀਂ ?
2. ਕੀ ਉਕਤ ਅਦਾਰਿਆਂ ਵੱਲੋਂ ਨਗਰ ਨਿਗਮ ਪਾਸੋਂ ਪਾਣੀ ਅਤੇ ਸੀਵਰੇਜ ਕੁਨੈਕਸ਼ਨ ਪਾਸ ਕਰਵਾਏ ਸੀ ਜਾਂ ਨਹੀਂ?

ਰਿਪੋਰਟ ਸਮੇਤ ਦਸਤਾਵੇਜ 3 ਦਿਨਾਂ ਦੇ ਅੰਦਰ-ਅੰਦਰ ਇਸ ਦਫਤਰ ਵਿੱਚ ਭੇਜੀ ਜਾਵੇ।

ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ,
ਲੁਧਿਆਣਾ (ਪੱਛਮੀ)।

1. ATP, Zone-C
2. XEN, (O&M) to report immediately so that it can be sent to SDM Office.

18/5/23

1. ATP-C
2. XEN (O&M).

ANNEXURE-F

119/ਐਸ.ਮੀ/ਅਮਰ
18/5/2023

ਵਿਸ਼ਾ:- ਮਿਤੀ 30/04/2023 ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੂਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ, ਗਿਆਸਪੁਰਾ ਵਿਖੇ ਹੋਈ ਗੈਸ ਲੀਕ ਦੇ ਹਾਦਸੇ ਸਬੰਧੀ।

ਹਵਾਲਾ:- ਪੱਤਰ ਨੰ: 1576 ਮਿਤੀ 17/05/2022 ਦੇ ਸਬੰਧ ਵਿੱਚ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਸਬੰਧੀ ਹਵਾਲੇ ਅਧੀਨ ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ ਲੁਧਿਆਣਾ (ਪੱਛਮੀ) ਵੱਲੋਂ ਆਏ ਪੱਤਰ ਦੇ ਸਬੰਧ ਵਿੱਚ ਦੱਸਿਆ ਜਾਂਦਾ ਹੈ ਕਿ (ਆਰਤੀ ਕਲੀਨਿਕ, ਗੋਇਲ ਕਨਫੈਕਸ਼ਨਰੀ / ਗੋਇਲ ਕੋਲਡ ਡਰਿੰਕਸ) ਬਿਲਡਿੰਗ ਦਾ ਨਕਸ਼ਾ ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ, ਲੁਧਿਆਣਾ ਦੀ ਬਿਲਡਿੰਗ / ਡਰਾਇੰਗ ਬ੍ਰਾਂਚ ਵੱਲੋਂ ਪ੍ਰਵਾਨ ਨਹੀ ਕੀਤਾ ਗਿਆ। ਇਹ ਰਿਪੋਰਟ ਮਾਨਯੋਗ ਜੁਆਇੰਟ ਕਮਿਸ਼ਨਰ(ਕੇ), ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ, ਲੁਧਿਆਣਾ ਜੀ ਨੂੰ ਭੇਜੀ ਜਾਵੇ ਤਾਂ ਜੋ ਓ.ਐਂਡ.ਐਮ ਸੈੱਲ ਬ੍ਰਾਂਚ ਦੀ ਰਿਪੋਰਟ ਨੂੰ ਇੱਕਠੀ ਕਰਕੇ ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ ਲੁਧਿਆਣਾ (ਪੱਛਮੀ) ਨੂੰ ਭੇਜੀ ਜਾਵੇ।

Zc'k Sinjh.

18/5/23

18/5/23
fyn 18/5/2023

SDM
(West)

Ksijl
19/05/23

ANNEXURE

SO/ATP-C/R
18-05-2023

ਦਫਤਰ ਉਪ ਮੰਡਲ ਮੈਜਿਸਟੇਰਟ, ਲੁਧਿਆਣਾ (ਪੱਛਮੀ)।

ਸੇਵਾ ਵਿਖੇ

91/ਸਮੀ:ਮ/ਸਮਾ
18/5/2023

ਚੁਆਇੰਟ ਕਮਿਸ਼ਨਰ,
ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ, ਲੁਧਿਆਣਾ।
ਫ਼: 1576 ਮਿਲੀ 17/5/23

ਵਿਸ਼:- ਮਿਤੀ 30/04/2023 ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੁਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ ਗਿਆਸਪੁਰਾ ਵਿਖੇ ਹੋਈ ਗੈਸ ਲੀਕ ਦੇ ਹਾਦਸੇ ਸਬੰਧੀ।

ਇਸੇ ਸਬੰਧੀ ਆਪ ਨੂੰ ਬੇਨਤੀ ਕੀਤੀ ਜਾਂਦੀ ਹੈ ਕਿ ਹੇਠ ਲਿਖੇ ਤੱਥਾਂ ਬਾਰੇ ਆਪਣੀ ਰਿਪੋਰਟ ਭੇਜੀ ਜਾਵੇ।

1. ਮੌਕੇ ਤੇ ਘਰਾਂ ਦੇ (ਆਰਤੀ ਕਲੀਨਿਕ, ਗੋਇਲ ਕਨਫੈਕਸ਼ਨਰੀ/ਗੋਇਲ ਕੇਲਡ ਡਰਿੰਕਸ) ਬਿਲਡਿੰਗਾਂ ਦਾ ਨਕਸ਼ਾ ਨਗਰ ਨਿਗਮ ਵੱਲੋਂ ਪ੍ਰਵਾਨ ਕੀਤਾ ਗਿਆ ਹੈ ਜਾਂ ਨਹੀਂ ?

2 ਕੀ ਉਕਤ ਅਦਾਰਿਆਂ ਵੱਲੋਂ ਨਗਰ ਨਿਗਮ ਪਾਸੋਂ ਪਾਣੀ ਅਤੇ ਸੀਵਰੇਜ ਕੁਨੈਕਸ਼ਨ ਪਾਸ ਕਰਵਾਏ ਸੀ ਜਾਂ ਨਹੀਂ?

ਰਿਪੋਰਟ ਸਮੇਤ ਦਸਤਾਵੇਜ 3 ਦਿਨਾਂ ਦੇ ਅੰਦਰ-ਅੰਦਰ ਇਸ ਦਫਤਰ ਵਿੱਚ ਭੇਜੀ ਜਾਵੇ।

ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ,
ਲੁਧਿਆਣਾ (ਪੱਛਮੀ)।

1. ATP, Zone-C
2. XEN, (O&M) to report immediately so that it can be sent to SDM Office.

18/05/23

1 ATP-C
2 XEN (O&M).

ANNEXURE-E

ਵਿਸ਼ਾ:- ਗੋਇਲ ਕੰਨਫੈਕਸ਼ਨਰੀ / ਗੋਇਲ ਕੋਲਡ ਡਰਿੰਕ ਅਤੇ ਆਰਤੀ ਕਲੀਨਿਕ ਸੂਆ ਰੋਡ ਗਿਆਸਪੁਰਾ ਲੁਧਿਆਣਾ ਦੀਆਂ ਬਿਲਡਿੰਗਾਂ ਦੀ ਉਸਾਰੀ ਸਬੰਧੀ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਸਬੰਧੀ ਦੱਸਿਆ ਜਾਂਦਾ ਹੈ ਕਿ ਗੋਇਲ ਕੰਨਫੈਕਸ਼ਨਰੀ / ਗੋਇਲ ਕੋਲਡ ਡਰਿੰਕ ਅਤੇ ਆਰਤੀ ਕਲੀਨਿਕ, ਸੂਆ ਰੋਡ, ਗਿਆਸਪੁਰਾ ਲੁਧਿਆਣਾ ਵਿਖੇ ਸਥਿਤ ਹੈ ਦਾ ਮੌਕਾ ਦੇਖਿਆ ਗਿਆ। ਇਸ ਸਬੰਧੀ ਇਲਾਕਾ ਨਿਵਾਸੀਆਂ ਪਾਸੋਂ ਇਹਨਾਂ ਬਿਲਡਿੰਗਾਂ ਦੀ ਉਸਾਰੀ ਸਬੰਧੀ ਪੁੱਛ-ਗਿੱਛ ਕੀਤੀ ਗਈ ਜਿਹਨਾਂ ਅਨੁਸਾਰ ਇਹ ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਅਧੀਨ ਉਸਾਰੀਆਂ ਸਬੰਧੀ ਰਿਪੋਰਟ ਹੇਠ ਲਿਖੇ ਅਨੁਸਾਰ ਹੈ:-

1. ਗੋਇਲ ਕੰਨਫੈਕਸ਼ਨਰੀ / ਗੋਇਲ ਕੋਲਡ ਡਰਿੰਕ ਸੂਆ ਰੋਡ ਵਾਲੀ ਬਿਲਡਿੰਗ ਵਿੱਚ ਗਰਾਉਡ ਫਲੋਰ ਤੇ ਕੰਨਫੈਕਸ਼ਨਰੀ ਅਤੇ ਕੋਲਡ ਡਰਿੰਕ ਦੀ ਦੁਕਾਨ ਅਤੇ ਫਸਟ ਫਲੋਰ ਤੇ ਉਹਨਾਂ ਦੀ ਰਿਹਾਇਸ਼ ਸੀ। ਆਸ ਪਾਸ ਲੋਕਾਂ ਵੱਲੋਂ ਦੱਸਿਆ ਗਿਆ ਹੈ ਕਿ ਮਾਲਕਾਂ ਵੱਲੋਂ ਇਹ ਇਮਾਰਤ ਦੀ ਉਸਾਰੀ ਸਾਲ-1993 ਵਿੱਚ ਕੀਤੀ ਗਈ ਸੀ।
2. ਆਰਤੀ ਕਲੀਨਿਕ ਵਾਲੀ ਬਿਲਡਿੰਗ ਵਿੱਚ ਵੀ ਗਰਾਉਡ ਫਲੋਰ ਤੇ ਕਲੀਨਿਕ ਅਤੇ ਫਸਟ ਫਲੋਰ ਤੇ ਉਹਨਾਂ ਦੀ ਰਿਹਾਇਸ਼ ਕੀਤੀ ਹੋਈ ਸੀ ਅਤੇ ਆਸ-ਪਾਸ ਦੇ ਲੋਕਾਂ ਤੋਂ ਪਤਾ ਲੱਗਿਆ ਕਿ ਇਹ ਬਿਲਡਿੰਗ ਸਾਲ-1997 ਦੌਰਾਨ ਬਣੀ ਸੀ।

ਇੱਥੇ ਇਹ ਵੀ ਦੱਸਣਾਯੋਗ ਹੋਵੇਗਾ ਕਿ ਨਗਰ ਨਿਗਮ, ਜੋਨ-ਸੀ ਦੀ ਬਿਲਡਿੰਗ ਬ੍ਰਾਂਚ ਦੇ ਰਿਕਾਰਡ ਅਨੁਸਾਰ ਇਹਨਾਂ ਬਿਲਡਿੰਗਾਂ ਦੇ ਮਾਲਕਾਂ ਵੱਲੋਂ ਨਾਂ ਤਾਂ ਉਸਾਰੀ ਸਮੇਂ ਕੋਈ ਨਕਸ਼ੇ ਪ੍ਰਵਾਨ ਕਰਵਾਏ ਜਾਣ ਅਤੇ ਨਾਂ ਹੀ ਸਰਕਾਰ ਦੀ ਰੈਗੂਲਰਾਈਜੇਸ਼ਨ ਪਾਲਿਸੀ ਅਧੀਨ ਮਾਲਕਾਂ ਵੱਲੋਂ ਇਹ ਬਿਲਡਿੰਗਾਂ ਰੈਗੂਲਰ ਕਰਵਾਉਣ ਸਬੰਧੀ ਕੋਈ ਜਾਣਕਾਰੀ ਉਪਲਬਧ ਹੈ।

ਰਿਪੋਰਟ ਪੇਸ਼ ਹੈ ਜੀ।

01.05.23
ਸਹਾਇਕ ਨਗਰ ਯੋਜਨਾਕਾਰ
ਜੋਨ-ਸੀ, ਨਗਰ ਨਿਗਮ
ਲੁਧਿਆਣਾ।

01/05/2023
ਬਿਲਡਿੰਗ ਨਰੀਖਕ
ਜੋਨ-ਸੀ, ਨਗਰ ਨਿਗਮ
ਲੁਧਿਆਣਾ।

JC (K) Supdt.
for further follow up please.
SDM (West)

01/05/23

ANNEXURE-[redacted]F

ਵਿਸ਼ਾ : ਡੀਲਿਮਿਟੇਸ਼ਨ, ਵੋਟਰ ਸੂਚੀਆਂ ਅਤੇ ਸਾਰਣੀ ਦਰੁਸਤੀ ਸੁਧਾਰ ਦੇ ਸਿਲਸਿਲੇ ਵਿੱਚ ਜਾਣਕਾਰੀ ਦੇਣ ਸਬੰਧੀ।

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਦੇ ਸਬੰਧ ਵਿੱਚ ਦੱਸਿਆ ਜਾਂਦਾ ਹੈ ਕਿ ਵਿਸ਼ੇ ਅਧੀਨ ਡੀਲਿਮਿਟੇਸ਼ਨ ਵੋਟਰ ਰਜਿਸਟ੍ਰੇਸ਼ਨ ਅਤੇ ਸਾਰਣੀ ਦਰੁਸਤੀ ਸੰਬੰਧੀ ਸੁਧਾਰ ਦੇ ਸਿਲਸਿਲੇ ਵਿੱਚ ਮਿਤੀ 30.04.23 ਨੂੰ ਸਵੇਰੇ ਸਿਵਲ ਸਕੱਤਰ ਉਪਰੰਤ ਮੀਟਿੰਗ ਹੋਣ ਦੀਆਂ ਸੰਭਾਵਨਾਵਾਂ ਹਨ ਅਤੇ ਸਾਰਣੀ ਦਰੁਸਤੀ ਅਤੇ ਡੀਲਿਮਿਟੇਸ਼ਨ ਦੇ ਕਾਰਜ ਵਾਸਤੇ ਘਰ ਵੀਜਾ ਸਮਾਂ ਹੱਦ ਤੈਅ ਹੈ ਕਿ ਡੀਲਿਮਿਟੇਸ਼ਨ ਵੀਜਾ ਦੇਣ ਸਮਾਂ ਹੱਦ ਦੇ ਅਤਾ ਪਤਾ ਕਿਹੜਾ ਸਮਾਂ ਹੱਦ ਹੈ ਅਤੇ ਸਾਰਣੀ ਦਰੁਸਤੀ ਅਤੇ ਡੀਲਿਮਿਟੇਸ਼ਨ ਦੇ ਕਾਰਜ ਵਾਸਤੇ ਘਰ ਵੀਜਾ ਸਮਾਂ ਹੱਦ ਦੇ ਅਤਾ ਪਤਾ ਹੈ ਅਤੇ ਸਾਰਣੀ ਦਰੁਸਤੀ ਅਤੇ ਡੀਲਿਮਿਟੇਸ਼ਨ ਦੇ ਕਾਰਜ ਵਾਸਤੇ ਘਰ ਦੀ ਪੂਰਤੀ ਦੇ ਵਿਸ਼ੇ ਵਿੱਚ ਸਾਰਣੀ ਦਰੁਸਤੀ ਸਾਰ ਸੀ ਸਾਰਣੀ ਦਰੁਸਤੀ ਦੇ ਘਰ ਦੇ ਸਵਾਲ ਦੇ ਸਾਰਥਿਕ ਉੱਤਰਤਾ ਦੀ ਵਜ੍ਹਾ ਕੁਝ ਕੰਮਾਂ ਤਹਿਤ ਉਹ ਜਾਰੀ ਸਨ। ਕਿਰਪਾ ਮੀਟਿੰਗ ਦਾ ਸਮਾਂ ਤਹਿ ਕਰਨ ਅਤੇ ਇਸ ਸਾਰਥਿਕ ਕਾਰਜ ਨੂੰ ਸਮਾਂ ਰਹਿੰਦੇ ਨੇਪਰੇ ਚਾੜ੍ਹਨ ਲਈ ਸਹਿਯੋਗ ਦੇਣ ਦੀ ਕਿਰਪਾਲਤਾ ਕਰਨੀ ਜੀ। ਮੀਟਿੰਗ ਵਿੱਚ ਪਹੁੰਚਣ ਲਈ ਕਿਰਪਾ ਕਰਕੇ ਡੀਲਿਮਿਟੇਸ਼ਨ ਵੋਟਰ ਰਜਿਸਟ੍ਰੇਸ਼ਨ ਦਾ ਪਹਿਲੀ ਮੀਟਿੰਗ ਦਾ ਸਵੇਰੇਖਰਨ ਸ੍ਰੀ ਅਸ਼ੋਕ ਡੀਲਿਮਿਟੇਸ਼ਨ ਦੇ ਨਾਲ ਉਪਰ ਪਾਸ ਹੈ ਅਤੇ ਸਾਰਣੀ ਦਰੁਸਤੀ ਅਤੇ ਡੀਲਿਮਿਟੇਸ਼ਨ ਦੇ ਕਾਰਜ ਵਾਸਤੇ ਘਰ ਦੇ ਸਵਾਲ ਦਾ ਜਵਾਬ ਉਪਰਾਂਤ ਪੱਤਰ ਕਰੀ ਜੀ। ਸਾਰਣੀ ਦਰੁਸਤੀ ਦੇ ਘਰ ਦਾ ਦੂਸਰਾ ਸਮੱਸਿਆ ਸਮਾਂ ਤੋਂ ਨਾਲ ਉਪਰ ਪਾਸ ਹੈ।
ਕਿਰਪਾ ਪੱਤਰ ਹੈ ਜੀ।

Pkgb
11/5/23

JC (K) M.
for further follow up please.

SDM (West)

Kajal
01/05/23

Annexure - G

Municipal Corporation Ludhiana

Principal Secretary,
Department of Local Govt., Punjab,
Chandigarh.

No. 166/PS/D Dated. 23/06/2023.

Sub: **Regarding investigation of the untoward incident of gas leak at Giaspura area on 30.04.2023.**

Sir,

With regard to subject cited above, it is submitted that a untoward incident of gas leak has been occurred in Giaspura on 30.04.2023 and some persons died in this gas leakage Incident. The undersigned constiture a committee vide order No.15/PS dated 30.04.2023 to invtestigate the incident of gas leakage happened in Giaspura.

The investigation report submitted by the committee is attached herewith for your kind information please.

DA/ As above

Commissioner,
Municipal Corporation,
Ludhiana.

No._____ Dated._____

Copy of above is forwarded to the Chairman, Punjab Pollution Control Board, Patiala for kind information please.

2. Copy of above is forwarded to the Deputy Commissioner, Ludhiana for information please.

Commissioner,
Municipal Corporation,
Ludhinana.

Municipal Corporation Ludhiana

Principal Secretary,
Department of Local Govt., Punjab,
Chandigarh.

No._____ Dated._____

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Commissioner,
Municipal Corporation,
Ludhiana.

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Copy of above is forwarded to the Chairman, Punjab Pollution Control Board, Patiala for kind information please.

2. Copy of above is forwarded to the Deputy Commissioner, Ludhiana for information please.

Commissioner,
Municipal Corporation,
Ludhinana.

Subject:- Regarding investigation of the untoward incident of gas leak at Giaspura area on 30-04-2023.

With reference to the matter mentioned above, a committee has been formed by the Hon'ble Commissioner through office order No. 15/PS dated 30-04-2023 to investigate the incident of gas leakage that occurred at Giaspura area on 30-04-2023. In accordance with the orders of the Hon'ble Commissioner, the committee's report is as follows:

Occurrence of the events

1. Mr. Swaran Chand, ADFO, stated that on 30-04-2023 at 8:15 am, the control room of the Fire Brigade, Municipal Corporation Ludhiana received information about a gas leak on Giaspura Sua Road. After receiving the information, the fire brigade personnel reached the spot around 08:40 hrs and found some individuals lying unconscious in front of the Amul milk shop. The individuals were immediately taken to the hospital by ambulance (**Annexure-'A'**) attached with photo). Subsequently, the higher officials of the municipal corporation were informed about the incident.

2. The Hon'ble Deputy Commissioner and Commissioner of Municipal Corporation arrived at the site, and other officers from the Municipal Corporation O&M Department, District Government officials, NDRF team, Punjab Pollution Control Board team, etc. joined them. The Deputy Commissioner, Commissioner of Municipal Corporation, and all the teams jointly inspected the site and found that it had a strong smell of rotten eggs. When the teams approached the site, the smell of gas became stronger. All the maintenance holes/haudis in the area were mapped (**Annexure-B**). The indicating map of the site is attached for reference (**Annexure-B-1**). It was seen that some dead bodies found next to the personal haudi of Goyal Cold drink. Also a maintenance hole near transformer was covered with a broken cover, which appeared to have been recently broken, and the malba (debris) of that cover was lying nearby on the site (attached at **Annexure-'C'**). The visible steel reinforcement of the broken maintenance holes cover was not rusted. Additionally, the team observed that the private haudi of Amul Milk/Goyal Cold Drink shop was blue in colour from the inside, whereas the haudi of nearby houses did not have this blue shade. The team also noted that there was no bad smell beyond the broken maintenance hole cover.

3. Meanwhile, the NDRF team, along with the Municipal Corporation team and PPCB team, wearing safety kits, took samples of water from maintenance hole chambers and sent for testing as per the details below:

i) Maintenance hole opp. Sitara Cinema (E) (S4), ii) Maintenance hole of main sua road opp. st. no. 4 near transformer (B) (S1), iii) Maintenance hole of main sua road opp. st. no. 5 near Jasbir Building material (A) (S3), iv) Maintenance hole of st. no. 4 (Sample) gali (B1) (A1), v) Gaar of personal haudi of Goyal Cold Drink (D1) & also a sample was taken from sewer Maintenance hole in Giaspura park (in the different area, to act as a control sample). The samples have later been sent to PBTI lab for testing. It is submitted that various samples were sent for testing by PPCB as well as MCL.

4. After consultation with Director CSIR, the NDRF team started checking of gas limits in the area using gas detection kits, from around 1.30 PM onwards. The concentration of gases was measured inside the maintenance hole and in the surrounding air, just at the ground level. Later in the evening, the NDRF team was joined by Dr. Surjeet, a representative of the CSIR Department, Chandigarh, for the same, and this continued throughout the night. A copy of the readings showed that the concentration of Hydrogen Sulphide (H_2S) and Carbon monoxide (CO) gases was very high inside these maintenance holes as detailed below. (Measurement sheets are attached at **Annexure- 'D'**).

Measurement of gas levels at various points

TIME & DATE	A		B		B1		C		D		D1		D2		E	
	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S
2-3 PM 30-04-23	-	190	-	195	80	13	0	195	0	180	47	40	47	174	15	10
5-6 PM 30-04-23	20	0	46	0	92	12	-	15	-	-	29	15	47	18	-	17
7-8 PM 30-04-23	0	0	80	13	20	0	17	85	46	100	296	1.5	47	17	0-20	15
10:00 PM 30-04-23	100	200	15	5	20	5	30	85	22	13	25	15	25	15	20	10
12:30 AM 01-05-23	50	7	40	6	14	5	12	10	15	25	5	18	5	11	7	12
2:30 AM 01-05-23	30	4	12	3	9	3	7	3	30	40	7	3	7	3	7	4
4:30 AM 01-05-23	5	2	2	5	6	2	0	3	10	15	0	3	0	3	0	3
6:30 AM 01-05-23	0	4	0	4	0	4	0	4	0	5	0	4	0	4	0	3
10:00 AM 01-05-23	0	0	0	0	0	0 1	0	0	2	0 0	0	0	0	0	0-1	0 0
4:00 AM 02-05-23	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0

5. Thus it was observed that concentration of H_2S was quite high (in the range of 174 to 195) in maintenance holes A, B, C, D & Haudi D1, D2, which were very close to the incident site. As we moved farther away from the incident site, the H_2S concentration was in the range of 10-15 (E/B1). Also, the concentration of CO was high in B1, D1, D2. This shows that there was particularly high concentration of these poisonous gases, particularly H2S and CO at the incident site in a very limited area. Further, since these measurements were taken after quite some time had passed since the incident in the morning, it is possible that the concentration of these gases could have been quite high at the time of the incident, leading to such instant deaths.

6. These were discussed telephonically with Dr. Anjan Ray, Director CSIR, who verbally suggested defusing/neutralizing the acidic gases with the help of a diluted caustic soda solution to prevent the further spread of poisonous gases through the sewer line. As per the verbal instructions from Director CSIR, the teams of the Municipal Corporation prepared caustic soda solutions and started pouring the solution into the maintenance hole chambers at around 6:30 pm. The exercise continued throughout the night & the readings of gas concentration were repeated

every 2 hours jointly by NDRF & MC teams. Wherever the gas concentration was high, caustic soda solution was then used to dilute it. The Municipal Corporation team added Caustic soda solution to the maintenance hole chambers as per requirement even during the night hours with the help of sewer jetting- cum- suction machine and washed the effected chambers with the help of fire tender. It was seen that the gas levels were steadily declining after 10 PM & came within permissible levels after that. These were continued to be measured till around 11.00 AM the next day, when the levels were found to be within permissible limits.

Details and analysis of the sewer condition in the area

7. It is submitted that the sewer near the incident site was laid 20 years ago by Punjab Water Supply and Sewerage Board (PWSSB). The design statement showing gradient, slope and discharge etc. was received from the record of PWSSB. The details, along with map are attached at **Annexure-E**. As per the record, the total length of the sewer line from Eastman chowk to Giaspura chowk is 1800 mtr. approx.

- The sewer in the area is 30" id is designed to take discharge of 3.56 cusec and designed discharge of this sewer is 7.02 cusec from Node no. N/10/1 to N/1.
- It is submitted that one no. of tube well exist in this area, upstream of this site, which is having approximately 0.208 cusec water generation per day.
- No. of water supply and sewer connections Domestic in the area are approximately 400 nos. and having 0.104 cusec waste water generation. 66 nos. of disposal connections having approximately 0.197 cusec say 0.2 cusec.

From the above it is evident that the total waste water discharge in the area (Tube well and Disposal) is 0.405 cusec. So it is clear that the capacity of main sewer is much more than the waste water flowing in the sewer system, so the sewer system is not over loaded.

The direction of sewer is from Ashirwad Kanda towards Giaspura Chowk and this sewer is flowing by the gravity as shown in the design statement that the gradient of the sewer is 1/2500.

The level of the chambers near incident site is mentioned in designed statement annexed at **Annexure-'F'.**

8. It is also submitted that cleaning and desilting of sewer lines is done through mechanised means regularly in the entire city. Almost all the major sewer lines are cleaned once every 3-5 years as per the norms. It is further submitted that this main sewer line was cleaned with super suction machines in March 2019, the photographs for the same have been attached for reference at **Annexure-'G'**. Further, in case of any problem or blockage in any particular sewer line, the cleaning of that line is taken as per the requirement. It was informed by the SDO-O&M, MCL of the area that cleaning of sewer lines on the downstream side of the affected area had been done recently in the month of April, 2023.

This was also evident from the fact that the levels of sewerage flow in sewer maintenance hole was much below the sewer capacity & no overflowing or blockage was visible.

Also, the residents of the area had mentioned that there was no issue of blockage or problem in the sewer flow. **(Annexure-'H').**

9. It is also submitted that various gases are produced due to decomposition of organic material of sewages. These sewer gases naturally include H2S, which is also commonly known as 'Sewer gas', and is produced as a result of decomposition of organic matter present in the sewer lines. The levels of such gases may vary inside the sewer, depending on the flow and the organic matter. It is pertinent to mention that no instance has ever been reported where the naturally occurring H2S from inside the sewers has caused deaths of any person outside in the open.

10. It is also submitted that multiple techniques are usually adopted for ventilation of sewers, which could lead to regular discharge of the gases into the air and avoid any accumulation inside to higher levels.

- Ventilating columns: The Ventilation shaft is provided along the sewer line at various points as per design. Ventilating shaft helps to remove the foul and explosive gases produced in the sewer.
- Ventilating Manhole covers: The manhole covers are sometimes provided with the perforations, through which the sewer gets exposed to the atmosphere. This will help in achieving ventilation.
- Road gulleys: In the areas with common storm water and sewerage system, road gulleys are provided, which could allow for drainage of storm water into the sewerage system, and also allow for back discharge of gases into the air.

11. In Municipal Corporation Ludhiana there is lack of dedicated storm water system and generally the sludge sewer is connected with road gullies chambers for the disposal of storm water. So there are provision of road gullies chambers in every street and main road, connected with branch or main sewer line. The existence of road gullies chambers with the sewer line helps in the dissipation of foul gases from sewer lines and keeps the sewage ventilated. So with these chances of accumulation of foul gases in MC sewer is minimal.

12. The sewer length in the area was examined and it was seen that 06 nos. of road gullies exist along with the maintenance hole chambers in that stretch having 150 mtr. from Jasbir Building material store to Sitara Cinema. And 19 nos. of road gullies already exists in the street opposite transformer in Street no. 04, Makkar colony. It is also mentioned that two additional road gully chambers were constructed from Jasbir Building material store to Sitara Cinema as remedial measure after the recommendation of the joint committee of MCL, PWSSB & Water and Sanitation Department constituted by Deputy Commissioner Ludhiana **(Annexure- I).**

13. It is also mentioned here that the main sewer line has been cleaned as per requirement and the road gullies chambers are cleaned before every rainy season. Further this is a regular exercise, which is done repeatedly.

Issues discussed in the meeting of the joint committee constituted by NGT

14. A fact-finding committee has also been constituted in this regarding of NGT. A meeting of this committee was held on 08-05-2023. Various issues as detailed below were discussed there:

i. Sh. Sheelendra Pratap Singh from Indian Institute of Toxicology research, Lucknow gave his observation that H_2S is natural occurring gas in sewer but such high amount of concentration is not usually heard of & could be due to anaerobic digestion of sewer waste along with high amount of acid/ metal.

ii. It was pointed out by Dr. Lakshmi, Epidemiologist from PGI Chandigarh that no such report of H_2S death in open space have been reported anywhere in the world.

iii. SE, PPCB informed that industries were checked within 50 mtr, 100 mtr & 500 mtr of the site & it was found that out of total 113 industries checked, 17 were found to be water polluting. Out of these 17 industries, 4 industries were at the downstream of the incident out of which 3 were acid consuming and 13 industries were found at the upstream out of which 11 was acid consuming.

iv. SE, PPCB also informed that they had checked unauthorised industrial units running from houses/ residential units in the area. On checking, it was found that 23 industries were running from 64 residential premises checked. Out of these 4 industries were water polluting & pickling/ electroplating units, which were acid & metal consuming (3 upstream & 1 downstream).

v. SE PPCB also presented samples reports of waste water collected from the maintenance hole chambers as attached at **Annexure-'J'**. From these reports, it was observed that the pH value of sewer water content of three maintenance holes mentioned at sr. no. B, C & D is between 2 to 3.

vi. NGT committee then visited the area along with the team from MCL and interviewed survivors and victims' family members. The interview transcripts are attached at **Annexure-'H'**. The people interviewed informed cohesively that there was no report of sewer block in fast few days or months. Further, all the members told committee that there was a peculiar smell which they had never smelled in past. Further, it was pointed out that there are large no. of electroplating and chemical industries running in this area, which are usually discharging their liquid waste into the sewer.

vii. The issue of discharge of electroplating industry in the city was also discussed. It was informed that a common CETP, operated by JBR technologies is responsible for collecting the wastewater from more than 1000 electroplating industry in the region, treating it and then ensuring discharge as per the norms. It was also suggested by member CPCB that audit of various electroplating industries and JBR technologies should be conducted by Punjab Pollution Control Board to

check the generation of water by the industry, the treatment of the wastewater and the mode of disposal of waste water generated after treatment.

Checking of organic discharge from meat shops into the sewer in the area

15. It is submitted that the special drives were conducted by the teams of O&M cell and Health branch of MCL on Sua Road, near Goyal Cold Drinks, Giaspura, on 8th June, 2023, and 22nd June, 2023. It was found that there are 06 nos. of meat shops in the vicinity of the area up stream of this site in approx. 150 mtr. stretch. Only one of the shops had a sewer connection with the possibility of its discharge into the sewer system. The approx. discharge from this shop is assessed to be approx 200 litres per day. It is submitted that though this discharge is negligible and itself could not lead to such high concentrations of H2S in the sewer in the area.

16. It is further stated that on 8th June, 2023, the Health branch issued 8 challans to meat shops, and 20 kgs of meat recovered during the drive was destroyed. Continuing this effort, another special drive was conducted on 22nd June, 2023, by the teams of MCL. During this drive, 13 challans were issued to meat shops, and 50 kgs of meat were destroyed by the Health branch. Only one of those meat shops had a sewer connection, which could had caused discharge into sewer system. This sewer connection has now been disconnected by O&M cell MCL. Pictures of this special drive and the copies of the challans have been attached at **Annexure-K.**

Checking of water closets in the affected houses

17. During the joint visit of MCL, PWSSB & Water and Sanitation Department, it was observed that the water closet was missing in the house of Aarti Clinic. It is possible that this could have led to the backflow of the gases from the sewer line into that house which could have lead to the higher concentrations there.

Chemical analysis report of the sewer samples from the area

18. The sample reports of water collected from various maintenance hole chambers & sent for testing by MCL has also been received and annexed at **Annexure-'L'**. From the test reports of personal Haudi of M/s Goyal Cold Drinks, it is evident that the various metals such as Nickle, Zinc, Copper, Lead, Chromium, Iron, and Arsenic are very higher side.

19. The samples of water taken from maintenance hole chambers and found high value of Hydrogen Sulphide. Hydrogen Sulphide is a colourless gas with the odor of rotten eggs. It is usually shipped as a liquid. Hydrogen Sulphide is found as a by-product of industrial and natural processes, and is used as a chemical reagent, in making heavy water, and is used in metallurgy, lubricants and cutting oils. The legal airborne permissible exposure limit (PEL) is 20 ppm not to be exceeded at any time, and 50 ppm as a maximum peak, not to be exceeded during any 10-minute work period.

20. Further, the reports of samples taken by PPCB and MC both point out to similar major facts that there was abnormally high concentration of acidic content (as is evident from the

abnormally low pH of around 2) and heavy metals in the manhole chambers and haudis in this localised area.

Expert opinions/ reports

21. It is further submitted that the officials from CPCB visited site of accident Giaspura, Ludhiana on 03.05.2023, namely Mr. G. Rambabu, Scientist D, Dr. Narender Sharma, Scientist E, Mr. Kamlesh Singh, Scientist E and Mr. Nazimuddin, Scientist F and have submitted their report in the matter. Some of the key points are reproduced as below: **(Annexure- M)**

"Presence of sulphide in sewer water as H2S is due to biochemical reduction of the sulphate present in water. The ratio of Sulphur (S). Hydrosulphide (H2S) and H2S in sewer water at any point of time depends on the pH of sewer water at that time. Intermittent discharge of acidic effluents from industries in mixed sewers acts as an agent for shifting the equilibrium. Acidic effluents are also a source of sulphate (due to sulphuric acid), which ultimately forms sulphide.

Further, if industrial effluents containing metals and heavy metals are discharged in the sewers, the metals are precipitated as metal sulphides in the sewer lines. These metal sulphides, in the presence of acids/acid effluents containing H2SO4 and/or HCl, end up generating hydrogen sulphide (H2S) gas.

Therefore, it can be concluded that intermittent discharge of acidic and metallic industrial effluent/waste into mixed sewers can be a source of sudden release of H2S gas in very high concentration from such sewers.

It is relevant to mention that H2S is a diprotic weak acid and even a saturated solution of H2S is not expected to have a pH less than 4.0. Therefore, it may be concluded that pH level of 2.5-2.6 as reported in main sewer water near the houses where deaths occurred is a result of acidic industrial effluent discharge.

The above facts strongly point towards the discharge of industrial effluent as the cause of highly acidic water in the main sewer in the area and the also the cause of release of H2S in the sewer line in high concentration, leading to immediate collapse and death of eleven persons.

As per recent media reports and the discussion held with Chief Environmental Engineer, PPCB, the industries in Ludhiana use both Hydrochloric acid and Sulphuric acid. It was also reported that few industries in Giaspura area have acid pickling step in their manufacturing process. The chloride content in the main sewer water near the accident was found higher in comparison to distant points (both upstream and downstream) which may be due to use of hydrochloric acid in the area. These facts also indicate that industrial discharge is a key factor in releasing of H2S in high concentrations."

22. A report has also been received from Dr. Anjan Ray, Director CSIR through his email dt 1.5.2023, which is as follows: **(ANNEXURE- N)**

"In continuation of our discussions throughout the day today in the aftermath of the Ludhiana Gas Leak, I have summarized my initial hypotheses and recommendations for the consideration of the local administration and of NDMA as follows:

i. *Evidence from the medical examiner and his preliminary forensic assessment suggests that the gas released contained hydrogen sulphide (H_2S) as the primary causal agent. This correlates with the foul smell noted by some affected residents and the symptoms outlined by the medical specialist.*

ii. *We cannot rule out carbon monoxide as a secondary causal agent. CO is colorless and is often found in sewer gas compositions. An authoritative recent review of sewer gas compositions can be found at https://www.sciencedirect.com/science/article/pii/S2772416622000808.*

iii. *Based on the hypothesis that H_2S is the primary causal agent, a frontline response of neutralizing the H_2S with appropriately diluted caustic soda has been advised. This appears to be working based on feedback from the team on the ground, as ambient H_2S levels have fallen sharply after the caustic treatment.*

iv. *It may be noted that sudden acidification of sewer contents (for instance, through the shock discharge of acidic effluent from any electroplating unit in the area) could cause a surge in H_2S levels. To determine if this might have been the cause, ICP analysis of trace elements and metals in the sewage samples may be carried out.*

v. *Unlike H_2S, there is no way as such of neutralizing CO. However, its vapour density (~14) is close to that of air (~14.7) and it should disperse naturally at a rate quicker than H_2S (V.D ~ 17), which is heavier than air.*

vi. *H2S readings will, therefore, vary across a vertical axis at ground level, 1.5 feet above ground (typical level of a person lying on a bed), and at 4.5 feet above ground (typical nostril level of a standing person), with the maximum concentration of the toxic gas being at the ground level. While CO will not show much variation. I remain at your service for additional questions, if any."*

23. Further, a study of the literature and scientific data points out that the role of these metals in formation and acidification is as follows: **(ANNEXURE- O)**

- Nickel (Ni): Nickel can act as a catalyst in certain chemical reactions that lead to the formation of H2S. It can enhance the conversion of sulphur-containing compounds into H2S. Additionally, nickel compounds may contribute to the acidification of certain environments.
- Zinc (Zn): Zinc play a role in acidification processes, particularly in the presence of acidic substances. It can react with acids, forming zinc salts and releasing hydrogen gas, thereby contributing to the overall acidification of a system.

- Chromium (Cr): Chromium compounds can contribute to acidification when they dissolve in water, forming acidic solutions.
- Iron (Fe): Iron is an essential component in various chemical reactions that lead to the production of H2S. Iron sulphide minerals, such as pyrite (FeS2), can release H2S when they come in contact with water and undergo chemical weathering or microbial activity. Iron can also participate in acidification processes, particularly through the formation of acidic solutions when iron compounds dissolve in water.

24. Conclusion

- The sewer system had sufficient capacity and as per the visible scenario, the cleaning reports of O&M branch of MCL and the feedback from the people interviewed, there was no report of sewer block in fast few days or months in the area.
- Sufficient number of Road gullies were constructed with the main and branch sewer line which act as vent for escaping of sewer gases. Hence the possibility of accumulation of gases in large quantity is minimal.
- Though there were some meat shops in the area, but only one of them was found to have a sewer connection. Though this could have led to some discharge of the organic matter in the sewer, but this could have lead to increase in the production of H2S gas inside the sewer only. In the current case, there is abnormally low pH, with the release of very high concentration of H2S gas from a particular outlet for a very short span of time, which does not seem possible merely due to a little increase in the organic load in the sewer.
- Reports of PPCB point out the existence of a number of industrial units in the vicinity (both authorised and illegal), which have been discharging the metals and acid into the sewer lines.
- An audit is also required into the treatment and discharge of wastewater of the more than 1000 electroplating units in the city through the CETP operated by JBR technologies. Without this information, it cannot be ruled out that there has been no illegal discharge of untreated waste of the electroplating industry (containing heavy metals as well) into the sewer lines of Ludhiana.
- Also, the interviews and discussion with the people of the locality show that there are a lot of electroplating & other industrial units nearby, some of which could have been dumping its waste illegally.
- It seems that the incident might have occurred due to some chemical reaction of some acids/ metals with naturally occurring sewer gases (H_2S)/ sewage, which could have led to a sudden release of very high concentration of H_2S gas for a short period of time leading to the death of the people instantaneously. This seems

likely based on reports of high concentration of metals & very low pH (showing acidification of the sample).

- Further, it was observed that H2S gas had been released into the air from a limited area in extremely high quantity for a very limited span of time, even leading to breakage of manhole covers and blackening of the cover, which does not seem possible as a part of natural sewer gas formation, and indicates occurrence of some sort of chemical reaction.
- Thus after talking to victims and local residents, visiting field and taking comments from experts in subject matter, committee is of view that this sudden release of very high concentration of H_2S is due to releasing of chemicals in sewer from various industrial units. However, the exact source is not known & is a matter of investigation.

25. **Suggestions:** For eliminating such incidents in the future, it is suggested that:

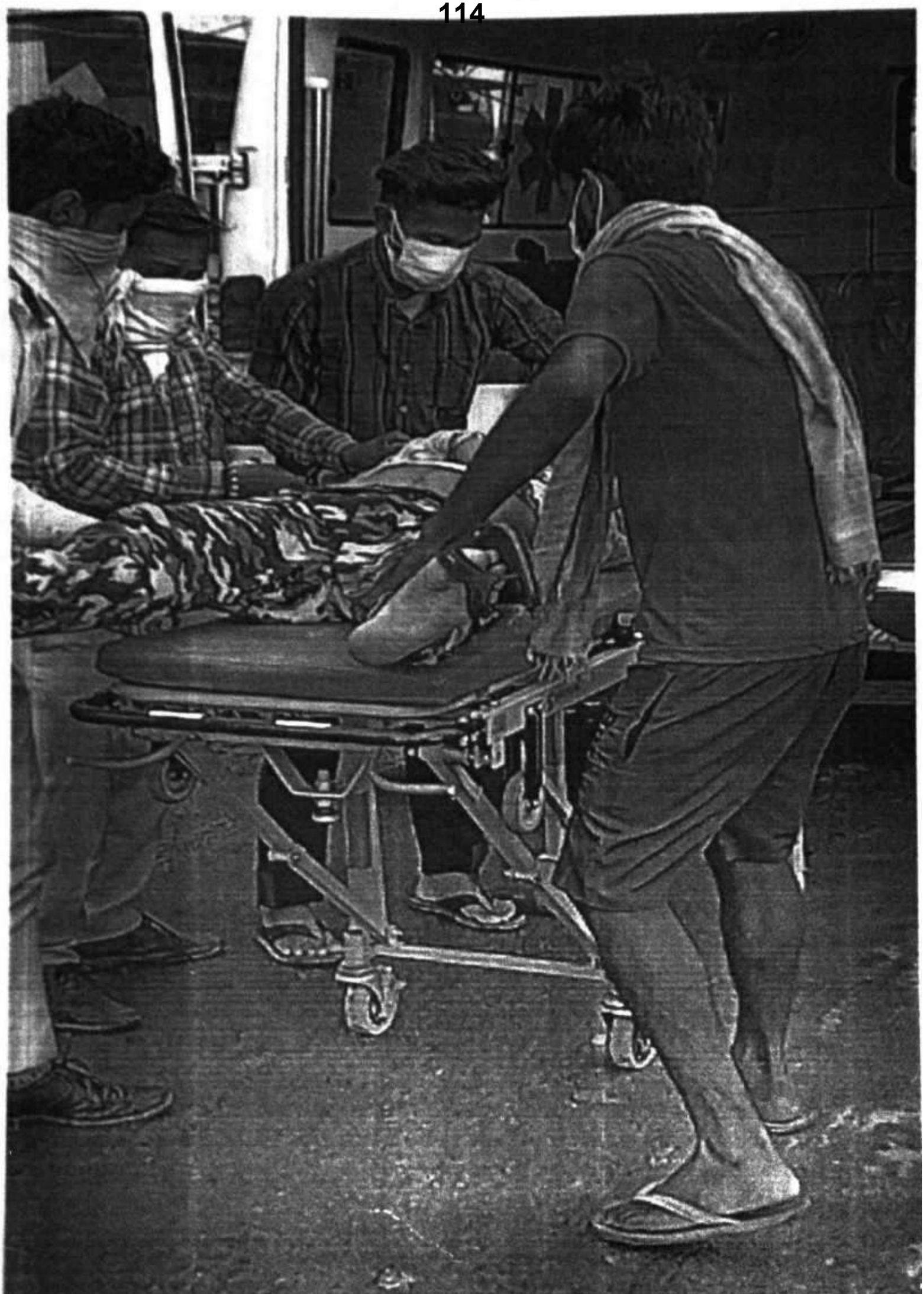
a) A special disaster management team should be set up in the city/ district to handle any such chemical and gas leakage disasters in the future.

b) A detailed audit of water consumption & waste water treatment of various types of industries should be conducted, either at the level of Punjab Pollution Control Board or jointly by MCL & PPCB.

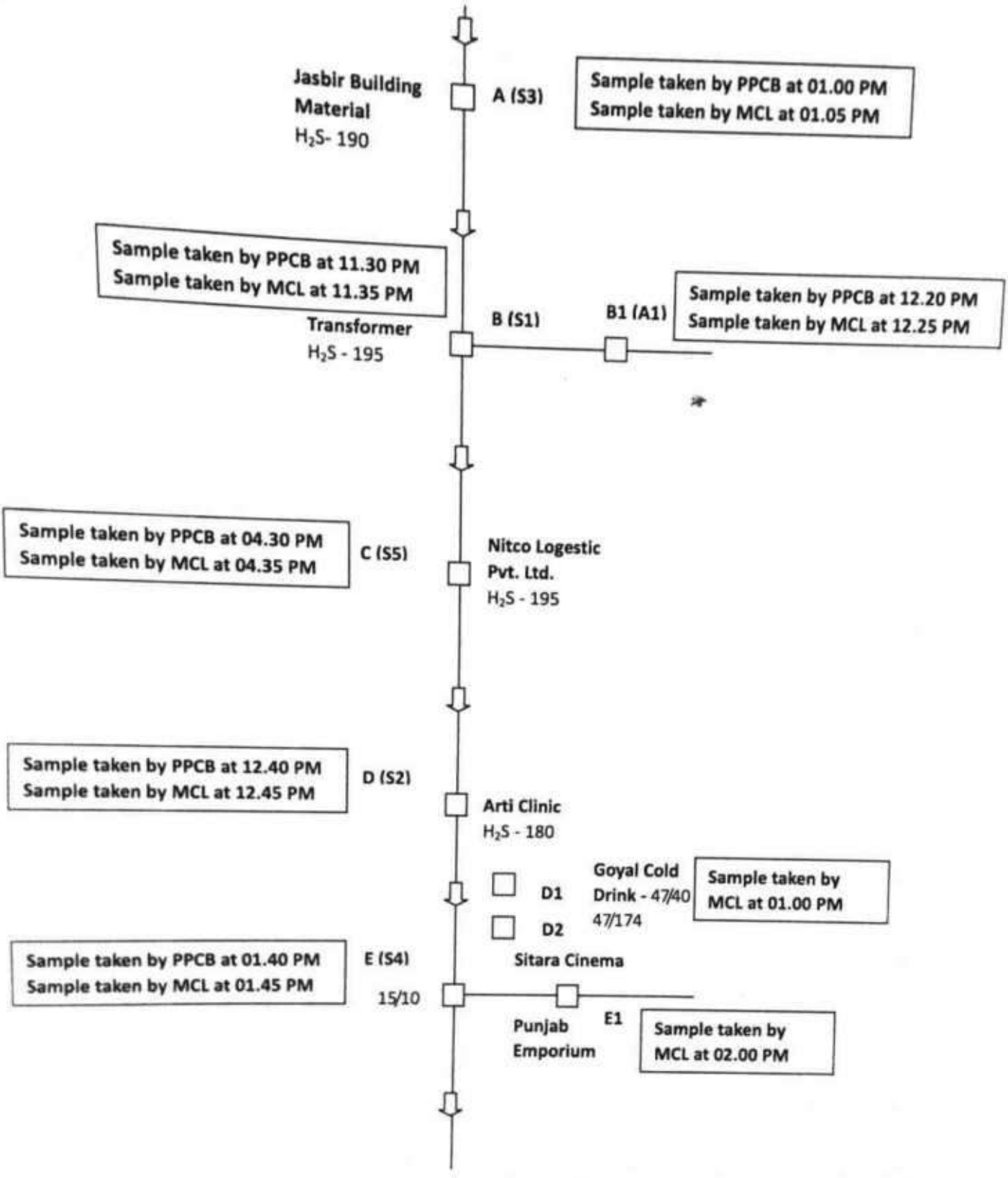
c) Proper plumbing systems should be adopted in households/buildings, i.e., proper sewer connections should be taken with proper water seal traps. The water inside the trap serves as a liquid seal that helps keep sewer gas smells from getting out of the drains. The depth of the water seal inside a trap should be enough to keep sewer gas away while not obstructing drainage from the system. Proper vent pipes/exhaust fans should be installed for a proper ventilation system.

26. It is also intimated that a magisterial inquiry has been initiated by the Hon'ble Deputy Commissioner, Ludhiana in this regard separately.

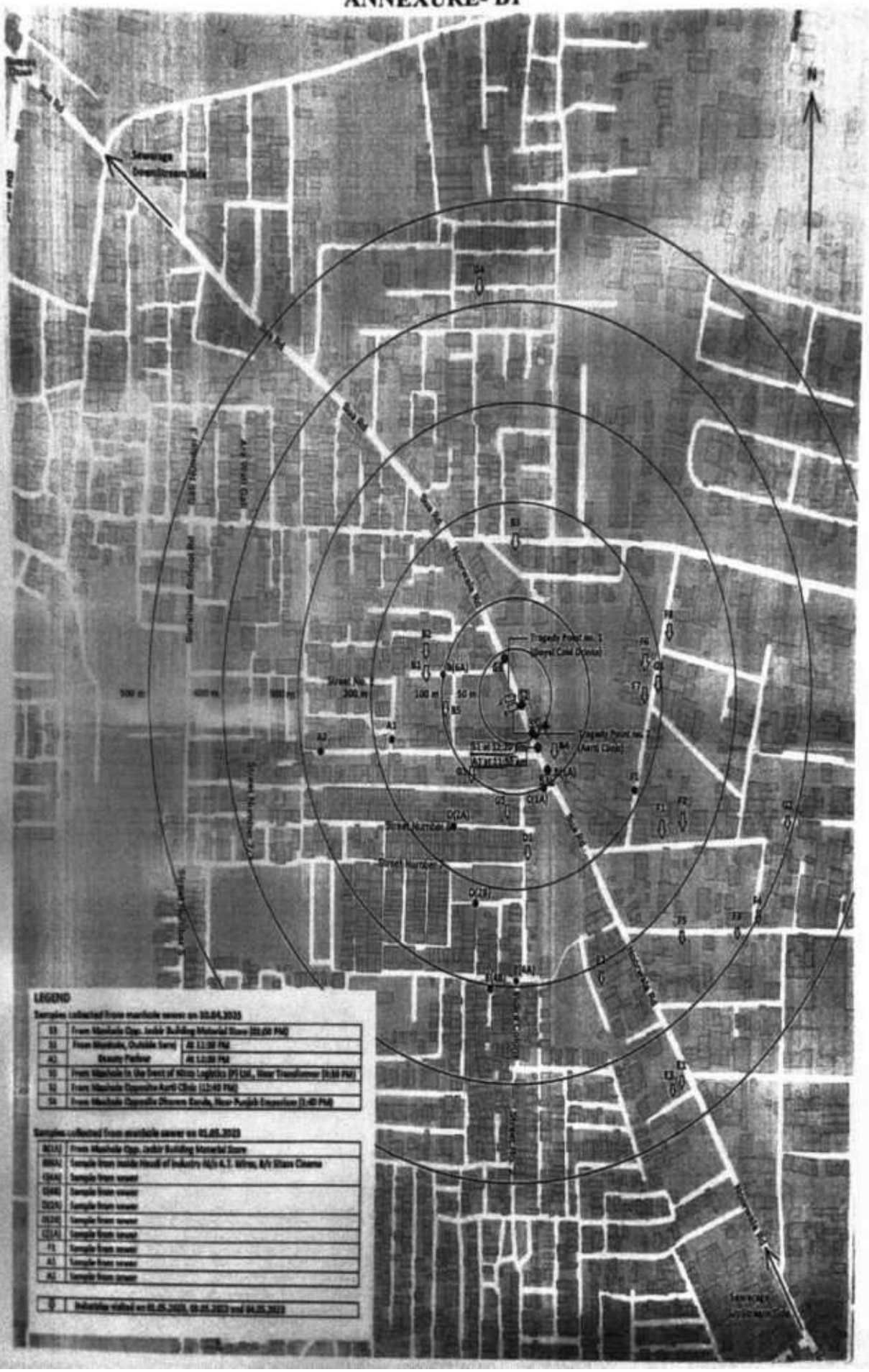
Aaditya Dachalwal	Kulpreet Singh	Ravinder Garg	Swarn Chand
Addl. Commissioner	Joint Commissioner	SE-O&M	ADFO



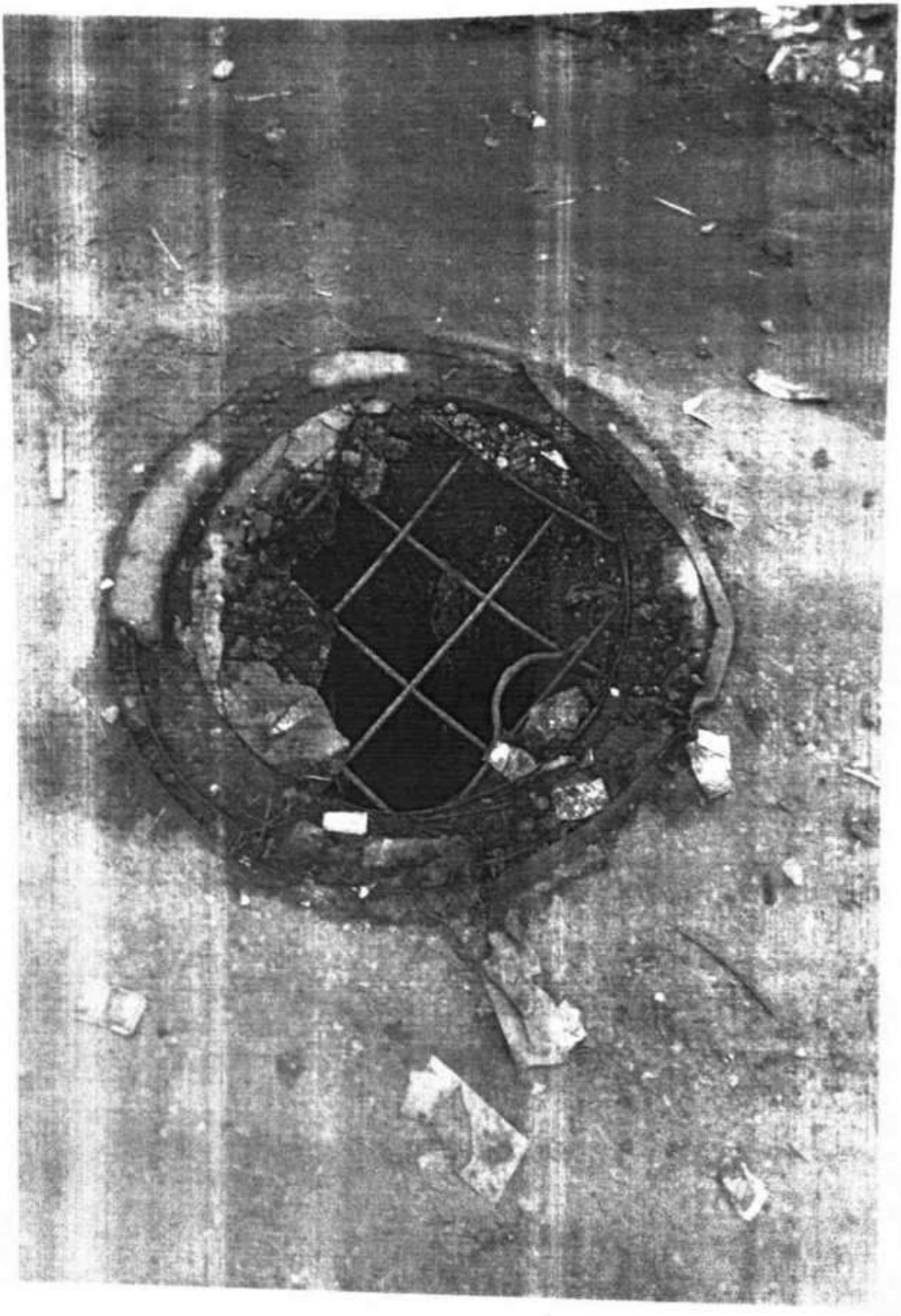
ANNEXURE- B


Jasbir Building Material
H_2S- 190
A (S3)
Sample taken by PPCB at 01.00 PM
Sample taken by MCL at 01.05 PM
Sample taken by PPCB at 11.30 PM
Sample taken by MCL at 11.35 PM
Transformer
H_2S - 195
B (S1)
B1 (A1)
Sample taken by PPCB at 12.20 PM
Sample taken by MCL at 12.25 PM
Sample taken by PPCB at 04.30 PM
Sample taken by MCL at 04.35 PM
C (S5)
Nitco Logestic Pvt. Ltd.
H_2S - 195
Sample taken by PPCB at 12.40 PM
Sample taken by MCL at 12.45 PM
D (S2)
Arti Clinic
H_2S - 180
D1
D2
Goyal Cold Drink - 47/40
47/174
Sample taken by MCL at 01.00 PM
Sample taken by PPCB at 01.40 PM
Sample taken by MCL at 01.45 PM
E (S4)
15/10
Sitara Cinema
Punjab Emporium
E1
Sample taken by MCL at 02.00 PM

ANNEXURE- B1


N
Sewage Downstream Side
Tragedy Point no. 1 (Gorai Canal Crossing)
Tragedy Point no. 2 (Aarey Canal)
Street No. 1
Street Number 2
Street Number 3
500 m
400 m
300 m
100 m
50 m
LEGEND

ANNEXURE- C



Hydrogen Sulphide Status

Timings	A		B		B1		C		D		D1		D2		E	
30/4/23	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S	CO	H_2S
1300 Hrs	–	190	–	195	80	13	–	195	–	180	42	40	44	184	15	10
1900-1800	20	0	46	0	92	12	-	15	–	–	29	15	44	18	–	17
1900-2000	0	0	80	13	20	0	17	85	46	100	296	1·5	44	17	0-20	15
2200 Hrs	100	200	15	5	20	5	30	85	22	13	25	15	25	15	20	10
0030 Hrs	50	7	40	6	14	5	12	10	15	25	5	18	5	11	7	12
0230 Hrs	30	4	12	3	9	3	7	3	30	40	7	3	7	3	7	4
0430 Hrs	5	2	2	5	6	2	0	3	10	15	0	3	0	3	0	3
~~0630 Hrs~~	~~0~~	~~4~~	~~0~~	~~4~~	~~0~~	~~4~~	~~0~~	~~4~~	~~0~~	~~5~~	~~0~~	~~4~~	~~0~~	~~4~~	~~0~~	
0630 Hrs	0	4	0	4	0	4	0	4	0	5	0	4	0	4	0	3
1055 Hrs	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	2
600 Hrs	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0

A- Turbine building roof.
B- Transformer
B_1- opposite to transformer
C- Nitco Logistic Pvt Ltd.
D- Aarti clinic
D_1- Gopal colonial
D_2- Gopal colonial
E- Punjab Emporium.

Surface level → 20/4/23 1300 Hrs to till applied caustic soda – 20-15 ppm (H_2S) After that H_2S nil in surface level.

D.L. Jakhar
Asstt. Comdt
7th NDRF

ANNEXURE- E

ਪੰਜਾਬ ਵਾਟਰ ਸਪਲਾਈ ਅਤੇ ਸੀਵਰੇਜ ਮੰਡਲ , ਲੁਧਿਆਣਾ

ਵੱਲ

ਕਾਰਜਕਾਰੀ ਇੰਜੀਨੀਅਰ,
ਜ਼ੋਨ -ਸੀ ਓਐਂਡਐਮ ਸੈੱਲ,
ਨਗਰ ਨਿਗਮ,
ਲੁਧਿਆਣਾ।

ਨੰਬਰ: 2852 ਮਿਤੀ: 18-05-2023

ਵਿਸ਼ਾ :- **Accident due to Gas Leak in a Factory in the Giaspura Area, Ludhiana Punjab on 30.04.2023 Ex-gratia from PMNRF-reg.**

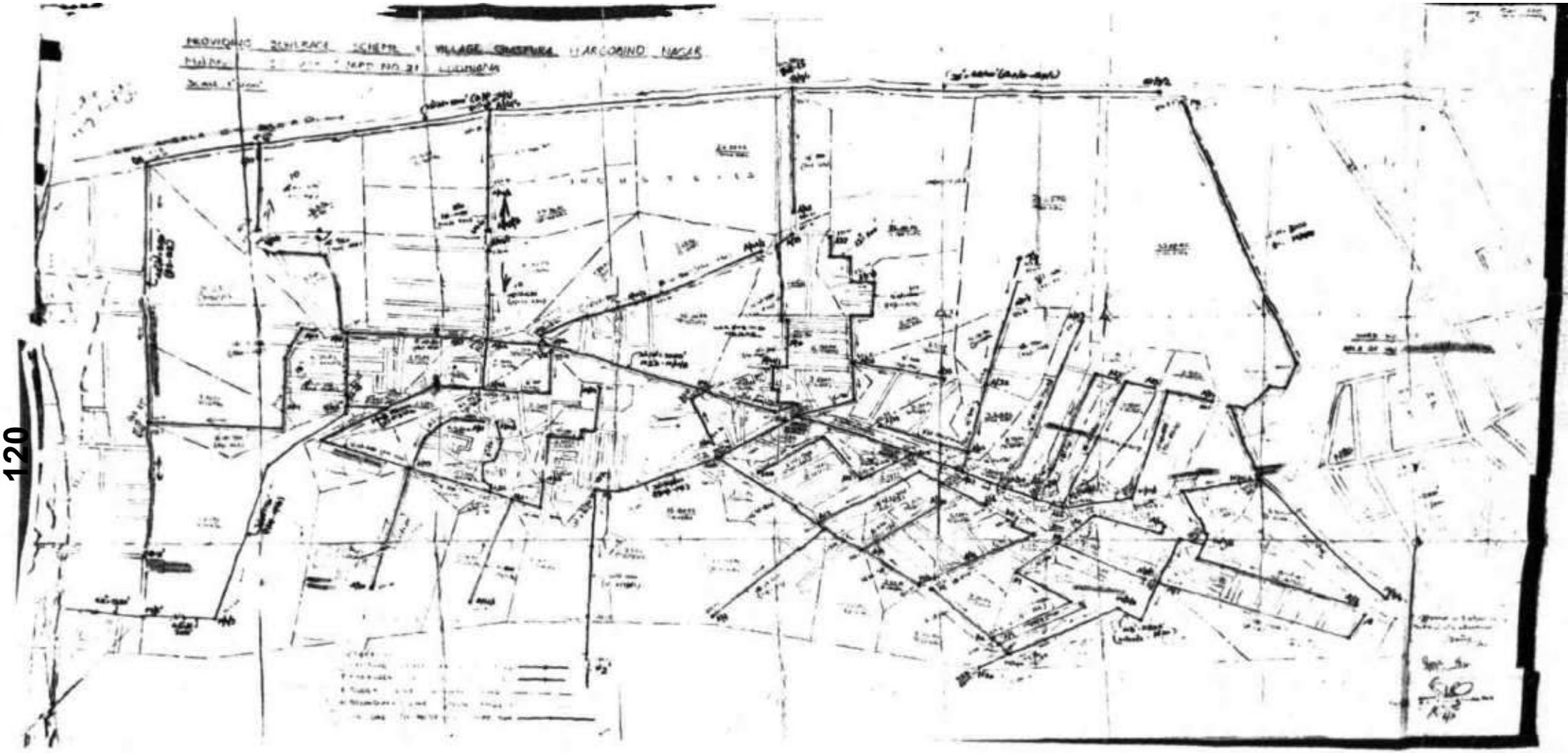
ਹਵਾਲਾ:- ਆਪ ਜੀ ਦੇ ਦਫਤਰ ਦਾ ਪੱਤਰ ਨੰ.104/XEN-C/O&M ਮਿਤੀ 18.05.2023.

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਦੇ ਸਬੰਧੀ ਹਵਾਲੇ ਅਧੀਨ ਪੱਤਰ ਰਾਹੀਂ ਆਪ ਜੀ ਵੱਲੋਂ ਮੰਗੀ ਗਈ ਸਬੰਧਤ ਏਰੀਏ ਦੀ ਅਪਰੂਵਡ ਹੋਈ ਡਿਜ਼ਾਇਨ ਸਟੇਟਮੈਂਟ ਸਮੇਤ ਡਰਾਇੰਗ ਅਨੁਸਾਰ ਮੇਨ ਸੀਵਰ ਲਾਈਨ ਨੋਡ ਨੰ. N/10/1 ਤੋ N/1 ਜਿਸ ਦਾ ਸਾਈਜ਼ 30" i/d. ਲੰਬਾਈ = 3600 ਫੁੱਟ, ਸਲੋਪ = 1/2500 , ਲਾਈਨ ਦਾ ਡਿਸਚਾਰਜ 3.56 ਕਿਊਸਿਕ, ਡਿਜ਼ਾਇਨ ਡਿਸਚਾਰਜ = 7.02 ਕਿਊਸਿਕ (ਕਾਪੀ ਨੱਥੀ)

ਉਪਰੋਕਤ ਅਨੁਸਾਰ ਮੰਗੀ ਗਈ ਸੂਚਨਾ ਆਪ ਜੀ ਦੀ ਅਗਲੀ ਯੋਗ ਕਾਰਵਾਈ ਹਿੱਤ ਹੈ ਜੀ।

ਨੱਥੀ/ ਉਕਤ ਅਨੁਸਾਰ

ਕਾਰਜਕਾਰੀ ਇੰਜੀਨੀਅਰ,
ਪੰਜਾਬ ਵਾਸ ਅਤੇ ਸੀਵਰੇਜ ਮੰਡਲ,
ਲੁਧਿਆਣਾ।
18/5/23

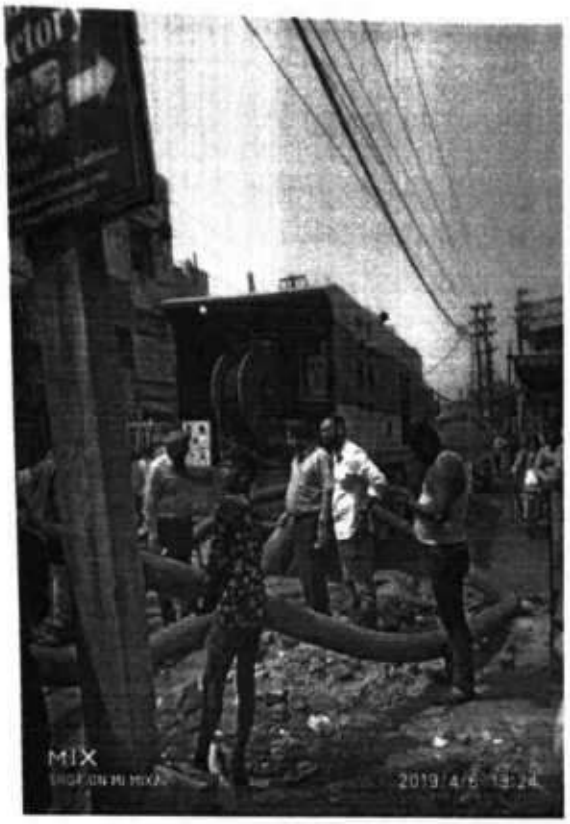


ANNEXURE- F

Detail of Ground Levels And Bed Levels as per Approved Design Statement of Giaspura Ludhiana.

Sr. No.	Name of Line	Upper G.L.	Lower G.L.	Upper B.L.	Lower B.L.	Remarks
1	A25-A26	824.31	823.00	819.50	816.97 (10") 815.72 (30")	
2	A29-A30	825.40	824.50	819.57	816.83 (10") 815.58 (30")	
3	A33-A23	822.00	823.40	816.61	816.46 (16") 815.46 (30")	
4	A21-A22	823.49	822.00	817.79	816.65 (8") 815.32 (30")	
5	A36-A38	823.10	821.67	817.65	816.65 (16") 815.14 (30")	
6	A40/1-A41	823.50	821.34	816.93	815.29 (12") 814.10 (30")	
7	A42/2-A42	823.00	823.20	817.26	815.13 (10") 813.68 (30")	

ANNEXURE- G



SUA ROAD NEAR SITARA CINEMA

CCTV AT SUA ROAD NEAR KAMAL KARYANA STORE

ANNEXURE- H
Interview of Victims

1. **Sh Gaurav Goyal (Mob 98738-84007) owner of Goyal Karyana Store**

He and his brother are running the karyana store. At the morning time of incident, he was inside the shop at ground floor and rest of the family members were upstairs in house.

He smelled a gas in the morning at 5 AM and after 7 AM it increased.

He observed breathing problem in the shop.

There was a light traffic on the road.

He tried to came out of the shop and fell unconscious at the entrance of the shop. After that he know nothing.

His brother, Bhabhi and mother came down the stairs from their house and died outside the shop having haudies on both ends of the shop.

In the previous evening on 29.04.2023 there was rain and smell was also observed at that time but it was less.

Sewer blockage is not observed in the past.

There are some chemical factories behind the incident site. The origin of gas may be due to dumping of acids/chemicals in the sewer system by some industries in this area.

2. **Sh. Sushil Verma, owner of Kundan Property Dealer adjacent to the Goyal Karyana Store.**

On the previous evening of the incident, there was rain and light smell of the gas was there. The smell was similar to sewer. Due to less smell they did not bothered.

Relatives of Goyal Karyana Store died and a woman came from opposite side of the Road and rescued an 8 months old child of the owner of Goyal Karyana Store. After half an hour that woman fell unconscious.

Immediate neighbours of Goyal Karyana Store tried to sprinkle water on the unconscious persons, but they also fell down and died.

Someone knocked the door of Doctor (owner of Aarti Clinic) for help. The Doctor came out to check the persons and felt some smell. He returned to his house and fell unconscious in front of his house cum clinic.

3. **Sh Harish Chander (Amit), dhaba owner Husband of Mrs. Rubi Devi**

He lives on 1st floor of Kundan Property Dealer.

He runs a dhabha on the other side of the Road opposite to the point of incident.

At the time of incident he was working in his dhaba and felt smell at 6:00 AM.

A lady came to Goyal Karyana Store for taking milk and started shouting that Gaurav has fell down.

To help Gaurav, he went to the Goyal Karyana Store and raised an alarm to Gaurav's mother to come down as Gaurav has fell down. Gaurav's mother, brother and Bhabhi along (with a little child) came down running from their house at first floor of Karyana Store.

Gaurav fell inside the shop near kenchi gate and his relatives fell down immediately near the entrance of the shop.

When these 04 fell down, he tried to help them. During rescue, he got a back stroke and rolled down to his dhaba. He sprinkled water on mouth and got some relief.

He again went to the shop to help. He picked up Rajesh who was unconscious, took him to Cancer Hospital by an auto.

His wife rescued the little baby of Goyal Karyana Store. When he came back from hospital, he found his wife unconscious.

The neighbours of Goyal Karyana Store also came for help, sprinkled water on the unconscious persons but they also fell down and died.

The smell was khatti (sour) and like rotten eggs.

Now his wife is fine.

On the previous evening there was rain and some smell was observed.

For his dhaba activities he brings water from some nearby place and the wastewater is thrown along the Road.

No burning activity of any waste is observed in the area. Such smell was not noticed earlier even in previous rainy seasons.

He remains in the shop from 6 AM to 9 PM. He never observed any discharge into sewer by any tanker etc. He also did not observe any disposal of solid waste in the sewer.

He is living in the area for the last eight years and he has not noticed such smell or overflowing of sewer.

4. **Sh Rajesh Kumar, owner of dhaba, opposite the point of incidents Husband of Mrs. Kavita Devi**

He is living in the area for the last ten years.

He opened the dhaba at 6 AM and was working with his wife and children.

The incident happened at around 6:30 AM or 7:00 AM.

A lady came to Goyal Karyana Store for taking milk and started shouting that Gaurav has been fell down.

He went to rescue Gaurav but could not lift him up. He raised an alarm.

Gaurav's mother came down first, brother (Sourav) and then his Bhabhi (with a little child) came down running from their house at first floor of Karyana Store. All fell down near the entrance of the shop.

He felt light smell but no problem was to him. He picked up the child and gave to his wife. He continues to help the victims and he fell down unconscious near gutter, immediately. He got conscious in the Cancer Hospital after 8 hours.

On his dhaba side, he did not feel any smell.

Waste water of dhaba is thrown along the road sides.

Earlier he never noticed such smell.

He never observed any tanker etc discharging effluent into sewer.

In this area, sewer cleaning was done about 7-8 months back only. 4-5 vehicles came for cleaning of the sewer.

5. **Sh Davinder Yadav**

He lives in the area from last 28-30 years.

He is friend of doctor (Aarti Clinic). By habit he drinks alcohol.

He made a telephone call to doctor at around 7:20 AM. But he did not pick the call up.

Then he went to the clinic and observed that the doctor with his family members (total 5 members) fell down on the floor.

He informed that he saw in the video that doctor first came to Goyal Karyana Store then came back in his clinic.

During rescuing with mouth cover, he started facing weakness and shivering and came back after two hours.

He observed small air bubble (Jhag) in the mouth of small child. He also observed some blood in nose of the child.

6. **Sh Jatinder Rai**

He sells pan, bidi etc.

When the incident happened, he was in bathroom.

He has not seen the incident.

7. **Sh Shambu Narain, Uncle of owner of the Aarti Clinic**

He lives in Jamalpur.

He received a phone call at 7:30 AM from nearby residents about the incident.

He reached the site and observed that all the five family members were lying on floor inside the clinic at around 8:00 AM.

One milkman known to doctor tried to pull the doctor outside the clinic but he felt smell / unconscious and ran away from the site.

When he reached the site Ambulance was available on site. They were helping the victims.

Being family members, his mind was not working at that time.

He also felt headache.

When he went inside the house. He also felt smell. No water was in latrin / haudies of the house.

His nephew (Doctor) sleep in clinic and rest of the family sleeps upstairs.

Up stair residence is open. If family members did not come down stair then nothing would happen to them.

ANNEXURE- I

ਦਫ਼ਤਰ ਡਿਪਟੀ ਕਮਿਸ਼ਨਰ - ਕਮ - ਜ਼ਿਲ੍ਹਾ ਮੈਜਿਸਟਰੇਟ, ਲੁਧਿਆਣਾ

OFFICE OF THE DEPUTY COMMISSIONER – CUM - DISTRICT MAGISTRATE, LUDHIANA

ORDER:

Immediately after the gas leak incident was reported at around 7:30AM on 30.04.2023, senior officials of District Administration, Police Commissionerate, Municipal Corporation (MC), Ludhiana, medical teams and forensic experts, as well as the 13th NDRF battalion stationed at Ladowal, Ludhiana and 7th Battalion, NDRF stationed at Bathinda rushed to the spot. The affected area was evacuated and cordoned off.

1. The NDRF teams began taking readings in the affected area with the help of hand-held gas detectors, especially near the seven (07) manholes from 1pm onwards on 30.04.2023 (Sunday). At 1pm on 30.04.2023, the level of H_2S at surface of one of the manhole was 15 ppm. While the reading of H_2S on the surface was between 10-15 ppm, it varied between 100-200 ppm inside the manholes. Subsequently, on the advice of Dr. Anjan Ray, former Director, Indian Institute of Petroleum (IIP) and an expert, the decontamination of the area with diluted caustic soda was started in the evening of 30.04.2023. NDRF teams informed that, on 01.05.2023, from 4AM till 4PM, readings were taken. As per the latest reading taken by NDRF at 4PM, the level of H_2S inside the one (01) manhole near Aarti Clinic, Giaspura, was 2 PPM, while CO level was Zero. Inside the other remaining six (06) manholes, both the H_2S and CO was Zero. As per the report of NDRF, after this, the H_2S levels in the ambient air were recorded as Zero.

2. Keeping in view that the levels of H_2S and CO have fallen to Zero in six (06) manholes and 2 PPM in the 7th manhole at 4PM on 01.05.2023, an Order constituting three (03)-member Technical Committee comprising of XEN, Water Supply & Sanitation (WSS), Ludhiana; XEN, PWSSB, Ludhiana, and XEN (O&M Cell), MC, Ludhiana was issued vide this Office Endst. No. 5362-5366/MA dated 01.05.2023. This Committee was entrusted with the task of physically checking the area still cordoned off by the Police i.e. 25 metre radius from the affected area for other factors affecting the safety of residents, give suggestions, if any, to ensure the safety of public, and submit its report thereof to ADC, Khanna by 01.05.2023.

Pursuant to the issuance of the above Order, the Committee officials visited the affected area on 01.05.2023 and inspected the three (03) buildings where the incident had happened on 30.04.2023. The Committee, in its report submitted on 01.05.2023, observed that these buildings have very less or no provision of cross-ventilation. The washrooms neither have vent pipes nor exhaust fans. One drainage vent was found inside the residential room of the building of Aarti Clinic, which should not have been there. Furthermore, these buildings are very congested. In view of the above observations, the Committee made the following suggestions to prevent occurrence of such an incident in the future:

(i). The buildings should have provision for proper cross-ventilation so that there is no possibility of any suffocation.

(ii). Washrooms should have exhaust fans and vent pipes so that the gases may be discharged.

(iii). With regard to the main sewer, the Committee suggested that all the manholes in the affected area should be provided with road gulleys or vent shafts so that the sewer gases, which are formed inside the sewer pipes, are discharged via these road gulleys or vent pipes.

3. A report as to the law and order situation in the affected area was taken from the Office of Commissioner of Police, Ludhiana. ADCP (South), Ludhiana, in its report to this Office sent vide No. 309/5A/ADCP South Ludhiana dated 02.05.2023, has reported that an FIR No. 112 dated 30.04.2023 u/s 304 of IPC was registered at PS Sahnewal. Investigation in the case is ongoing and all possible angles are being probed. The situation in the area is peaceful.

Keeping in view the NDRF Report as per which the H_2S levels in the ambient air were recorded as Zero at 4PM on 01.05.2023 and the report of the police today mentioning that the law & order situation in the affected area as peaceful, the cordon is, hereby, ordered to be removed in the affected area in Giaspura, Ludhiana with directions to the Municipal Corporation (MC), Ludhiana to carry out the tasks required for implementing the suggestions made by the three (03)-member Technical Committee detailed at Para 2 (iii) above.

Furthermore, the residents of the area are advised to carry out the tasks suggested by the Technical Committee at para 2 (i) and 2 (ii) before occupying their houses.

O/C Deputy Commissioner,
Ludhiana

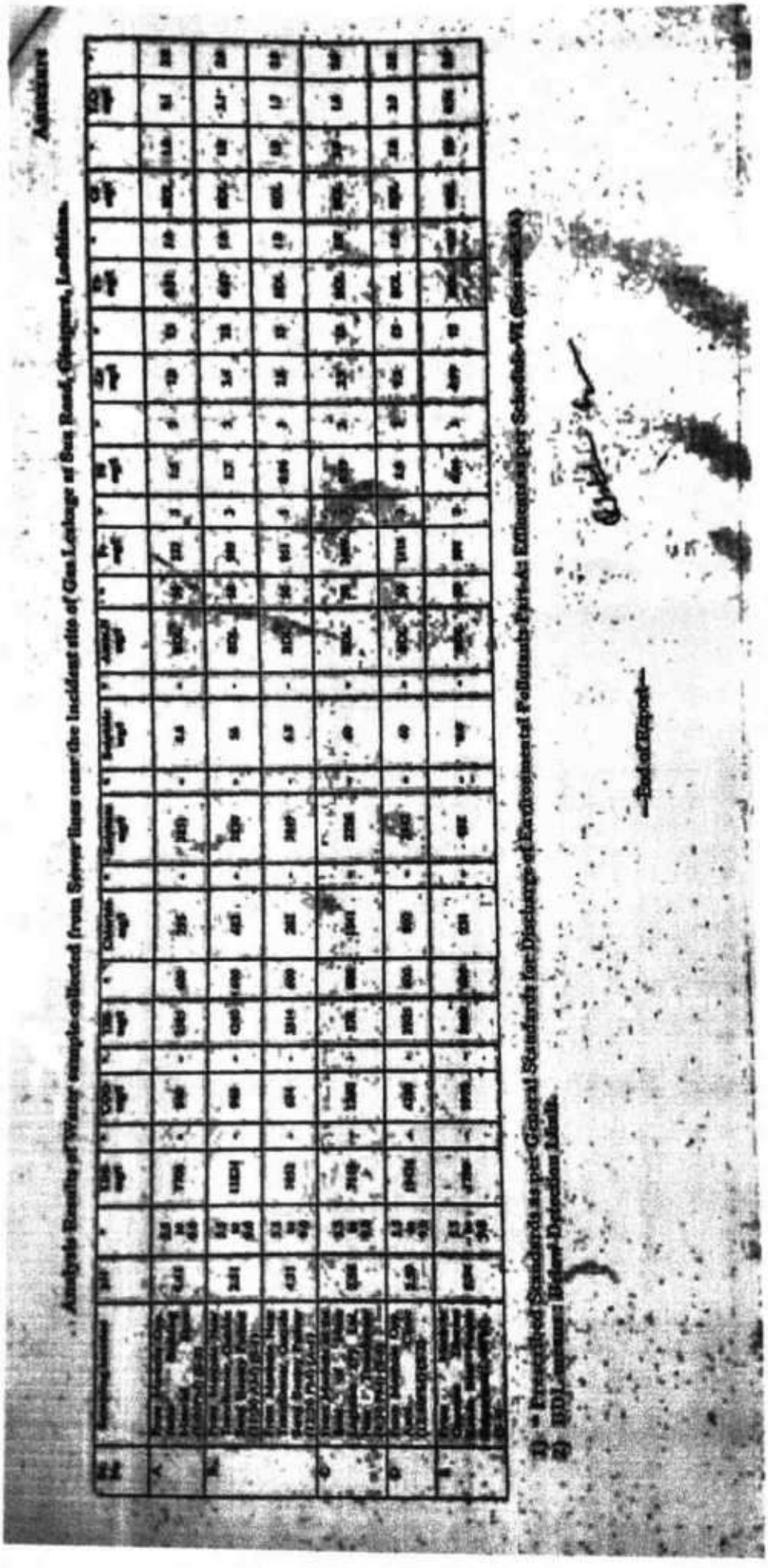
Endst. No. 5367 - 5371 / MA, Dated: 02.05.2023

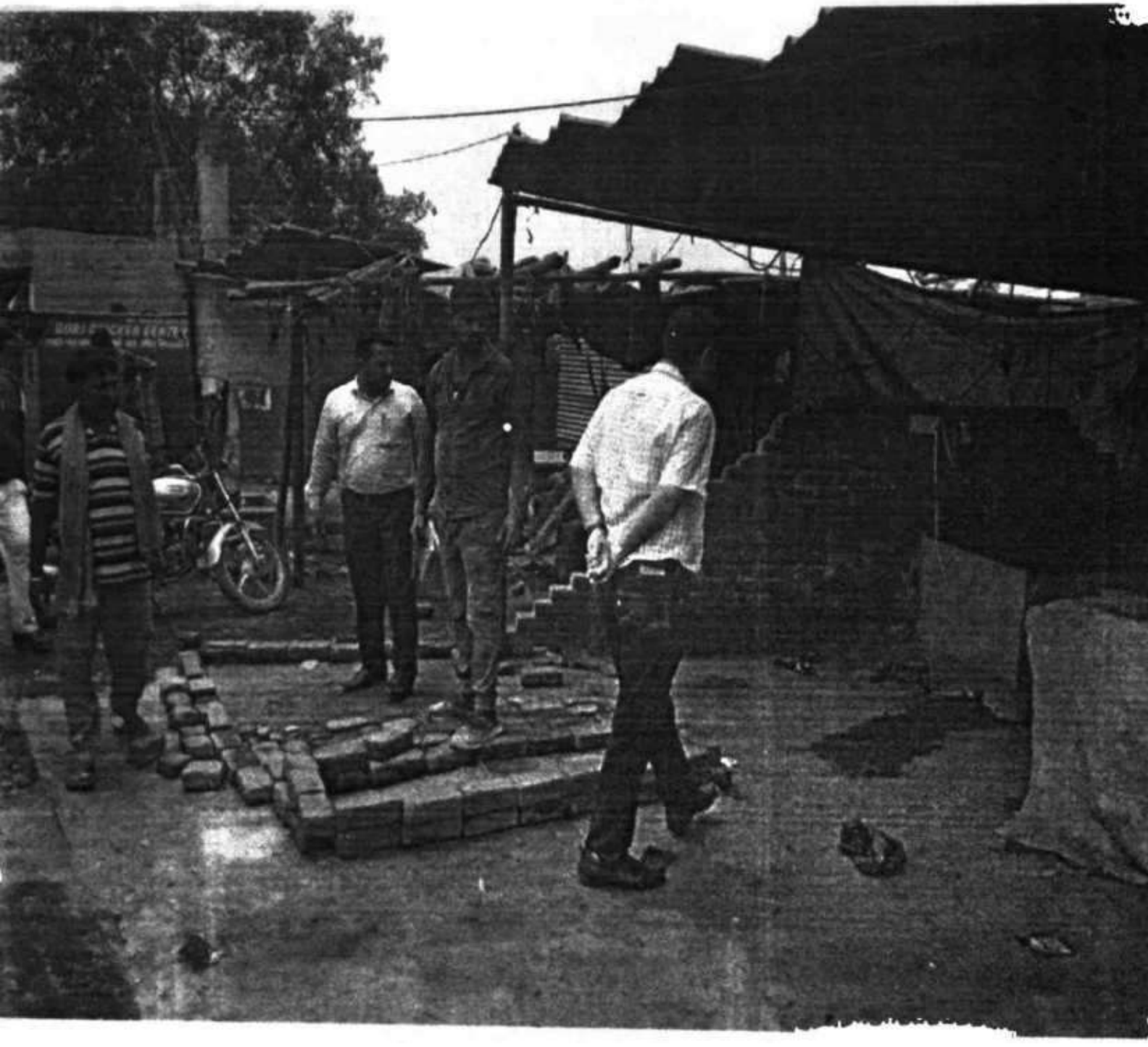
A copy of the above is forwarded to the following for information and necessary action:

1. Commissioner of Police, Ludhiana
2. Commissioner, Municipal Corporation (MC), Ludhiana - for information, and with a request that Building Inspectors may kindly be directed to liaise with the residents of the affected area for implementation of the suggestions of the Technical Committee, as detailed at Para 2 (i) and 2 (ii) above.
3. Civil Surgeon, Ludhiana
4. ADC, Khanna
5. SDM, Ludhiana (West)

O/C Deputy Commissioner,
Ludhiana

ANNEXURE- J





ANNEXURE- L

Sr. No.	Parameter	Units	Sample Test Report (from Punjab Biotechnology Incubator Lab, Mohali) Locations					
			M/H OPP. Sitara Cinema (Sea Road)	M/H of main sea road opp.St.no.4	M/H of main sea road opp.St.no.5	M/H of St.no.4 (Sample) gali	A.T. wires (sea road)	GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS IN PUBLIC SEWER AS PER THE ENVIRONMENT (PROTECTION)RULES, 1986
1	Nickel (as Ni)	mg/l	1.29	0.06	0.18	0.02	BDL(MDL0.01)	3.00
2	Zinc (as Zn)	mg/l	4.46	0.12	0.26	0.12	0.01	15.00
3	Copper (as Cu)	mg/l	0.28	0.02	0.04	0.02	BDL(MDL0.01)	3.00
4	Lead (as Pb)	mg/l	0.03	0.02	0.03	BDL(MDL0.01)	BDL(MDL0.01)	1.00
5	Chromium (as Cr)	mg/l	3.73	0.14	0.63	BDL(MDL0.01)	BDL(MDL0.01)	2.00
6	Iron (as Fe)	mg/l	0.31%	718	899	4.9	4.3	3.00
7	Silver (as Ag)	mg/l	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	-
8	Arsenic (As)	mg/l	0.05	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	0.20
9	Mercury (as Hg)	mg/l	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	0.01
10	Cadmium (Cd)	mg/l	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	1.00
11	Uranium	mg/l	0.04	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	-
12	Selenium (as Se)	mg/l	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	0.05
13	Tin (as Sn)	mg/l	0.03	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	BDL(MDL0.01)	-
14	Aluminium (as Al)	mg/l	20.2	0.88	2.04	0.56	0.31	-

BDL:Below Detection Limit MDL:Method Detection Limit

Sample Registration No. : PBTI/ENV/010523/000062

Sample code given by customer : Gaa of Personal Haudi of Goyal Cold Drinks

Test Results

S.No.	Parameter	Results	Units	Standard / Specification / Method Followed
1	Nickel (as Ni)	21.63	mg/kg	AOAC 990.08
2	Zinc (as Zn)	196	mg/kg	AOAC 990.08
3	Copper (as Cu)	28.26	mg/kg	AOAC 990.08
4	Lead (as Pb)	13.82	mg/kg	AOAC 990.08
5	Chromium (as Cr)	20.97	mg/kg	AOAC 990.08
6	Iron (as Fe)	1.3	%	AOAC 990.08
7	Silver (as Ag)	BDL(MDL 0.5)	mg/kg	AOAC 990.08
8	Arsenic (As)	2.6	mg/kg	AOAC 990.08
9	Mercury (as Hg)	BDL(MDL 0.1)	mg/kg	AOAC 990.08
10	Cadmium (as Cd)	BDL(MDL 0.5)	mg/kg	AOAC 990.08
11	Uranium	1.34	mg/kg	AOAC 990.08
12	Selenium (as Se)	BDL(MDL 0.5)	mg/kg	AOAC 990.08
13	Tin (as Sn)	BDL(MDL 0.5)	mg/kg	AOAC 990.08
14	Aluminium (as Al)	0.42	%	AOAC 990.08

BDL:Below Detection Limit MDL:Method Detection Limit

10/5/2023

Authorized Signatory

Punjab Biotechnology Incubator Lab

Report on Ludhiana gas poisoning accident

A gas poisoning accident that occurred on the morning of 30.04.2023 at Giaspura area in Ludhiana city, in which eleven persons died instantly was covered by TV news and reported in national dailies the next day.

In view of the above, a team of CPCB officers visited Ludhiana on 03.05.2023, interacted with the officers of Punjab Pollution Control Board , and also visited the site of accident at Giaspura, Ludhiana.

As per various media reports regarding observations of various agencies involved in investigations immediately after the accident and the discussions held by CPCB team with the Chief Environmental Engineer of PPCB, the cause of deaths has been linked to release of sewer gas through the manholes in the connecting branch sewers at two places and exposure of the eleven deceased persons to **H_2S** in very high concentration, leading to their immediate collapse and death.

At the accident site, it was observed that there are branch sewer lines / sewer connections from the two nearby houses where the deaths occurred that join the main sewer line that runs below the main road in front of these houses. The analysis report of the main sewer water collected by PPCBfew hours after the accident from the manhole near the point of accident indicated pH of the sewer as highly acidic and ranging between 2.5 and 2.6. It was also reported that main sewer line near the point where this incident happened was found filled/chocked.

Presence of sulphide in sewer water as **H_2S** is due to biochemical reduction of the sulphate present in water. The ratio of Sulphur (S), Hydrosulphide (HS) and H_2S in sewer water at any point of time depends on the pH of sewer water at that time. Intermittent discharge of acidic effluents from industries in mixed sewers acts as an agent for shifting the equilibrium. Acidic effluents are also a source of sulphate (due to sulphuric acid), which ultimately forms sulphide.

Further, if industrial effluents containing metals and heavy metals are discharged in the sewers, the metals are precipitated as metal sulphides in the sewer lines. These metal sulphides, in the presence of acids/acid effluents containing H_2SO_4 and/or HCl, end up generating hydrogen sulphide (H2S) gas.

Therefore, it can be concluded that intermittent discharge of acidic and metallic industrial effluent/waste into mixed sewers can be a source of sudden release of **H_2S** gas in very high concentration from such sewers.

It is relevant to mention that H_2S is a diprotic weak acid and even a saturated solution of H_2S is not expected to have a pH less than 4.0. Therefore, it may be concluded that pH level of 2.5-2.6 as reported in main sewer water near the houses where deaths occurred is a result of acidic industrial effluent discharge.

The above facts strongly point towards the discharge of industrial effluent as the cause of highly acidic water in the main sewer in the area and the also the cause of release of **H_2S** in the sewer line in high concentration, leading to immediate collapse and death of eleven persons.

As per recent media reports and the discussion held with Chief Environmental Engineer, PPCB, the industries in Ludhiana use both Hydrochloric acid and Sulphuric acid. It was also reported that few industries in Giaspura area have acid pickling step in their manufacturing process. The chloride content in the main sewer water near the accident was found higher in comparison to distant points (both upstream and downstream) which may be due to use of hydrochloric acid in the area. These facts also indicate that industrial discharge is a key factor in releasing of H_2S in high concentrations.

The details of sewer network of Giaspura area were not available with officers of Municipal Corporation, who were present at the site during the visit. All the industries located along the sewer network are required to be surveyed by local authorities to identify the possible sources of acidic and metals, heavy metals and sulphide containing industrial effluent/waste.

Further, Hon'ble National Green Tribunal, Principal Bench has constituted a Joint Committee with members from various agencies including CPCB to investigate the matter, arrive at a conclusion and take remedial measures to prevent such accidents in future.

G. Rambabu, Scientist 'D'

Kamlesh Singh, Scientist 'E'

Dr. Narender Sharma, Scientist 'E'

Nazimuddin, Scientist 'F'

ANNEXURE- N

Gmail

Municipal Corporation <adcmcl3@gmail.com>

Fwd: Ludhiana Gas Leak - preliminary findings and recommendations

2 messages

commissioner corporation ludhiana <commissionermcl@gmail.com> Mon, May 1, 2023 at 4:59 PM
To: Municipal Corporation <adcmcl3@gmail.com>

---------- Forwarded message ---------
From: **Dr. Anjan Ray** <anjan.ray@iip.res.in>
Date: Mon, May 1, 2023, 12:01 AM
Subject: Ludhiana Gas Leak - preliminary findings and recommendations
To: <commissionermcl@gmail.com>
Cc: Anjan Ray <director@iip.res.in>, S. Anantha Ramakrishna <anantha@csio.res.in>, Kamal Kishore <kkishore@ndma.gov.in>

Dr Shena Aggarwal
Ludhiana MC Commissioner

Dear Dr Aggarwal

In continuation of our discussions through the day today in the aftermath of the Ludhiana Gas Leak, I have summarised my initial hypotheses and recommendations for consideration of the local administration and of NDMA as follows:

1. Evidence from the medical examiner and his preliminary forensic assessment suggest that the gas released contained hydrogen sulphide (H2S) as a primary causal agent. This correlates with the foul smell noted by some affected residents and the symptoms outlined by the medical specialist.

2. We cannot rule out carbon monoxide as a secondary causal agent. CO is colourless and is often found in sewer gas compositions. An authoritative recent review of sewer gas compositions can be found at https://www.sciencedirect.com/science/article/pii/S2772416622000808

3. Based on the hypothesis that H2S is the primary causal agent, a frontline response of neutralising the H2S with appropriately diluted caustic soda has been advised. This appears to be working based on feedback from the team on the ground, as ambient H2S levels have fallen sharply after the caustic treatment.

4. It may be noted that sudden acidification of sewer contents (for instance, through shock discharge of acidic effluent from any electroplating unit in the area) could cause a surge in H2S levels. To determine if this might have been the cause, ICP analysis of trace elements and metals in the sewage samples may be carried out.

5. Unlike H2S, there is no way as such of neutralising CO. However, its vapour density (~14) is close to that of air (~14.7) and it should disperse naturally at a rate quicker than H2S (V.D ~ 17), which is heavier than air.

6. H2S readings will therefore vary across a vertical axis at ground level, 1.5 feet above ground (typical level of a person lying on a bed), and at 4.5 feet above ground (typical nostril level of a standing person), with the maximum concentration of the toxic gas being at the ground level. While CO will not show much variation.

I remain at your service for additional questions, if any.

Warm regards
Anjan

ANNEXURE- O

IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Arsenic, Metals, Fibres and Dusts. Lyon (FR): International Agency for Research on Cancer; 2012. (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 100C.)

NICKEL AND NICKEL COMPOUNDS

Nickel and nickel compounds were considered by previous IARC Working Groups in 1972, 1975, 1979, 1982, 1987, and 1989 (IARC, 1973, 1976, 1979, 1982, 1987, 1990). Since that time, new data have become available, these have been incorporated in the *Monograph*, and taken into consideration in the present evaluation.

1. Exposure Data

1.1. Identification of the agents

Synonyms, trade names, and molecular formulae for nickel, nickel alloys, and selected nickel compounds are presented in Table 1.1. This list is not exhaustive, nor does it necessarily reflect the commercial importance of the various nickel-containing substances, but it is indicative of the range of nickel alloys and compounds available, including some compounds that are important commercially, and those that have been tested in biological systems. Several intermediary compounds occur in refineries that cannot be characterized, and are thus not listed.

Table 1.1

Chemical names (CAS names are given in italics), synonyms, and molecular formulae or compositions of nickel, nickel alloys and selected nickel compounds.

1.2. Chemical and physical properties of the agents

Nickel (atomic number, 28; atomic weight, 58.69) is a metal, which belongs to group VIIIB of the periodic table. The most important oxidation state of nickel is +2, although the +3 and +4 oxidation states are also known (Tundermann *et al*., 2005). Nickel resembles iron, cobalt, and copper in its chemical properties. However, unlike cobalt and iron, it is normally only stable in aqueous solution in the + 2 oxidation state (Kerfoot, 2002). Selected chemical and physical properties for nickel and nickel compounds, including solubility data, were presented in the previous *IARC Monograph* (IARC, 1990), and have been reported elsewhere (ATSDR, 2005).

1.3. Use of the agents

The chemical properties of nickel (i.e. hardness, high melting point, ductility, malleability, somewhat ferromagnetic, fair conductor of heat and electricity) make it suitable to be combined with other elements to form many alloys (NTP, 2000; Tundermann *et al*., 2005). It imparts such desirable properties as corrosion resistance, heat resistance, hardness, and strength.

Nickel salts are used in electroplating, ceramics, pigments, and as intermediates (e.g. catalysts, formation of other nickel compounds). Sinter nickel oxide is used in nickel catalysts in the ceramics industry, in the manufacture of alloy steel and stainless steel, in the manufacture of nickel salts for specialty ceramics, and in the manufacture of nickel–cadmium (Ni–Cd) batteries, and nickel–metal-hydride batteries. Nickel sulfide is used as a catalyst in the petrochemical industry or as an intermediate in the metallurgical industry.

According to the US Geological Survey, world use of primary nickel in 2006 was 1.40 million tonnes, a 12% increase over 2005. Stainless steel manufacture accounted for more than 60% of primary nickel consumption in 2006 (USGS, 2008). Of the 231000 tonnes of primary nickel

consumed in the USA in 2007, approximately 52% was used in stainless and alloy steel production, 34% in non-ferrous alloys and superalloys, 10% in electroplating, and 4% in other uses. End uses of nickel in the USA in 2007 were as follows: transportation, 30%; chemical industry, 15%; electrical equipment, 10%; construction, 9%; fabricated metal products, 8%; household appliances, 8%; petroleum industry, 7%; machinery, 6%; and others, 7% (Kuck, 2008).

1.3.1. Metallic nickel and nickel alloys

Pure nickel metal is used to prepare nickel alloys (including steels). It is used as such for plating, electroforming, coinage, electrical components, tanks, catalysts, battery plates, sintered components, magnets, and welding rods. Ferronickel is used to prepare steels. Stainless and heat-resistant steels accounted for 93% of its end-use in 1986. Nickel-containing steels with low nickel content (< 5%) are used in construction and tool fabrication. Stainless steels are used in general engineering equipment, chemical equipment, domestic applications, hospital equipment, food processing, architectural panels and fasteners, pollution-control equipment, cryogenic uses, automotive parts, and engine components (IARC, 1990).

Nickel alloys are often divided into categories depending on the primary metal with which they are alloyed (e.g. iron, copper, molybdenum, chromium) and their nickel content. Nickel is alloyed with iron to produce alloy steels (containing 0.3–5% nickel), stainless steels (containing as much as 25–30% nickel, although 8–10% nickel is more typical), and cast irons. Nickel–copper alloys (e.g. Monel alloys) are used for coinage (25% nickel, 75% copper), industrial plumbing (e.g. piping and valves), marine equipment, petrochemical equipment, heat exchangers, condenser tubes, pumps, electrodes for welding, architectural trim, thermocouples, desalination plants, ship propellers, etc. Nickel–chromium alloys (e.g. Nichrome) are used in many applications that require resistance to high temperatures such as heating elements, furnaces, jet engine parts, and reaction vessels. Molybdenum-containing nickel alloys and nickel–iron–chromium alloys (e.g. Inconel) provide strength and corrosion resistance over a wide temperature range, and are used in nuclear and fossil-fuel steam generators, food-processing equipment, and chemical-processing and heat-treating equipment. Hastelloy alloys (which contain nickel, chromium, iron, and molybdenum) provide oxidation and corrosion resistance for use with acids and salts. Nickel-based super-alloys provide high-temperature strength and creep, and stress resistance for use in gas-turbine engines (ATSDR, 2005).

Other groups of nickel alloys are used according to their specific properties for acid-resistant equipment, heating elements for furnaces, low-expansion alloys, cryogenic uses, storage of liquefied gases, high-magnetic-permeability alloys, and surgical implant prostheses.

1.3.2. Nickel oxides and hydroxides

The nickel oxide sinters are used in the manufacture of alloy steels and stainless steels.

Green nickel oxide is a finely divided, relatively pure form of nickel monoxide, produced by firing a mixture of nickel powder and water in air at 1000 °C (IARC, 1990). It is used to manufacture nickel catalysts and specialty ceramics (for porcelain enamelling of steel; in the manufacture of magnetic nickel-zinc ferrites used in electric motors, antennas and television tube yokes; and as a colourant in glass and ceramic stains used in ceramic tiles, dishes, pottery, and sanitary ware).

Black nickel oxide is a finely divided, pure nickel monoxide, produced by calcination of nickel hydroxycarbonate or nickel nitrate at 600 °C; nickel trioxide (Ni_2O_3), an unstable oxide of nickel, may also be called 'black nickel oxide' (IARC, 1990). Black nickel oxide is used in the manufacture of nickel salts, specialty ceramics, and nickel catalysts (e.g. to enhance the activity of three-way catalysts containing rhodium, platinum, and palladium used in automobile exhaust control).

Nickel hydroxide is used as a catalyst intermediate, and in the manufacture of Ni–Cd batteries (Antonsen & Meshri, 2005).

1.3.3. Nickel sulfides

Nickel sulfide is used as a catalyst in petrochemical hydrogenation when high concentrations of sulfur are present in the distillates. The major use of nickel monosulfide is as an intermediate in the hydrometallurgical processing of silicate-oxide nickel ores (IARC, 1990). Nickel subsulfide is used as an intermediate in the primary nickel industry (ATSDR, 2005).

1.3.4. Nickel salts

Nickel acetate is used in electroplating, as an intermediate (e.g. as catalysts and in the formation of other nickel compounds), as a dye mordant, and as a sealer for anodized aluminium.

Nickel carbonate is used in the manufacture of nickel catalysts, pigments, and other nickel compounds (e.g. nickel oxide, nickel powder); in the preparation of coloured glass; and, as a neutralizing compound in nickel-electroplating solutions.

Nickel ammonium sulfate is used as a dye mordant, in metal-finishing compositions, and as an electrolyte for electroplating.

Nickel chloride is used as an intermediate in the manufacture of nickel catalysts, and to absorb ammonia in industrial gas masks.

Nickel nitrate hexahydrate is used as an intermediate in the manufacture of nickel catalysts and Ni–Cd batteries.

Nickel sulfate hexahydrate is used in nickel electroplating and nickel electrorefining, in 'electroless' nickel plating, and as an intermediate (in the manufacture of other nickel chemicals and catalysts) (Antonsen & Meshri, 2005).

1.3.5. Other nickel compounds

The primary use for nickel carbonyl is as an intermediate (in the production of highly pure nickel), as a catalyst in chemical synthesis, as a reactant in carbonylation reactions, in the vapour-plating of nickel, and in the fabrication of nickel and nickel alloy components and shapes.

Nickelocene is used as a catalyst and complexing agent, and nickel titanate is used as a pigment (Antonsen & Meshri, 2005).

No information was available to the Working Group on the use of nickel selenides or potassium nickelocyanate.

1.4. Environmental occurrence

Nickel and its compounds are naturally present in the earth's crust, and are emitted to the atmosphere via natural sources (such as windblown dust, volcanic eruptions, vegetation forest fires, and meteoric dust) as well as from anthropogenic activities (e.g. mining, smelting, refining, manufacture of stainless steel and other nickel-containing alloys, fossil fuel combustion, and waste incineration). Estimates for the emission of nickel into the atmosphere from natural sources range from 8.5 million kg/year in the 1980s to 30 million kg/year in the early 1990s (ATSDR, 2005). The general population is exposed to low levels of nickel in ambient air, water, food, and through tobacco consumption.

1.4.1. Natural occurrence

Nickel is widely distributed in nature and is found in animals, plants, and soil (EVM, 2002). It is the 24th most abundant element, forming about 0.008% of the earth's crust (0.01% in igneous

Annexure – A1

PUNJAB POLLUTION CONTROL BOARD

Zonal Office-1, E-648-B, Phase-V, Focal Point, Ludhiana

Tele Fax:- 0161-4673789 Website:- www.ppcb.gov.in email:- ppcbzo1ldh@gmail.com

No. 1849 **Email** **Dated** 4/5/23.

To

The SDM (West),
Ludhiana.

Subject: **Regarding mishappening on 30.04.2023 due to gas leakage at Guru Teg Bahadur Nagar, Sua Road, Near Indra Colony, Giaspura, Ludhiana.**

Reference: **Your Office letter no. 1/Special dated 01.05.2023.**

In reference to the above, please find enclosed herewith a copy of interim report in the matter.

DA/as above

Senior Environmental Engineer

Endst No..... **Dated.....**

A copy of the above to the following for information, please:

1. The Chief Environmental Engineer, Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-2, Ludhiana.

DA/as above

sd/-

Senior Environmental Engineer

Subject:- Interim report of Punjab Pollution Control Board in the matter of leakage of gas at Guru Teg Bahadur Nagar, Sua Road, Near Indira Colony, Giaspura Ludhiana on 30.04.2023.

It is intimated that an incidence of leakage of gas was observed from sewer line at Guru Teg Bahadur Nagar, Sua Road, Near Indira Colony, Giaspura Ludhiana on 30.04.2023. A call from District Administration was received to the Environmental Engineer, Regional Office-2, Ludhiana morning on 30.04.2023 at around 08:40 am. Accordingly, the scientific and technical teams of PPCB reached the site of gas leakage immediately and thereafter, as per directions of ADC (G), Ludhiana; the effluent samples of the sewage at upstream and downstream of the incident point were collected to identify initially and promptly the nature of gas for carrying out rescue operations. These samples were sent to PPCB Lab for analysis. A copy of the part results received so far is attached for ready reference as per **Annexure-1**.

2. The area was cordoned off by the National Disaster Response Force (NDRF) team and District Administration on 30.04.2023 and the electric connection of the entire area was also disconnected. The preliminary investigation / survey of the area around the site of incident could not be carried out to identify as to whether any industrial untreated effluent has been discharged to identify the culprits as all the industries of the area were lying closed being Sunday. Meanwhile, after analysis through high-tech scanners by the NDRF teams; District Administration had confirmed that the incident has occurred due to the release of H_2S gas from sewer line.

3. Deputy Commissioner, Ludhiana vide its letter dated 30.04.2023 has ordered for conducting **Multi Sectoral Inquiry** into the incident of gas leakage with following members:

(i) Ms. Swati Tiwana, SDM (West), Ludhiana
(ii) Mr. Kulpreet Singh, PCS, Joint Commissioner, MC, Ludhiana.
(iii) Mr. Vaibhav Sehgal, PPS, ACP, Ludhiana
(iv) Er. R.K. Ratra, SEE, PPCB, Ludhiana
(v) Er. Paramjeet Singh, SEE, PPCB, Ludhiana
(vi) Mr. Gaurav Puri, Deputy Director of Factories, Ludhiana

4. During discussions with the Police Authorities, it was informed that CCTV cameras of the area were scanned, and no suspicious activity was observed near the incident area discharging any effluent / chemical etc. directly into sewer. At around 09:00 PM, the SDM (West) directed that a joint survey of the area be conducted around the place of incidence to identify the culprit by the officers of Punjab Pollution Control Board along with officers of Municipal Corporation Ludhiana and Deputy Director of Factories to check the discharge of any chemical effluent from nearby industries in the sewer.

5. Accordingly, on 01.05.2023, the officers from Punjab Pollution Control Board from offices at Ludhiana, Amritsar, Batala, Hoshiarpur & Fatehgarh Sahib were deputed for inspections and the teams of technical and scientific officers of PPCB headed by Environmental Engineers were constituted. A detailed survey of the upstream and downstream of the point of incident was jointly conducted by teams of PPCB and MCL. The

teams prepared their joint inspection reports at each and every industry. Photography and videography was got conducted. The joint teams certified that they have scanned the area physically and no industry was found discharging acidic effluent into MC sewer during the visits. In the first phase, the area was surveyed in a phased manner i.e. upto 50 mtr upstream & downstream from the point of incidence, upto 50-100 mtr upstream & downstream and then upto 500 mtr on upstream & upto 200 mtr on downstream of point of incidence. During visits, the teams also collected the sewage samples from different locations and sent to Boards lab for analysis. The abstract of visits is as under:

Total no. of industries visited	Distance from point of incidence					
	Upstream & downstream Upto 50 mtr		Upstream & downstream 50-100 mtr		Upstream upto 500 mtr & downstream upto 200 mtr	
	Total water polluting industries found	Pickling / electroplating etc. industries	Total water polluting industries found	Pickling / electroplating etc. industries	Total water polluting industries found	Pickling / electroplating etc. industries
113	0	0	2	0	15	14

Out of the total 113 industries, 17 were found water polluting by the joint team. Out of these 17 industries, 4 industries were at the downstream of the incident. out of which, 3 were acid consuming. 13 water polluting industries were found at the upstream out of which 11 were acid consuming. None of these 13 industries was observed to be discharging any acidic effluent into sewer line by the joint team of PPCB / MCL. **It is pertinent to mention here that no acid consuming industry was found within 100 mtr distance from the place of incident. Samples from 10 locations were collected to check any contamination due to discharge of any effluent or any other chemical into public sewer, which are under analysis. Table showing detail of visits conducted by the teams is enclosed as Annexure-2. During survey, some premises were found closed and further joint survey of the area with Municipal Corporation, Ludhiana is under progress.**

6. The analysis of sample collected on 01.05.2023 by joint teams of PPCB and MCL are still under analysis at Central Lab of PPCB, Head Office, Patiala. There may be many other factors which could be the cause of formation of H_2S at that particular location, where accident has happened.

7. Initial discussions with experts revealed that the said accident might have occurred due to high concentration of hydrogen sulphide and carbon monoxide dissipated due to blockage of sewer line. This choking of sewer line could lead to heavy accumulation of organic matter which eventually lead to Bio-chemical degradation with more H2S formation. Further, the anaerobic digestion occurring due to sewer blockage may lead to formation of gases like H_2S, Carbon monoxide, CH_4, CO_2 etc. There are also many small slaughter houses, dhabas in the close vicinity of the highly populated area, which could have lead to huge amount of organic loading in the sewer lines.

8. Further, such large casualties due to leakage of sewer gas is the first such incident in the history of PPCB and is an unusual event and PPCB has no such expertise to deal with such situations. Therefore, to evaluate the causes of formation and leakage of gas at such magnitude that resulted in so many deaths requires scientific and technical intervention from the experts in the respective fields. Therefore, it is suggested that scientific experts in the field from reputed research organizations may also be included in the Multi Sectoral Inquiry committee.

9. It is further informed that NGT while taking Sou Moto cognizance of the gas leak incident in O.A. no. 327 / 2023 has passed orders on 02.05.2023. The operative part of the order produced below:

"4. We constitute an eight member fact-finding joint Committee to be headed by Chairman, Punjab State PCB. Other members of the Committee will be Regional Director (North), CPCB, Industrial Toxicology Research Centre (ITRC), Lucknow, nominee of Director, PGI Chandigarh, nominee of NDRF, State PCB, District Magistrate, Ludhiana and Commissioner, Municipal Corporation, Ludhiana. State PCB will act as nodal agency for coordination and compliance. The Committee may meet within one week from today and complete its task preferably within one month. It will be free to interact with any other department, institution or individual and undertaking visit to concerned sites. The Committee will be free to function online or offline as the situation may warrant. The Committee may give its report to this Tribunal on or before 30.06.2023 by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image PDF. If any violators are identified, they may also be given a copy of the report for their response, if any, before the next date.

5. In the meanwhile, the District Magistrate, Ludhiana may ensure payment of compensation @ Rs. 20 lakhs each to the heirs of 11 persons who have died, deducting the amounts, if any, already paid within one month. The Committee may mention the details of persons who have died and persons injured with extent of injuries suffered by them. It may also recommend measures to be taken in future to prevent such incidents."

4/5/23

Senior Environmental Engineer
Zonal Office-1, Ludhiana

4/5/2023

Senior Environmental Engineer
Zonal Office-2, Ludhiana

Annexure - 1

E-2023

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA

WATER ANALYSIS REPORT (Partial parameters)

1. Laboratory Sample No. — E-2997-3002/ H.O.Lab. Monitoring/2023
2. ULR No. — ULR-TC704518000000006389
2. Name of Industry — Water sample collected from Sewer lines near the Incident site at Sus Road, Giaspura, Ludhiana.
3. Name of Sample collecting Officer — Er. Rozert Dhamija, AEE, RO-I, Ludhiana, Sh. Dalbir Singh, ASO & Sh. Sonu Kumar, SA
4. Designation of authorizing Test — Environmental Engineer, RO-II,Ludhiana
5. Type of Sample — Grab
6. Date &Time of Sample collection — 30.4.2023
7. Date &Time of Sample receipt in Lab. — 01.05.2023
8. Period of Analysis — 01.05.2023 to 01.05.2023
9. Test Methods — As per relevant parts of IS:3025/&Methods of APHA

Results

Sr.no	Sampling location	pH	Chloride mg/l	Sulphide mg/l
A	From Manhole Opp. Jasbir Building Material Store (1:00PM)	4.41	295	8.8
B	From Manhole Near Transformer, Outside Saroj Beauty Parlour(11:30 AM)	2.51	683	56
	From Manhole Near Transformer, Outside Saroj Beauty Parlour(11:30 AM)12:20 PM	4.31	202	6.8
C	From Manhole in the front of Nitco Logistics (P) Ltd, Near Transformer (4:30 PM)	2.58	1541	60
D	From Manhole Opp. Aarti Clinic (12:40PM)	2.59	800	60
E	From Manhole Opposite Dharam Kanda near Punjab Emporium(1:40PM)	5.74	231	6.0

Remarks: The rest of parameters under analysis, consolidated report to be released later.

---End of Report---

for Scientific Officer

Endst. No: 10309-11 Dt. 3-5-23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.

for Asstt. Scientific Officer

Annexure-2

Status of Joint Surveillance by officers of PPCB and MCL at Giaspura Ludhiana on 01.05.2023

Team	PPCB Officers in team	MCL Officer in team	Total no. of industries visited	Distance from point of incidence					
				Upstream & downstream Upto 50 mtr		Upstream & downstream 50-100 mtr		Upstream upto 500 mtr & downstream upto 200 mtr	
				Total water polluting industries found	Pickling / electroplating etc. industries	Total water polluting industries found	Pickling / electroplating etc. industries	Total water polluting industries found	Pickling / electroplating etc. industries
Team A	Er. Vicky Bansal, EE, Er. Deepak Chadha, AEE, Er. Rantej Sharma AEE, Sh. Dalvir Singh, ASO,	Er Jaideep, SDO	18	0	0	0	0	0	0
Team B	Er. Sandeep Kumar, EE, Er. Jaspal Singh AEE, Er. Bhisham, AEE Er. Rajpal Gill, AEE, Sh. Sandeep Kaur, ASO,	Er Amandeep Singh Grewal, SDO	36	0	0	2	0	3	3
Team C	Er. Samita, EE, Er. Gurinderpal Chhinna, AEE, Er. Harpreet, AEE, Smt. Gurjot Kaur, SA,	Er. Amarjeet Juneja, JE	11	0	0	0	0	0	0

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Team D	Er. Satyajeet Attri, EE Er. Amritpal Chahal, AEE, Er. Vinod Kumar, AEE, Sh. Paramjeet Singh, SA,	Er Amritpal Singh, SDO	3	0	0	0	0	1	0
Team E	Er. Shiv Kumar EE, Er. Jatinder Kumar, AEE, Er. Anish Kumar, AEE, Sh. Paramjeet Singh, SA,	Er Amritpal Singh, SDO	7	0	0	0	0	3	3
Team F	Er. Vicky Bansal, EE, Er. Rubal Goyal AEE, Er. Pritpal Kaur, AEE, Sh. Dalvir Singh, ASO,	Er. Rajinder Singh, JE	38	0	0	0	0	8	8
	Total		**113**	**0**	**0**	**2**	**0**	**15**	**14**

Abstract

- **Total industries visited** : **113**
- **Water polluting industries visited** : **17**
  (U/Stream 13 out of which 11 were pickling / electroplating etc.)
  (D/Stream 4 out of which 3 were pickling / electroplating etc.)

Annexure A2

PUNJAB POLLUTION CONTROL BOARD
Zonal Office-1, E-648-B, Phase-V, Focal Point, Ludhiana
Tele Fax:- 0161-4673789 Website:- www.ppcb.gov.in email:- ppcbzo1ldh@gmail.com

No...1898... Dated...06/05/23

To

The SDM (West),
Ludhiana.

Subject: **2nd Interim report: Regarding mishappening on 30.04.2023 due to gas leakage at Guru Teg Bahadur Nagar, Sua Road, Near Indra Colony, Giaspura, Ludhiana.**

Reference: **Your Office letter no. 1/Special dated 01.05.2023 and this office letter no. 1849 dated 04.05.2023.**

In continuation to above referred letter of this office, please find enclosed herewith a copy of 2nd interim report in the matter.

DA/as above

Senior Environmental Engineer

Endst No..... **Dated.....**

A copy of the above to the following for information, please:

1. The Chairman, Punjab Pollution Control Board, Head Office, Patiala
2. The Member Secretary, Punjab Pollution Control Board, Head Office, Patiala
3. The Chief Environmental Engineer, Punjab Pollution Control Board, Ludhiana.
4. The Sr. Environmental Engineer, Punjab Pollution Control Board, Zonal Office-2, Ludhiana.

DA/as above

Senior Environmental Engineer

Subject:- 2nd Interim report of Punjab Pollution Control Board in the matter of leakage of gas at Guru Teg Bahadur Nagar, Sua Road, Near Indira Colony, Giaspura Ludhiana on 30.04.2023.

It is intimated that vide letter no. 1849 dated 04.05.2023, 1st interim report in the subject matter was sent to your office.

2. The details of subsequent actions taken by the PPCB in the matter and findings thereof are added below.

3. A copy of the part results of the effluent samples collected on 30.04.2023 from the sewerage network at upstream and downstream of the incident point to identify initially and the nature of gas received vide PPCB Head Office Lab report no. 10309-11 dated 03.05.2023 were forwarded to your office in the interim report. Now, analysis report for some more parameters has been released by PPCB Head Office Lab vide report no. 10677-81 dated 05.05.2023. The results are being analyzed. A copy of this analysis report is enclosed as per **Annexure-1**

4. The analysis of sample collected on 01.05.2023 by joint teams of PPCB and MCL are still under analysis at Central Lab of PPCB, Head Office, Patiala.

5. On the directions of the District Administration, door to door survey was again carried out near the place of incident on 03.05.2023 along with the officials of Municipal Corporation, Ludhiana. Further, some of the industries which were found closed on 01.05.2023 & now found in operation on 03.05.2023 were also visited. The details of the survey carried out is as under:

No. of Residential houses visited to check Industrial activity	No. of industries found	Water polluting industries found	Pickling/ electroplating etc. industries
64	23	04	04 (03 upstream & 01 downstream)

6. Thereafter, the survey was again continued on 04.05.2023 for further inspection of the area. The details of the survey carried out is as below:-

No. of industries visited	Water polluting industries found	Pickling / electroplating etc. industries
2	2	2 (both upstream)

The process of further inspection of industries in the area is under progress.

7. The list of water polluting industries identified on 01.05.2023, 03.05.2023 & 04.05.2023 is enclosed as **Annexure-2.** Further, technical and scientific investigation of the inspections done is going on.

Observations and findings

1. The PPCB has analyzed the visit reports of 22 industries visited on 01.05.2023, 03.05.2023 and 04.05.2023 and categorized the industries on their pollution potential and intensity of violation. The acid consuming/ electroplating industries who were found discharging

untreated effluent into sewer or not made agreement with any CETP/ re-processors or have not got their effluent lifted through CETP operator/ re-processors in April, 2023 even once, are major violators. The list is attached as **Annexure-3.** Besides, there are three non-acid consuming water polluting industries, which have provision to discharge their untreated effluent into public sewer. These industries are mentioned in Table B of Annexure-2.

2. The Board is monitoring the industries from time to time and initiate action against the violating industries. The action includes show cause notices, closure of the industries, disconnection of electric connection, sealing of polluting processes and imposition of Environmental Compensation. From the period 01.04.2022 to 30.04.2023, 24 industries were found violating in and around Sua Road. Out of 24, directions for closure of 10 industries were issued and show cause notices to 14 industries have been issued.
3. **Issue of stopping of clearance certificate:** Earlier, no new industry was allowed electric connection without the NOC and consent & clearance certificate from Punjab Pollution Control Board. In 2013, to facilitate the industrial growth, this mandate was waived off. Thereafter, PSPCL is allowing the electric connection to the industries without the NOC / clearance. This not only led to haphazard growth of industries without environmental norms, without the coming to the knowledge of the PPCB.
4. **Addition of polluting processes:** There are more than 40000 registered / unregistered units with industry department. They are operating in unplanned areas having mixed land use pattern with residential, commercial and industrial establishments. Some of the units add polluting processes without any intimation or approval from the PPCB, resulting in environmental violations. It is very difficult to identify such unit with meager engineer staff.
5. No sewer vents have been observed near the point of incident. Non availability of ventilation pipes in the affected stretch might have led to heavy accumulation of sewer gases such as H2S, CO, etc. This gas is also a cause of sewer men deaths across the country as tiny proportions are also considered lethal.
6. Residents of the affected area informed that sewer line of this area usually remained choked. Jetting and super suction machine at the night of incidence were operated late night. This incident occurred in a very short span of sewage network. The manholes at non-uniform interval were observed near the incident site. The sewer connection of one of the affected house is in the reverse direction to the natural flow / gradient of the main sewer, which may have led to the blockage. This requires a design auditing from expert in the field.
7. The sewer opening/ WC opening/ wash basin drains may have acted as a reverse ventilation pipeline dissipation of H2S in the affected premises. Poor ventilation system may have affected the dissipation of H2S gas and have aggravated the situation. H2S gas is the inherent component of sewage network and formed due to anaerobic digestion of organic matter. The vicinity in and around the incident is densely populated and several commercial establishments discharging heavy organic load such as dhabas, meat shops / slaughter houses etc. are located in the area. It is required to be checked as to whether the sewer connection of the affected premises have been approved by the Municipal Corporation or have been connected by the owner of the premises against the sewer designs in un-authorized manner.
8. Considering the poor ventilation of the houses, building plans are required to be assessed.
9. The Government of Punjab, Department of Science, Technology and Environment has issued directions vide memo no. 10/228/2019/STE-5/594066/1 dated 10.10.2019 u/s 5 of

Environment (Protection) Act, 1986 to various departments and Municipal Corporation, Ludhiana. One of the direction is reproduced below:

> ***No new connection or enhancement of existing connection by MC, Ludhiana. MC, Ludhiana shall not grant any new connection or enhancement of existing connection to municipal sewer for discharging industrial effluents.***

In compliance of the above directions, Punjab Pollution Control Board is not allowing any new industry to discharge its industrial effluent into sewer. The Municipal Corporation, Ludhiana is custodian of municipal sewer and no industry can discharge its effluent into sewer without permission of Municipal Corporation, Ludhiana.

10. Further, such large casualties due to leakage of sewer gas is the first such incident in the history of PPCB and is an unusual event and PPCB has no such expertise to deal with such situations. Therefore, to evaluate the causes of formation and leakage of gas at such magnitude that resulted in so many deaths requires scientific and technical intervention from the experts in the respective fields. Therefore, it is suggested that scientific experts in the field from reputed research organizations may also be included in the Multi Sectorial Inquiry committee.
11. In compliance to the NGT orders in O.A. no. 327/ 2023 passed on 02.05.2023, the meeting of the Fact Finding Committee is fixed on 08.05.2023 at Ludhiana.

Senior Environmental Engineer
Zonal Office-1, Ludhiana

Senior Environmental Engineer
Zonal Office-2, Ludhiana

Annexure-1

AB POLLUTION CONTROL BOARD VATAVARAN BHAVAN,
NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

ratory Sample No.	E- 2997-3002/ H.O.Lab. Monitoring/2023
R No.	ULR-TC704518000000006389
Name of Industry	Water sample collected from Sewer lines near the Incident site of Gas Leakage at Sua Road, Giaspura, Ludhiana.
3. Name of Sample collecting Officer	Er. Rozert Dhamija, AEE, RO-I, Ludhiana, Sh. Dalbir Singh, ASO & Sh. Sonu Kumar, SA
4. Designation of authorizing Test	Environmental Engineer, RO-II, Luhdiana
5. Type of Sample	Grab
6. Date &Time of Sample collection	30.4.2023
7. Date &Time of Sample receipt in Lab.	01.05.2023
8. Period of Analysis	01.05.2023 to 05.05.2023
9. Test Methods	As per relevant parts of IS:3025/&Methods of APHA

Results

"As per Annexure Attached"

for Scientific Officer

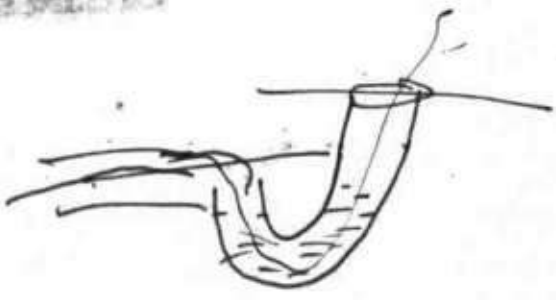
Endst. No: 10677-81 Dt. 05-05-23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PS to Chairman, Punjab Pollution Control Board, Patiala

for Asstt. Scientific Officer 5/5/23

5/5/23 5/5/23



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Annexure

Analysis Results of Water sample collected from Sewer lines near the Incident site of Gas Leakage at Sua Road, Giaspura, Ludhiana.

Sr. No	Sampling location	pH	*	TDS mg/l	*	COD mg/l	*	TSS mg/l	*	Chloride mg/l	*	Sulphate mg/l	*	Sulphide mg/l	*	Amm.N mg/l	*	Fe mg/l	*	Ni mg/l	*	Zn mg/l	*	Pb mg/l	*	Cd mg/l	*	T.Cr mg/l	*
A	From Manhole Opp. Jathir Building Mauvid Store (1:00PM) (S-3)	4.41	5.5 to 9.0	7706	-	840	-	3585	600	295	-	3851	-	8.8	-	BDL	50	333	3	1.5	3	7.0	15	0.51	1.0	BDL	1.0	9.1	2.0
B	From Manhole Near Transformer, Outside Saroj Beauty Parlour (11:30 AM) (S-1)	2.51	5.5 to 9.0	11824	-	946	-	4240	600	683	-	2830	-	56	-	BDL	50	989	3	1.7	3	3.4	15	0.67	1.0	BDL	1.0	3.1	2.0
	From Manhole Near Transformer, Outside Saroj Beauty Parlour (12:20 PM) (A-1)	4.31	5.5 to 9.0	7052	-	674	-	3814	600	202	-	3849	-	6.8	-	BDL	50	951	3	0.96	3	2.8	15	BDL	1.0	BDL	1.0	1.7	2.0
C	From Manhole in the front of Nitco Logistics (P) Ltd, Near Transformer (4:20 PM) (S-5)	2.58	5.5 to 9.0	7116	-	1240	-	570	600	1541	-	2256	-	60	-	BDL	50	1499	3	0.59	3	2.7	15	BDL	1.0	BDL	1.0	1.6	2.0
D	From Manhole Opp. Aarti Clinic (12:40PM) (S-2)	2.59	5.5 to 9.0	19426	-	4280	-	3905	600	800	-	3842	-	60	-	BDL	50	1118	3	1.9	3	9.2	15	BDL	1.0	BDL	1.0	3.7	2.0
E	From Manhole Opposite Dharam Kanda wire Punjab Emporium (1:40PM) (S-4)	8.74	5.5 to 9.0	1739	-	1978	-	3680	600	231	-	982	-	6.0	-	BDL	50	291	3	0.46	3	0.99	15	BDL	1.0	BDL	1.0	0.56	2.0

1) * Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)
2) BDL means : Below Detection Limit.

---End of Report---

[1][SCHEDULE – VI]

(See rule 3A)

GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS

S. No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for irrigation	Marine coastal areas
1	2	3			
		(a)	(b)	(c)	(d)
1.	Colour and odour	See 6 of Annexure-I	--	See 6 of Annexure -I	See 6 of Annexure-I
2.	Suspended solids mg/l, Max.	100	600	200	(a) For process waste water-100 (b) For cooling water effluent 10 percent above total suspended matter of influent.
3.	Particulate size of suspended solids	Shall pass 850 micron IS Sieve	--	--	(a) Floatable solids, max. 3 mm. (b) Settleable solids, max. 850 microns.
[2]4.	***	*	--	***	--
5.	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature	shall not exceed 5°C above the receiving water temperature	--	--	shall not exceed 5°C above the receiving water temperature

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1 Schedule VI inserted by Rule 2(d) of the Environment (Protection) Second Amendment Rules, 1993 notified vide G.S.R. 422(E) dated 19.05.1993, published in the Gazette No. 174 dated 19.05.1993.

2 Omitted by Rule 2(d)(I) of the Environment (Protection) Third Amendment Rules, 1993 vide Notification No.G.S.R.801(E), dated 31.12.1993.

S. No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for irrigation	Marine coastal areas
1	2	3			
		(a)	(b)	(c)	(d)
7.	Oil and grease mg/l Max.	10	20	10	20
8.	Total residual chlorin mg/l Max.	1.0	--	--	1.0
9.	Ammonical nitrogen (as N), mg/l Max.	50	50	--	50
10.	Total Kjeldahl Nitrogen (as NH_3) mg/l, Max.	100	--	--	100
11.	Free ammonia (as NH_3) mg/l, Max.	5.0	--	--	5.0
12.	Biochemical Oxygen demand [1][3 days at 27°C] mg/l max.	30	350	100	100
13.	Chemical Oxygen Demand, mg/l, max.	250	--	--	250
14.	Arsenic (as As), mg/l, max.	0.2	0.2	0.2	0.2
15.	Mercury (as Hg), mg/l, Max.	0.01	0.01	--	0.01
16.	Lead (as Pb) mg/l, Max.	0.1	1.0	--	2.0
17.	Cadmium (as Cd) mg/l, Max.	2.0	1.0	--	2.0
18.	Hexavalent Chromium (as Cr+6), mg/l max.	0.1	2.0	--	1.0

[1] Substituted by Rule2 of the Environment (Protection) Amendment Rules, 1996 notified by G.S.R.176, dated 2.4.1996 may be read as BOD (3 days at 27°C) wherever BOD 5 days 20°C occurred.

S. No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for irrigation	Marine coastal areas
1	2	3			
		(a)	(b)	(c)	(d)
19.	Total chromium (as Cr.) mg/l, Max.	2.0	2.0	--	2.0
20.	Copper (as Cu) mg/l, Max.	3.0	3.0	--	3.0
21.	Zinc (As Zn.) mg/l, Max.	5.0	15	--	15
22.	Selenium (as Se.) mg/l, Max.	0.05	0.05	--	0.05
23.	Nickel (as Ni) mg/l, Max.	3.0	3.0	--	5.0
[1]24.	• • •	•	•	•	•
[1]25.	• • •	•	•	•	•
[1]26.	• • •	•	•	•	•
27.	Cyanide (as CN) mg/l Max.	0.2	2.0	0.2	0.2
[1]28.	• • •	•	•	•	•
29.	Fluoride (as F) mg/l Max.	2.0	15	--	15
30.	Dissolved Phosphates (as P), mg/l Max.	5.0	--	--	--
[2]31.	• • •	•	•	•	•
32.	Sulphide (as S) mg/l Max.	2.0	--	--	5.0
33.	Phenolic compounds (as C_6H_5OH) mg/l, Max.	1.0	5.0	--	5.0

[1] Omitted by Rule 2(d)(i) of the Environment (Protection) Third Amendment Rules, 1993 vide Notification No.G.S.R.801(E), dated 31.12.1993.

S. No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for irrigation	Marine coastal areas
1	2	3			
		(a)	(b)	(c)	(d)
34.	Radioactive materials :				
	(a) Alpha emitter micro curie/ml.	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	(b) Beta emitter micro curie/ml.	10^{-6}	10^{-6}	10^{-7}	10^{-6}
35.	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
36.	Manganese (as Mn)	2 mg/l	2 mg/l	–	2 mg/l
37.	Iron (as Fe)	3 mg/l	3 mg/l	–	3 mg/l
38.	Vanadium (as V)	0.2 mg/l	0.2 mg/l	–	0.2 mg/l
39.	Nitrate Nitrogen	10 mg/l	–	–	20 mg/l
[1]40.	• • •	•	•	•	•

[1] Omitted by Rule 2(d)(i) of the Environment (Protection) Third Amendment Rules, 1993 vide Notification No. G.S.R. 801(E) dated 31.12.1993

Annexure-2

Details of Water Polluting Industries (Acid consuming / electroplating) visited on 01.05.2023, 03.05.2023 & 04.05.2023 at Giaspura Road, Ludhiana:

No.	Date of Visit	Name and address of the Industry	Coordinates (Longitude & Latitude)	Pickling/ Electroplating industry etc.
1.	01.05.2023	M/s A.T. Wires, B/s Sitara Cinema, Sua Road, Ludhiana	30.867158, 75.903661	Yes
2.	01.05.2023	M/s JMD Happy Ispat, B/s Sitara Cinema, Sua Road, Ludhiana	30.867271, 75.903548	Yes
3.	01.05.2023	M/s Aggarwal Wire & Steel Products, Shanti Nagar, SuaRoad, Ludhiana	30.868335, 75.90489	Yes
4.	01.05.2023	M/s Bansal Manufacturing Company, 536/35/1/4, Giaspura, Sua Road, Ludhiana	30.863310, 75.907319	Yes
5.	01.05.2023	M/s Sidana Wires, GiaspuraSua Road, Ludhiana	30.864321, 75.906217	Yes
6.	01.05.2023	M/s Trimurti Exports, Industrial Area-C, Giaspura, Ludhiana	30.863312, 75.907306	Yes
7.	01.05.2023	M/s Pullman Sales Corporation, Nr. Nanaksar Kanda, Sua Road, Giaspura, Ludhiana	30.865663, 75.907050	Yes
8.	01.05.2023	M/s Indian Bicycles, 536/258/1, Industrial Area-C, Sua Road, Ludhiana	30.865755, 75.907284	Yes
9.	01.05.2023	M/s Maharaja International (Unit-I), BXX1X-536/26/3, Sua Road, Ludhiana	30.864722, 75.908056	Yes
10.	01.05.2023	M/s Maharaja International (Unit-II), BXX1X-536/26/38, Sua Road, Ludhiana	30.864917, 75.908366	Yes
11.	01.05.2023	M/s Maharaja International (Unit-III), BXX1X-536/26/35, Sua Road, Ludhiana	30.864735, 75.907306	Yes
12.	01.05.2023	M/s Malwa Auto, Enterprises, Nr. NanaksarDharam Kanda, DhandariKalan, Sua Road,Ludhiana	30.867196, 75.906763	Yes
13.	01.05.2023	M/s DKT Industrial Company, Giaspura, Dhandari Kalan, Sua Road, Ludhiana	30.867053, 75.906778	Yes
14.	01.05.2023	M/s Shivam Auto Industries, Nr. Nanaksar Dharam Kanda,	30.867528, 75.907166	Yes

Annexure-A3
PLC-3

		DhandariKalan, Sua Road, Ludhiana		
	03.05.2023	M/s Guru Nanak Enterprises, Industrial Area-C, Sua Road, Ludhiana	-	Yes
16.	03.05.2023	M/s Anmol Enterprises, Giaspura, Sua Road,Ludhiana	-	Yes
17.	03.05.2023	M/s Pal Enterprises, Industrial Area-C, Sua Road,Ludhiana	-	Yes
18.	04.05.2023	M/s RP Enterprise, Giaspura, Sua Road, Ludhiana	-	Yes
19.	04.05.2023	M/s Munna Zinc, Giaspura, Sua Road, Ludhiana	-	Yes

TABLE B: **Details of Water Polluting Industries (but not acid consuming / electroplating) visited on 01.05.2023, 03.05.2023 & 04.05.2023 at Giaspura Road, Ludhiana:**

Sr. No.	Date of Visit	Name and address of theIndustry	Coordinates (Longitude & Latitude)	Pickling/ Electroplating industry etc.
1.	01.05.2023	M/s Star Industry, Opp. Jasbir, Building Material Sua Road, Ludhiana	30.866405, 75.905522	No
2.	01.05.2023	M/s Ganga Export International, B-29-458/4/97B/3, B/s Sitara Cinema, Sua Road, Ludhiana	30.866779, 75.90388	No
3.	01.05.2023	M/s Shiv Cycle Industries, St. no. 7, Makkar Colony, SuaRoad, Ludhiana	30.865523, 75.905118	No

Annexure-3

Major violators as observed during visits on 01.05.2023, 03.05.2023 and 04.05.2023. The acid consuming / electroplating industries who were found discharging untreated effluent into sewer or not made agreement with any CETP / re-processors or have not gottheir effluent lifted through CETP operator / re-processors in April, 2023 even once, are major violators and may be considered as suspects:

S.No.	Name and address of the industry	Major violations
1.	M/s Guru Nanak Enterprises, Khasra No. 66/12, Industrial Area-C, Sua Road, Ludhiana	• Zinc plating and acid pickling. • No agreement with CETP/ re-processors. • Maintaining outlet for discharge of untreated effluent into sewer. • The industry has not obtained any NOC from the Board. • Direction issued for closure, disconnection of electricity and to initiate legal action.
2.	M/s Munna Zinc Plating, St. No.4, Guru Amardass Colony, Giaspura, Ludhiana	• Zinc plating unit. • No agreement with CETP. • The industry has not obtained any NOC from the Board. • Direction issued for closure and disconnection of electricity.
3.	M/s A.T. Wires, Giaspura, Sua Road, Ludhiana.	• Acid pickling • Pump provided. • Spillage of yellow colour was found near houdi which further connected to MCL Sewer. • Stagnated effluent was seen in houdi.
4.	M/s Bansal Manufacturing Company, N-XXIX, 536/35/B/1/4, Giaspura, Sua Road, Ludhiana	• Acid pickling. • Agreement made but no lifting of effluent during April, 2023 and previous months. • No record maintained. • Show cause notice issued for violation.
5.	M/s Malwa Auto Industries, Near Nanaksar Dharam Kanda, Sua Road, Dhandari Kalan, Industrial Area –C, Ludhiana.	• Acid pickling. • Agreement made but no lifting of effluent during April, 2023 and previous months.
6.	M/s Trimurti Exports, Behind Kharay Kanda, Sua Road, Industrial Area-C, Giaspura, Ludhiana	• Electroplating • Agreement made but no lifting of effluent during April, 2023. • No record produced. • Show cause notice issued for violation.
7.	M/s Paul Industry, Sua Road, Ludhiana	• Acid pickling. • Agreement made but no lifting of effluent during April, 2023.

Annexure-A3
PC-3

PUNJAB POLLUTION CONTROL BOARD
Zonal Office-1, E-648-B, Phase-V, Focal Point, Ludhiana
Tele Fax:- 0161-4673789 Website:- www.ppcb.gov.in email:- ppcbzo1ldh@gmail.com

No. 2216 Speed Post/online Dated 19/5/23

To

The SDM (West),
Ludhiana.

Subject: **Analysis results in the matter of leakage of gas at Guru Teg Bhadur Nagar, Sua Road, Near Indra Colony, Giaspura, Ludhiana by Punjab Pollution Control Board.**

Reference: **This office letter no. 1849-51 dated 04.05.2023 and 1898-1902 dated 06.05.2023.**

Vide above referred letters, 1st and 2nd interim reports on the action taken in the matter of leakage of gas at Guru Teg Bhadur Nagar, Sua Road, Near Indra Colony, Giaspura, Ludhiana were submitted by the Punjab Pollution Control Board (PPCB). Also, analysis results of samples collected on 30.04.2023 from the main sewer line near the affected area received from Central lab of PPCB vide no. 10309-11 dated 03.05.2023 and 10677-81 dated 05.05.2023, were sent.

2. On 01.05.2023, samples from the branch lines of the sewer in nearby vicinity collected by the Joint team of PPCB & Municipal Corporation, Ludhiana were collected and sent to Central lab of PPCB at Patiala. Now, the results of these samples have also been received vide no. 10752-56, 10762-66, 10757-61, 10767-71, 10777-81, 10772-76, 10747-51 & 10742-46 all dated 06.05.2023. Copies are enclosed as **Annexure-A.**

8257 22/5/23

This is for your information, please.

DA/ as above

Senior Environmental Engineer

Endst. No..... **Dated .....**

A copy of the above is forwarded to the following for information:

1. The Chairman, Punjab Pollution Control Board, Patiala.
2. The Member Secretary, Punjab Pollution Control Board, Patiala.
3. The Chief Environmental Engineer, Punjab Pollution Control Board, Ludhiana.
4. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-2, Ludhiana.

DA/ as above

Senior Environmental Engineer

Annexure - A

FL 1 8/5/2023

1329 09/5/23

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

1. Laboratory Sample No. ULR No.	E- 3009-3010/ H.O.Lab. Monitoring/2023 ULR-TC704518000000006394
2. Name of Industry	Sewer Lines, Street No.04, Giaspura, Ludhiana
3. Name of Sample collecting Officer	Er. Deepak Chadha AEE, Er. Rantej Sharma, AEE, Sh Dalbir Singh, ASO
4. Designation of authorizing Test	Environmental Engineer, RO-II, Ludhiana.
5. Type of Sample	Grab
6. Date &Time of Sample collection	01.05.2023
7. Date &Time of Sample receipt in Lab.	02.05.2023
8. Period of Analysis	02.05.2023 to 06.05.2023
9. Test Methods	As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	From Sewer manhole Location-1	From Sewer manhole Location-2	Prescribed Standard
1	pH	6.8	7.0	5.5 to 9.0
2	TDS mg/l	902	860	-
3	EC	1378	1027	-
4	Sulphate mg/l	30	196	-
5	Chloride mg/l	144	134	-
6	COD mg/l	539	482	-
7	Sulphide mg/l	2.4	2.0	-
8	Iron mg/l	2.6	2.2	3.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)
2) BDL means Below Detection Limit

---End of Report---

Scientific Officer 6/5/23

Endst. No: 10752-58 Dt. 06/05/23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

for Asstt. Scientific Officer 6/5/23

6/5/23 06/05/23

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

1308
09/5/23

1. Laboratory Sample No. ULR No.	E- 3007/ H.O.Lab. Monitoring/2023 ULR-TC704518000000006392
2. Name of Industry	Indra Colony, Near Giaspura, Sub-street No.01, Ludhiana
3. Name of Sample collecting Officer	Er. Shiv Kumar, EE, Sh. Anish Sharma, AEE, Er. Jatinder Kumar, AEE & Sh. Paramjit Singh, SA
4. Designation of authorizing Test	Environmental Engineer, RO-II, Ludhiana.
5. Type of Sample	Grab
6. Date &Time of Sample collection	01.05.2023
7. Date &Time of Sample receipt in Lab.	02.05.2023
8. Period of Analysis	02.05.2023 to 06.05.2023
9. Test Methods	As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	Sewer Line Sub Street No. I	Prescribed Standard
1	pH	5.7	5.5 to 9.0
2	TDS mg/l	1138	-
3	EC	1532	-
4	Sulphate mg/l	25	-
5	Chloride mg/l	194	-
6	COD mg/l	486	-
7	Sulphide mg/l	4.2	-
8	Iron mg/l	2.2	3.0
9	Zinc mg/l	0.3	15
10	T.Cr mg/l	BDL	2.0
11	Nickel mg/l	BDL	3.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)

2) BDL means Below Detection Limit

---End of Report---

Scientific Officer
6/5/23

Endst. No: 10762-66 Dt. 06/05/23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

6/5/23
for Asstt. Scientific Officer
6/5/23
06/05/23

FR

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

1327
09/5/23

1. Laboratory Sample No. ULR No.	E- 3008/ H.O.Lab. Monitoring/2023 ULR-TC704518000000006393
2. Name of Industry	St No.06, Gurutegh Bahadur Nagar, Giaspura, Ludhiana
3. Name of Sample collecting Officer	Er. Samita, EE, Er. G.S. Chinna, AEE, Er. Harpreet Singh, AEE, Mrs. Gurjot Kaur, SA
4. Designation of authorizing Test	Environmental Engineer, RO-II, Ludhiana.
5. Type of Sample	Grab
6. Date &Time of Sample collection	01.05.2023
7. Date &Time of Sample receipt in Lab.	02.05.2023
8. Period of Analysis	02.05.2023 to 06.05.2023
9. Test Methods	As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	Collected from Manhole in Street No 6	Prescribed Standard
1	pH	7.2	5.5 to 9.0
2	TDS mg/l	625	-
3	EC	828	-
4	Sulphate mg/l	30	-
5	Chloride mg/l	106	-
6	COD mg/l	922	-
7	Sulphide mg/l	2.6	-
8	Iron mg/l	2.0	3.0
9	Zinc mg/l	0.2	15
10	T.Cr mg/l	BDL	2.0
11	Nickel mg/l	BDL	3.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)

2) BDL means Below Detection Limit

---End of Report---

Scientific Officer
6/5/23

Endst. No: 10757-61 Dt. 06/05/23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

8/5/23
Asstt. Scientific Officer
06/05/23

2.

Ft h 8/5/23

1326
09/5/23

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

1. Laboratory Sample No.	E- 3006/ H.O.Lab. Monitoring/2023
ULR No.	ULR-TC70451800000000639l
2. Name of Industry	Smart Colony, Near Indra Colony Sub-street No.02, Giaspura, Ludhiana
3. Name of Sample collecting Officer	Er. Shiv Kumar, EE, Er. Jatinder Kumar, AEE, Er.Anish Sharma, AEE, Sh. Paramjeet Singh, SA
4. Designation of authorizing Test	Environmental Engineer, Regional Office-II, Ludhiana.
5. Type of Sample	Grab
6. Date &Time of Sample collection	01.05.2023
7. Date &Time of Sample receipt in Lab.	02.05.2023
8. Period of Analysis	02.05.2023 to 06.05.2023
9. Test Methods	As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	Sewer line Sub-Street No.02	Prescribed Standard
1	pH	7.0	5.5 to 9.0
2	Total Dissolved Solids mg/l	908	-
3	Chemical Oxygen Demand mg/l	630	-
4	E.C	1086	-
5	Sulphide mg/l	12	-
6	Chloride mg/l	130	-
7	Sulphate mg/l	20	-
8	Iron mg/l	9.4	3.0
9	Zinc mg/l	0.8	15
10	Nickel mg/l	BDL	3.0
11	Total Chrome mg/l	BDL	2.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)

2) BDL means Below Detection Limit

---End of Report---

Scientific Officer
4/5/23

Endst. No: 10767-71 Dt. 06/05/23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

6/5/23
for Asstt. Scientific Officer

6/5/23 06/05/23

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

8/5/2023
1375
04/5/23

1. Laboratory Sample No. / ULR No. — E- 3004-3005/ H.O.Lab. Monitoring/2023 / ULR-TC704518000000006390
2. Name of Industry — Sewer Line of Street No. 7 & 8, Giaspura, Ludhiana
3. Name of Sample collecting Officer — Er. Satyajeet Attri, EE, Er. Vinod Kumar, AEE, Er. Amritpal Singh Chahal, AEE & Sh. Paramjeet Singh SA
4. Designation of authorizing Test — Environmental Engineer, Regional Office-II, Ludhiana.
5. Type of Sample — Grab
6. Date &Time of Sample collection — 01.05.2023
7. Date &Time of Sample receipt in Lab. — 02.05.2023
8. Period of Analysis — 02.05.2023 to 06.05.2023
9. Test Methods — As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	Manhole of Sewer (Gali no. 07)	Manhole of Sewer (Gali no. 08)	Prescribed Standard
1	pH	7.4	7.0	5.5 to 9.0
2	EC	1005	1091	-
3	Total Dissolved Solids mg/l	749	955	-
4	Chemical Oxygen Demand mg/l	297	687	-
5	Chloride mg/l	152	161	-
6	Sulphate mg/l	27	77	-
7	Sulphide mg/l	1.0	5.6	-
8	Iron mg/l	2.9	2.1	3.0
9	Zinc mg/l	0.2	0.2	15
10	Nickel mg/l	BDL	BDL	3.0
11	Total Chrome mg/l	BDL	BDL	2.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)
2) BDL means Below Detection Limit

---End of Report---

Scientific Officer
6/5/23

Endst. No: 10777-81 Dt. 06/5/23

A copy of the above is forwarded to the: -
1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

Asstt. Scientific Officer
6/5/23
06/05/23

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

1924 09/5/23

1. Laboratory Sample No. / ULR No. — E- 3003/ H.O.Lab. Monitoring/2023 / ULR-TC704518000000006389
2. Name of Industry — Manhole at Meeting Point of St. No. 4 with main Sua Road Village Giaspura, Tehsil Ludhiana West, Distt Ludhiana
3. Name of Sample collecting Officer — Er. Bihsham AEE, Er. Rajpal Gill, AEE, Er. Maniderjeet Singh JEE
4. Designation of authorizing Test — Environmental Engineer, RO-II, Ludhiana
5. Type of Sample — Grab
6. Date &Time of Sample collection — 01.05.2023
7. Date &Time of Sample receipt in Lab. — 02.05.2023
8. Period of Analysis — 02.05.2023 to 06.05.2023
9. Test Methods — As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	From manhole situated at Meeting Point of St. No. 4, Makkar Colony with main Sua Road at upstream of point Zero	Prescribed Standards
1	pH	6.8	5.5 to 9.0
2	TDS mg/l	1005	-
3	Sulphate mg/l	211	-
4	Chloride mg/l	158	-
5	EC	1218	-
6	COD mg/l	470	-
7	Sulphide mg/l	0.4	-
8	Iron mg/l	48.1	3.0
9	Nickel mg/l	BDL	3.0
10	Zinc mg/l	2.3	15
11	Chromium mg/l	BDL	2.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)

2) BDL means Below Detection Limit

---End of Report---

for Scientific Officer
6/5/23

Endst. No: 10772-76 Dt. 06/05/23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

for Asstt. Scientific Officer
6/5/23
06/05/23

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

1323
09/5/23

1.	Laboratory Sample No. ULR No.	E- 3011/ H.O.Lab. Monitoring/2023 ULR-TC704518000000006395
2.	Name of Industry	AT Wires, Backside Sitara Cinema, Sua Road, Ludhiana
3.	Name of Sample collecting Officer	Er. Sandeep Kumar, EE, Er. Jaspal Singh, AEE,
4.	Designation of authorizing Test	Environmental Engineer, RO-II, Ludhiana.
5.	Type of Sample	Grab
6.	Date &Time of Sample collection	01.05.2023
7.	Date &Time of Sample receipt in Lab.	02.05.2023
8.	Period of Analysis	02.05.2023 to 06.05.2023
9.	Test Methods	As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	Sampling done from the inside Houdle of the unit	Prescribed Standard
1	pH	4.5	5.5 to 9.0
2	TDS mg/l	1451	-
3	EC	1746	-
4	Sulphate mg/l	279	-
5	Chloride mg/l	220	-
6	COD mg/l	124	-
7	Sulphide mg/l	4.7	-
8	Iron mg/l	18	3.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)
2) BDL means Below Detection Limit

---End of Report---

Scientific Officer
6/5/23

Endst. No: 10747-51 Dt. 06/05/23

A copy of the above is forwarded to the: -
1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

for Asstt. Scientific Officer
5/5/23
06/05/23

PUNJAB POLLUTION CONTROL BOARD VATAVARAN BHAVAN, NABHA ROAD, PATIALA
WATER ANALYSIS REPORT

1392/09/5/23

Laboratory Sample No.	E- 3012/ H.O.Lab. Monitoring/2023
ULR No.	ULR-TC704518000000006396
2. Name of Industry	(F) Point, Sua Road
3. Name of Sample collecting Officer	Er. Pritpal Kaur, AEE, Sh. Dalbir Singh, ASO
4. Designation of authorizing Test	Environmental Engineer, RO-II, Ludhiana.
5. Type of Sample	Grab
6. Date &Time of Sample collection	01.05.2023
7. Date &Time of Sample receipt in Lab.	02.05.2023
8. Period of Analysis	02.05.2023 to 06.05.2023
9. Test Methods	As per relevant parts of IS:3025/&Methods of APHA

Results

Sr. No.	Parameters	Sampling from one no. location from Sewer drain	Prescribed Standard
1	pH	7.3	5.5 to 9.0
2	TDS mg/l	898	-
3	EC	1092	-
4	Sulphate mg/l	116	-
5	Chloride mg/l	180	-
6	COD mg/l	656	-
7	Sulphide mg/l	4.8	-
8	Iron mg/l	2.2	3.0

Remarks: 1) Prescribed Standards as per General Standards for Discharge of Environmental Pollutants Part-A: Effluents as per Schedule-VI (See rule 3A)

2) BDL means Below Detection Limit

---End of Report---

Scientific Officer

Endst. No: 10742-46 Dt. 06/05/23

A copy of the above is forwarded to the: -

1. The Chief Environmental Engineer (Water), Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal Office-II, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional Office-II, Ludhiana.
4. PA to Member Secretary, Punjab Pollution Control Board, Patiala.
5. PA to Chairman, Punjab Pollution Control Board, Patiala.

for 6/5/23
Asstt. Scientific Officer

06/05/23

ANNEXURE-II

PUNJAB POLLUTION CONTROL BOARD
Zonal Office-1, E-648-B, Phase-V, Focal Point, Ludhiana
Tele Fax:- 0161-4673789 Website:- www.ppcb.gov.in email:- ppcbzo1ldh@gmail.com

No. 2936 Speed Post/Online Dated 21/6/23

To

The Member Secretary,
Punjab Pollution Control Board,
Vatavaran Bhawan, Nabha Road,
Patiala.

Sub:- Submission of 2nd report by Punjab Pollution Control Board to the Fact-Finding Committee constituted by Hon'ble National Green Tribunal in OA no. 327/2023 titled as News item published in India Today dated 30.04.2023 titled "3 minors among 11 dead in Ludhiana gas leak, Punjab govt. announces Rs 2 lakh ex-gratia".

Ref:- This office letter no. 2320 dated 29.05.2023.

It is submitted that the 1st meeting of the Facts-Finding Joint Committee constituted on the subject cited above, was held on 08.05.2023 and its minutes were circulated to its members vide e-mail dated 11.05.2023.

In compliance, the Board vide its letter no. 2320 dated 29.05.2023 has submitted 1st interim report to the Fact Finding Committee.

In continuation to the report submitted vide letter under reference, the Punjab Pollution Control Board has examined this incident through various scientific interventions and has also taken Expert opinions. The Board has also examined the literature published in various international Journals/papers for understanding the cause of the incident. Following findings have been observed:-

1. **Formation of Hydrogen Sulphide (H_2S) in Sewers**

Hydrogen Sulphide is commonly known as sewer gas and is formed under anaerobic conditions through microbial biochemical degradation of organic matter including human excreta, kitchen refuse, detergents, animal waste, Oil & Grease, etc. which are usually present in the waste streams. Hydrogen Sulphide is generated in relatively stagnant waste water systems or at low velocities of sewer streams. Higher Organic load leads to more generation of H2S gas in sewer lines.

Mechanisms for the creation and release of H_2S gas also occur when sulphate or oxygen is used/depleted to produce Sulphide. **Sulphate reducing bacteria** acts as a major source for microbial biochemical degradation of organic matter and release of H2S gas. Sulphates are present in great abundance in municipal wastewater systems and primarily stems from household cleaning detergents. Once the anaerobic conditions reduce Sulphates to Sulphides, it reacts with hydrogen to produce Hydrogen Sulphide.

$$SO_4^{2-} + \text{organic matter} + \text{anaerobic Bacteria} \rightarrow S^{2-} + H_2O + CO_2$$

$$S^{2-} + 2H^+ = H_2S.$$

2. Factors affecting the formation of H_2S gas in sewer

Formation of H2S gas in sewers depend on Flow (Velocity) of Sewage in pipes, Slope of the pipe, Ratio of wetted perimeter of the pipe wall to surface width of the stream, Temperature of the Sewage, Biochemical Oxygen Demand, Presence of Sulphates, Available Oxygen and Retention Time in the System.

3. Reasons for H_2S gas accumulation in sewers

Blocked Air Vents, Clogged Drains, ill Designed Sewers, Blockage/Stagnation, Slow Velocities of Sewage and Sludge/Slime Formation etc are the possible reasons for accumulation of H2S gas in sewer lines.

4. Optimum pH for H2S generation

Nearly 90 % of Sulphide will be present as H_2S at pH 6 as depicted in graph attached as **Annexure-A** (*Source:- Journal Presented by Jason Kane at Queensland Water industry operation conference and exhibition, USA*). This graph further depict that even at pH 5, 100% of Sulphides get converted to H2S. This implies that majority of the Sulphides are converted to H_2S at pH 6 and there is no special requirement of very low pH for generating high concentration of H_2S as all the H2S exist at pH of 5

5. Development of anaerobic conditions and generation of Sulphuric acid in sceptic conditions in sewers through Bio-chemical Oxidation as reflected from analysis results.

Hydrogen Sulphide is Biochemically oxidized in presence of moisture to form **Biogenic Sulphuric Acid.** Colonisation by aggressive acidophilic bacteria is capable of generating enough sulphuric acid to reduce the **surface pH to 1-2**, whereas Thiobacilli is capable of generating sufficient sulphuric acid to further reduce the pH to 1. Higher concentration of H2S in sewer lines leads to increased bio-chemical oxidation of Sulphides to Sulphuric Acid.

Further, the Sulphuric acid is also generated in the Municipal Sewers through Chemical Oxidation of H2S in presence in aqueous medium. The rate of chemical Sulphide oxidation increases exponentially with Hydrogen Sulphide concentrations and chemical sulphide oxidation is resultant into the formation of Sulphuric Acid. Hence, with the increase in the concentration of H2S, there is increase in Sulphuric Acid generation.

As per analysis report, the low pH between 2.51-2.59 is observed at manholes close to incident site (Affected stretch) . Whereas, it is 4.41 at Upstream and 5.74 at Downstream of incident point. Had there been any acidic industrial discharge from upstream in the sewer line , the pH.levels at upstream and downstream of the incident point should have been equivalent to pH levels in the affected stretch and all the parameters should have shown a uniform trend in the samples drawn from all the manholes.

Low pH in the affected stretch and relatively high pH at the upstream and downstream of the incident site clearly shows the built up of anaerobic conditions and after affects of H2S generation leading to biochemical formation of sulphuric acid thereby lowering of pH in the affected stretch and sustaining in the adjoining pockets

6. **Effects of Iron and other metals in H2S generation**

There are number of units engaged in machining processes (non-water polluting) operating in Ludhiana and particularly in this area. These units are covered under White Category and exempted by the CPCB from consent management in the notification for categorization of industries. Iron in particle form from such industries may have entered into sewers and got accumulated due to sludge settling and converted to dissolved solids due to low pH in the affected pocket. Iron concentration in the range of 300 mg/l on upstream and downstream comparing to high concentration of Iron (1000-1500 mg/l) in the affected pocket substantiates the above hypothesis. Further, the results in the branch sewer suggests relatively low iron content (Maximum 9 ppm), which suggest that accumulation of iron content happens only in the affected pocket and not due to discharge from any adjoining units.

The concentration of other metals is not significant comparing to iron and the general standards prescribed by the ministry for such discharges into the Municipal Sewer. As far as presence of metals especially Iron, Zinc, Nickel, Chrome or any other heavy metal in the sewerage sample is concerned, these cannot lead to the generation of H2S. On the contrary, iron and other metals in the aqueous medium or iron salts would combine with sulphide ions (from H_2S or any other source of sulphide) to immediately convert to highly stable iron/metal sulphide through an irreversible reaction leading to the formation of respective metal sulphides. Hence, due to above property of metals, iron, nickel, zinc, chromium etc. would never be a source of H2S generation, rather are used as H2S scavengers to remove sulphide from various streams likely to contain H2S.

Further, Dosing of Ferrous or Ferric iron as either a chloride or a sulphate has been a proven mechanism for hydrogen sulphide control applications. Iron salts bind with Hydrogen sulphide leading to production of Iron sulphides in stable forms through an irreversible reaction. Dosing of Ferrous or Ferric iron as either a chloride or a sulphate has been able to control Hydrogen Sulphide levels in Bio gas digesters. Iron salts are used in Biogas digesters to suppress H2S generation. These iron sulphides are very fine particles having very low sedimentation properties and are generally carried along with the sewer stream.

7. **Susceptibility of industrial discharge at incident site.**

A detailed survey of the upstream and downstream of the point of incident was jointly conducted by teams of PPCB and MCL from 01.05.2023 to 04.05.2023. The joint teams have scanned the area physically upto 500 mtr on upstream & upto 200 mtr on downstream of point of incidence.

During the visits, 179 establishments including residential and commercial were inspected. Out of these 179 establishments, 22 industries were found water polluting. These are tiny electroplating/pickling/barrelling units. The observation and findings w.r.t the visits conducted is as under:-

1. There is no large or medium industry in the area surveyed. All the industries are of tiny/small scale.
2. Out of 22 water polluting industries, 15 industries were located at the upstream (13 acid consuming/electroplating and 2 caustic barrelling). Amongst 13, 6 are acid pickling and 7 are electroplating. **There is no acid consuming industry within 100mtr radius of the incident.**
3. Two caustic barrelling units have no role in discharge of acidic effluent. Whereas, 6 tiny pickling units have total effluent generation of 17.5 KLM (Average 0.7 KLD). All of these tiny units are member of one or other re-processors. In case, if assumed that any discharge have been made from these units, it will not be as concentrated as fresh acid but must be spent acid. It will not be possible for an inert acid with such a low volume to travel more than 100mtrs and sustain low pH around 2.5 in affected stretch despite high dilution available in the public sewer from domestic and other sources. Further to add that on the previous evening, there was heavy rain in the affected area and lot of rain water was carried out by the sewerage stream leading to further dilution of industrial effluent if any available in the sewerage network. Further, on 30.4.2023, when the sampling of main sewer line were collected from the affected area, no industry in the vicinity was in operation being Sunday, gas leak tragedy and forced power cut due to gas leak. This implies that the low pH at the incident site was not due to any industrial discharge but it was some localized reason that contributed to the low pH.
4. Above findings are supported by the analysis report as low pH between 2.51-2.59 is observed at manholes close to incident site, whereas, it is 4.41 at Upstream and 5.74 at Downstream of incident point. Had there been any acidic industrial discharge from upstream in the sewer line , the pH levels at upstream and downstream of the incident point should have been the same as that of the affected stretch and all the parameters should have shown a uniform trend in the samples drawn from all the manholes.
5. Further, samples from 9 locations of the branch sewer lines in the adjoining streets in the periphery of 500 m u/s and 200 m d/s were collected to check the sources of different parameters when all the water polluting industries were in operation on 1.5.2023. pH of these points has been observed to be near to neutral except at one point q(5.7). Therefore, contribution of the industries from nearby vicinity, seems not possible.
6. The possibility of accidental injection of industrial effluent or deliberate discharge of acidic effluent or suspicious matter through tankers or any other mode in the manholes of the sewer line near the affected site has already been ruled out by the police authorities during preliminary investigation. CCTV cameras of the area were scanned by the Police Authorities and as informed, no suspicious activity was observed near the incident area

upstream upto about 1 KM (Eastman Chowk) discharging any unethical effluent/ chemical etc. directly into sewer by any unsocial element.

7. **It is further observed that the incident occurred in a very short stretch i.e. around 3 houses. Had there been any gas formation due to industrial discharge, a long stretch of houses would have been affected. As such, the hypothesis of industrial discharge leading to formation of any gas could be ruled out.**

8. **Comments on the analysis results of the samples collected by Punjab Pollution Control Board.**

A. On the day of incident i.e.30.4.2023, samples were collected from 6 manholes of sewer line immediate near to the affected site. The details are as under:-

Ref No.	Sampling Location	Reference w.r.t zero point (incident point)	Time	Sample no.
A	From Manhole Opp. Jasbir Building Material Store	Upstream near to incident point	01:00 PM	S-3
B	From Manhole Near Transformer, Outside Saroj Beauty Parlour	Immediate Upstream the incident point	11:30 AM	S-1
			12:20 PM	A-1
C	From Manhole in the front of Nitco Logistics (P) Ltd, Near Transformer	Immediate u/s the incident point	04:30 PM	S-5
D	From Manhole Opp. Aarti Clinic	Opp. to the Incident point.	12:40 PM	S-2
E	From Manhole Opposite Dharam Kanda near Punjab Emporium)	Immediate d/s the incident point	01:40 PM	S-4

The analysis results are examined and observed:

a. low pH between 2.51-2.59 is observed at Point B,C and D close to incident site. Whereas, it is 4.41 at Point A (U/S) and 5.74 at Point E (D/S) of incident point.
b. High Concentration of iron between 951-1499 mg/l is observed at Point B,C and D. Whereas, it is found to be 333 mg/l and 291 mg/l at upstream and downstream respectively.
c. High Concentration of Sulphides between 56-60 mg/l is observed at Point B,C and D. Whereas, it is found to be 8.8 mg/l and 6.0 mg/l at upstream and downstream respectively.
d. Similar is the case of chlorides. Its concentration 683-1541 mg/l at B,C and D whereas on upstream and downstream, it is 295 mg/l and 231 mg/l respectively.
e. High TDS @19426 observed near the incident point whereas, It was 7706 at upstream and 1730 at downstream. Similarly, High COD of 4280 mg/l was observed near incident point whereas, it was 840 mg/l on upstream and 1978 mg/l on downstream
f. Concentration of Nickel is between 0.44-1.7 mg/l, whereas Zinc was found between 0.99-7.0 mg/l, T.Chrome concentration was observed between 0.56 to 9.1 mg/l. A general trend of reduction in the concentration of these metals is observed from upstream to downstream.

g. Concentration of Sulphates at Point B, C and D is found between 2756-3849 mg/l. It is 3851 mg/l at A (upstream) and only 882 mg/l downstream at E.

h. Parameters like Cadmium and Amm Nitrogen were found BDL(Below Detectable Limits) and Lead @ 0.51 and 0.67 mg/l is found at Point A and B respectively. It was BDL on rest of the points of sampling.

B. On 01.05.2023, samples from 9 locations of the branch sewer lines in the adjoining streets in the periphery of 500 m u/s and 200 m d/s were collected to check the sources of different parameters when the water polluting industries were in operation. Summary at 9 points of samples is as below:

a) pH varied from 5.7 to 7.4
b) COD varied from 297 to 922 mg/l
c) TDS varied from 625 to 1138 mg/l
d) Chloride varied from 106-194 mg/l
e) Sulphide varied from 0.4 to 12 mg/l
f) Sulphates varied from 20 to 211 mg/l
g) Iron varied from 2 to 9.4 mg/l
h) Zinc varied from 0.2 to 2.3 mg/l
i) Nickel and Chrome were found Beyond Detectable limits.

From the perusal of above results collected on 30.4.2023 from the main sewer line and on 1.5.2023 from the branch sewer lines, it is observed that the pocket in the affected stretch is not behaving in unison with the rest of the sewer line of the area. High accumulation of various pollutants is observed in this pocket indicating some abnormality in the flow of sewer or some blockage in that particular stretch only. The parameters reflected in the samples collected from the branch sewer lines near the water polluting industries supports the hypothesis of no contribution from these industries and rather built of anaerobic/sceptic conditions in the affected stretch.

9. <u>Sources responsible for High Organic load at the site</u>

a) **Densely Populated Vicinity:**-The Area is a house to crowded habitats mainly made by migrant labours who work in the industries. There are several vehras in which migrant labours are living in congested areas and other commercial establishments contributing to huge organic load. The vicinity in and around the incident site is densely populated

b) **Cluster of Meat and Fish processing shops and dhabas:**- There is a Cluster of nearly 10 fish/Meat shops located in the upstream of the incident point which are discharging the washing water with high Organic loads into sewers. Besides, There are around 6-7 dhabas opposite to the point of incident which are also a source of high organic load. They neither have any adequate disposal for highly organic effluent nor any adequate solid waste disposal arrangements. Broken manhole near the Meat shops indicate that the solid waste might be dumped in municipal sewer which leads to choking and heavy accumulation of organic matter.

10. <u>Sources responsible for accumulation of H2S in affected pocket</u>

Initial discussions with experts revealed that in case, waste water stream in a sewer line remains in running condition with proper ventilation of sewage network, the generation of H2S at such a lethal concentration is not possible as there would be no anaerobic conditions developed in sewer line, which is a pre-requisite for generation of H2S gas. However, in case there is a built up of organic matter due to blockage/stagnation in sewer /slow velocities of sewage/ ill designed sewer, there is possibility of sludge/slime formation, only then Bio-chemical degradation of organic matter would lead to the generation of gases like methane and H2S. Even if, the H2S

generates and proper vents are available, the chances of accumulation of H2S at such high concentrations is not possible. Inadequate vents to the sewer lines accompanied by no or poor ventilation in the residences of affected houses might have aggravated the problem resulting in the accumulation of H2S gas in the affected pocket.

As such, following might have been the main reasons for accumulation and reverse dissipation of H2S gas:-

a. Requirement of Sewer Vents

Sewer vents need to be provided to prevent sewer gases from entering the home and allows wastewater gases and odors to escape through the plumbing vent stack. Non availability of ventilation pipes in the affected stretch might have led to heavy accumulation of sewer gases such as H2S, CH4, CO etc. This gas is also a cause of sewer men deaths across the country as concentrations about 200 -250 ppm are also considered lethal. Further, the H2S levels at the night of incident even after caustic dosing were also measured to be very high (around 200 PPM) by NDRF teams which clearly shows that the H2S built up was there even after caustic dosing in the evening. This clearly shows development of anaerobic conditions due to deposition of organic matter and inadequate slime stripping in the affected stretch. Dr. Charan Kamal, District Forensic Officer, Ludhiana told the Fact-Finding Joint Committee on 8.5.2023 that in the past, he has experienced 6-7 incidents from H2S gas and all the incidents were happened due to sewer gases.

b. Reverse Ventilation of H2S Gas and Unscientific sewer connections by affected households.

The sewer connection made by M/s Goyal Karyana Store was unscientific which lead to reverse ventilation of H2S gas in their residence. The sewer opening / WC opening / wash basin drains may have acted as a reverse ventilation pipeline dissipation of H2S in the affected premises. Poor ventilation system particularly in the affected houses might have affected the dissipation of H2S gas and have aggravated the situation. No fatality was observed due to any dissipation of H2S in the main sewer line which was near to other end of the road. The incident occurred in a very small stretch at the opposite end of the main sewer line. As the sewer line of the 3 affected houses are interconnected, the possibility of hitting of the inspection chamber by someone with some stick/chemical thereby disturbance of the traps and leading to sudden dissipation of gas can not be ruled out.

c. Slime deposition in the sewer line near to the affected stretch

Inadequate slime stripping and slime deposition in the sewer line is one of the main reasons for accumulation of H2S at the affected stretch. The slime deposition was removed at night at around 1:00 AM using jetter and supersuction machines which clearly shows that thick sludge was deposited at bottom of the sewer line and clubbed with all the factors stated above has lead to heavy accumulation only in the affected stretch and reverse dissipation in the affected households. Further even if H2S is formed, the same would have not been reversely dissipated had there been the presence of sewer vents and provisions of scientific sewer connections with adequate ventilation arrangements by the affected households.

11. <u>Scientific and Technical Views of the Experts</u>

A. The Preliminary Report along with Findings and recommendations from Dr. Anoop Grover, Professor, Department of Chemical Engineering, Thapar Institute of

B. The report on the visit of Expert Committee comprising of Professor Sushil Mittal, Vice Chancellor, Sardar Beant Singh State University, Gurdaspur (Now Vice Chancellor, Punjab Technical University) and Professor Raj Kumar Gupta, Department of Chemical Engineering, Thapar Institute of Technology is attached as **Annexure-C.**

C. The copies of literature obtained from various Journals/papers published internationally supporting the above hypothesis is attached alongwith as **Annexure-D.**

Thus, in view of the literature and Expert views, the Punjab Pollution Control Board is of the view that the formation and accumulation of H2S gas at the point of incident is due to the anaerobic biochemical degradation of Organic matter and not due to discharge of industrial chemical effluent as described above.

DA/As above

Senior Environmental Engineer

Endst No **Dated**

A copy of the above is forwarded to the following for information, please.

1. The Chief Environmental Engineer, Punjab Pollution Control Board, Ludhiana.
2. The Senior Environmental Engineer, Punjab Pollution Control Board, Zonal office-2, Ludhiana.
3. The Environmental Engineer, Punjab Pollution Control Board, Regional office-2, Ludhiana.

DA/As above

Senior Environmental Engineer

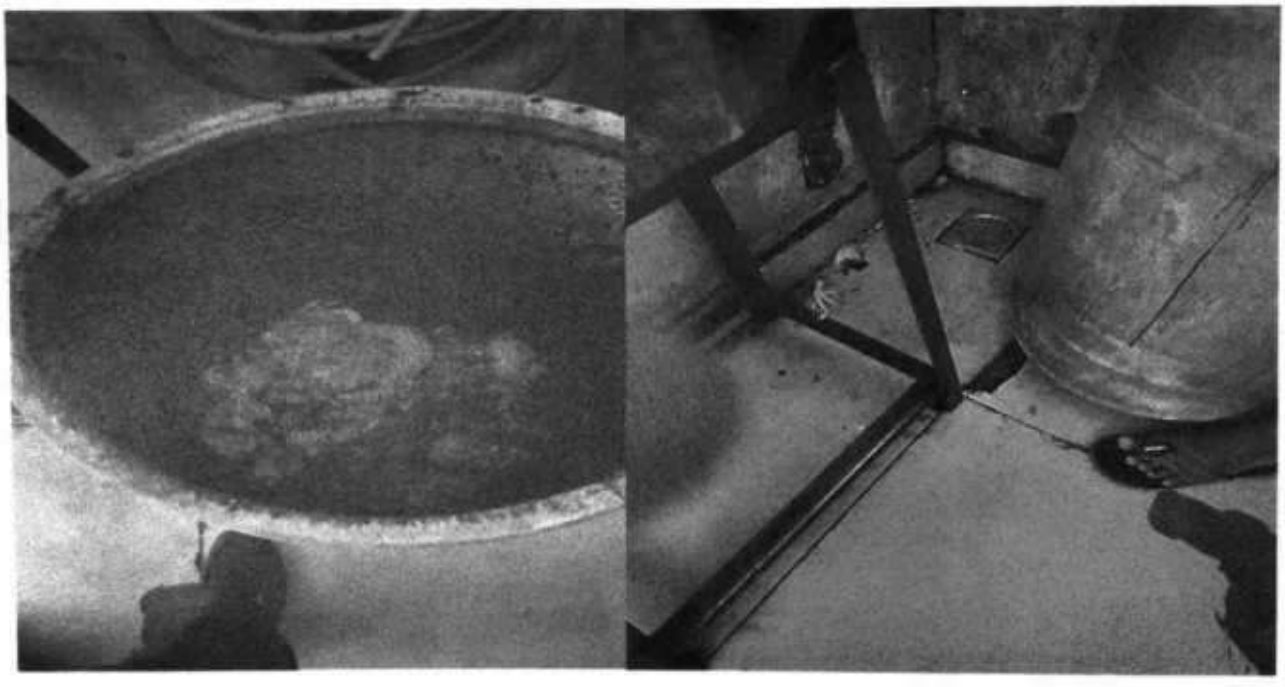
AFFECTED STRETCH

M/S Goyal Cold Drinks

House of the deceased

UNAUTHORIZED MEAT/SLAUGHTERING SHOPS

Cluster of meat shops are located in the upstream of the incident point which are discharging the washing water with high Organic loads into sewers

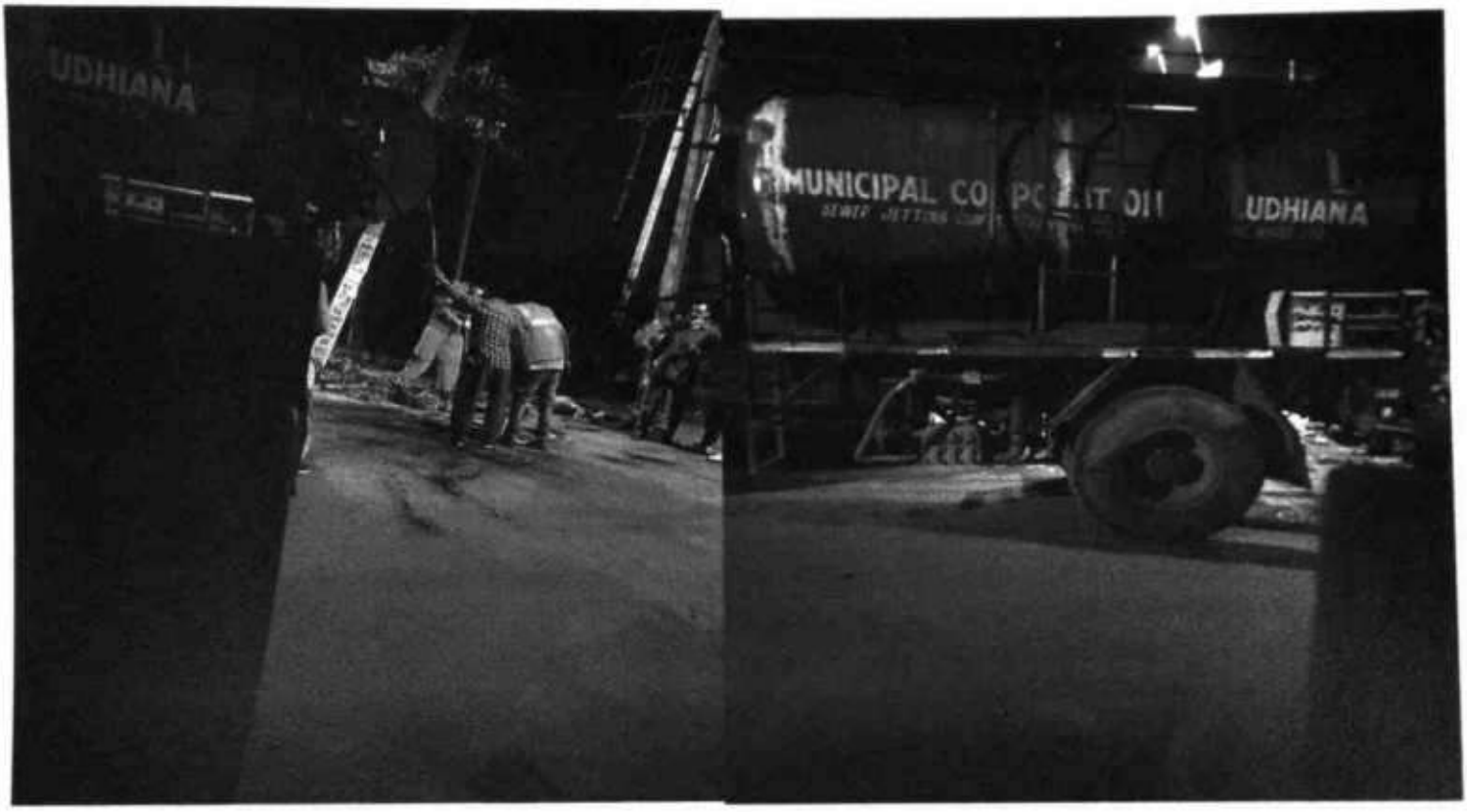


No adequate solid waste handling which leads to choking of sewers

Illegal Outlet for discharge of high organic loaddirectly into sewer .

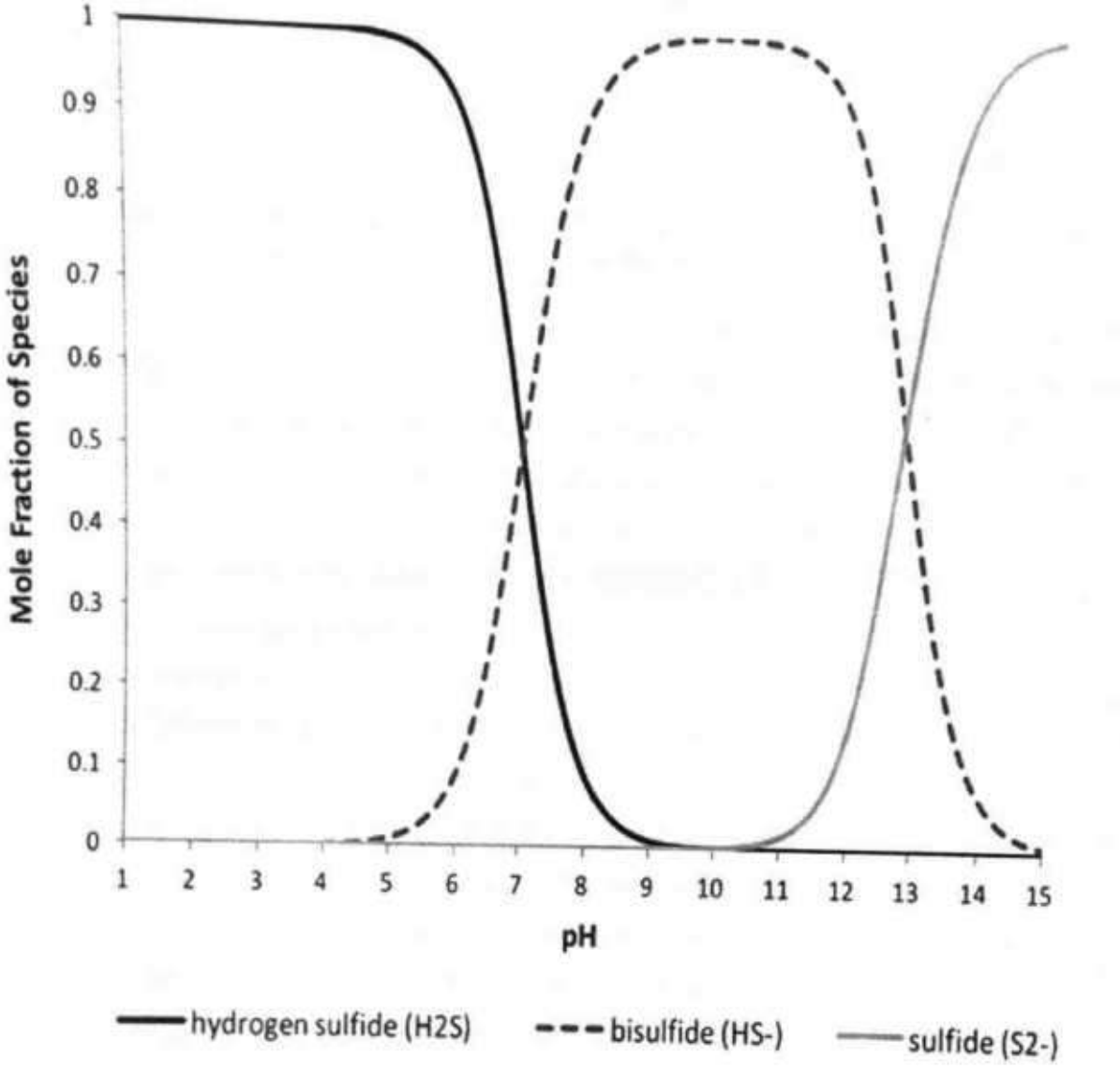
NO OR POOR VENTILATION IN THE HOUSES OF THE DECEASED

SEWER CHOKING CLEANED AND SLIME REMOVAL BY JETTER AND SUPERSUCTION MACHINES AT INCIDENT NIGHT1.5.2023 (AROUND 1:00 am) AT THE TRAGEDY SITE



CONSTRUCTION OF ROAD GULLIES AND PROVISION OF VENTILATION JALIS 2 DAYS AFTER INCIDENT

Annexure-A



H2S and pH: As visualized above, H2S begins to dissociate at a pH of ~5, and forms 100% HS- at a pH of ~9. At a pH above 15, we see 100% S2-.

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01/05/2023

Subject: **Findings and recommendations during visit to Sua Road, Giaspura, Ludhiana regarding inspection and investigation of gas leak accident.**

This is in reference to the above subject matter, I visited the said site on 01.05.2023 at 11:30 AM. During my visit, I met Ms. Swati Tiwana, SDM (West), Ludhiana and she introduced me to the Hon'ble Deputy Commissioner Ma'am. ADC (General), Officers from Punjab Pollution Control Board, Director of factories and Police authorities were also present. Gist of my interaction with all the above administrative staff and my opinion is as follows:

1. It has been told that as per the findings of NDRF and CSIO, the gas leakage accident might have occurred due to high concentration of hydrogen sulphide (H_2S) and carbon monoxide dissipated due to blockage of sewerage lines. One of the person from the deceased family tried to open up the block sewer using stick or might be with chemicals led to immediate release of huge amount of H_2S. As H_2S is a toxic gas which can cause severe health risk. As per the cited literature concentrations above 500 ppm is lethal for human beings which can cause immediate death. As per the discussions on the site this concentration was much higher when it was immediately released from the sewer. Role of H_2S in immediate deaths of persons is imminent as H_2S cause inhibitions of the cytochrome oxidase enzyme system resulting in lack of oxygen use in cells
2. I along with Ms. Swati Tiwana, SDM (West), Ludhiana and other administrative staff visited the house where five family members were died due to acute gas exposure. Based upon our findings we conclude the house was constructed with very poor ventilation. Moreover, there was sewer opening in the bedroom itself where the family members might have been present. The H_2S gas might have found its route as back flow into this room which could have led to high concentration of this gas in that room leading to deaths.

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3. While inspecting the nearby areas it is observed that it is densely populated area without any proper arrangement of sewer flow. This could lead to heavy accumulation of organic matter which eventually lead to bio-chemical degradation with more H_2S formation. Heavy rain on the proceeding evening of fateful tragedy i.e. on 29.04.2023 may have contributed to the regular flow in sewerage line and might have created temporary blockage in lines.
4. There were no ventilation pipes (vent pipes) provided with sewer lines along the affected stretch, which might have accelerating the buildup of H_2S and other gases in the sewage system.
5. I could try co-relating this incident with industrial discharge also from nearby industries. But based upon my observations and personal opinion, if it could have been the industrial untreated discharge, the long stretch of houses would have been affected. However, the diameter of the affected area was limited to 3-4 houses so, hypothesis of industrial discharge could be neglected. Even if it is presumed that there is some untreated industrial discharge in that particular stretch then in that case; the severity of high concentration of H_2S is not possible. If administration recommends, the sampling of sewer manholes can be carried out.
6. Once again based upon the onsite discussions with concerned officials, I could co-relate this incident as a case of sewer blockage where anaerobic digestion of organic matter led to formation of H_2S. During anaerobic digestion / fermentation, bio-chemical reactions lead to the formation of gases like carbon monoxide along with other gases like H_2S, CH_4, CO_2, N_2O, H_2. Also, H_2S combines with oxygen to form sulphuric acid which eventually can lead to reduction in pH of slurry.

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There were many small slaughter houses, dhabas in the close vicinity of the affected site which could have led to release of huge amount of organic content in the sewer lines. Again, this organic content is feeder to anaerobic digestion which ultimately lead to formation of H_2S, CO and other gases.

7. Based upon the overall inspection of the site and subsequent interactions with all the administrative staff, I have some personal recommendations to cope up future incidents like this:

   i. While designing sewer lines, the contribution of rainwater run off should also be accounted for. Regular cleaning of sewer lines where there is a poor drainage systems and provision of vent pipes in the sewer lines should be provided. Moreover, illegal connections from the households to the main sewer line should be checked regularly.

   ii. Regular mock drills for gas leakage safety, fire from gas leakage would be adopted by Municipal Corporation for densely populated area like this.

   iii. Municipal Corporation and other regulatory bodies should collaborate with institutes of repute to develop state of the art technologies to avoid any such incident in near future.

Dr. Anoop Verma

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Prof. (Dr) Susheel Mittal CChem FRSC
VICE CHANCELLOR

Ref. No. SBSSU/1205
Date 25/05/2023

Preliminary report on the visit of the Expert Committee comprising of Professor Susheel Mittal, Vice Chancellor, Sardar Beant Singh State University, Gurdaspur and Professor Raj Kumar Gupta, Department of Chemical Engineering, Thapar Institute of Engg. & Technology, Patiala on May 2, 2023 at 3.30 PM

The committee visited the site of the incident on May 2, 2023 (Tuesday). The committee was briefed about the incident. The committee interacted with local residents and witnesses of the incident and spent about 90 minutes at the site. It was informed to the committee that PPCB had already collected samples of sewerage line from the incident site on 30.4.2023 and other nearby locations on 1.5.2023. Preliminary observations of the committee are:

1. Incident happened on early morning of April 30, 2023 (Sunday) around 7 AM, as informed by the local residents who were available for the comments.
2. Incident site is surrounded by commercial, residential and tiny industrial establishments like fabrication units, machining units, buffing/polishing addas, wire drawing units. Some tiny electroplating units are also reported to be working in the vicinity. In front of the incident site, there are number of small food eateries (dhabas and tea shops). On the upstream of the incident point, there is a cluster of raw fish and meat slaughtering shops.
3. Brother of one of the victims, owner of Goyal Karyana Store informed us that his brother suddenly fell unconscious and died near the 'Haudi' just outside the shop when he visited the shop. His mother and brother's wife also died on the spot when they came down from the house on the first floor of the shop where they lived, on hearing voices of the passer-byes.
4. It was also informed by the residents that five persons died inside the Aarti Clinic, located next to Goyal Karyana Store. Some more people are reported to have died near the incident site.
5. When our team visited the site, whole of the incident site was found clean and man-hole covers of sewerage lines replaced and cleaning of the sewerage line done, as

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Date.....

informed by the residents. Further, the residents informed us that the main sewerage line might have been blocked as it was cleaned with super suction machines in the late night on 30.4.2023. They also told us that the problem of sewerage line blockage is common in this area.

6. Poor or no ventilation was found in the residences of affected persons
7. We were informed by the people that the cause of deaths could be inhalation of H_2S, as declared by the NDRF and district administration also.

As per the information available to us supported with Chemical Testing Reports (provided by PPCB) of the samples reported above, following are our **preliminary findings:**

a. Loss of life was due to inhalation of some poisonous gases like Hydrogen sulphide (H_2S) in high concentration (more than 700 ppm).
b. H_2S is mainly generated in the sewer from the biochemical degradation of human excreta, kitchen refuse, detergents, oil and grease, animal waste by microflora of organisms, which are always present in the waste aqueous streams. Where ever there is blockage of the sewer stream or a sludge deposition in the sewer line, it leads to anaerobic conditions. Possibilities of accumulation of high concentration of H_2S is highly probable when there is sewerage line blocked. Since the sewerage manholes in the vicinity of the Karyana Store and Aarti Clinic were all tightly covered, the sewerage pipe became a closed chamber leading to accumulation of the H_2S gas.
c. A high concentration built up of the gas in the underground pipe might have been triggered by the residents in the affected houses, who tried to clear the blocked sewerage themselves.

Some additional findings based on the lab test reports:

1. Low pH in the range of 2.5 reported in the sewerage samples collected from manholes near the affected site indicated anaerobic conditions in the said sewer line portion. pH conditions are reported to be in the range 4.4 to 5.7 in the upstream and downstream stretches of the sewer line, which indicates building up of anaerobic condition only in the accident area and sustaining in adjoining pockets.
2. High concentrations of sulphides in the range 56-60 mg/L in the affected sewerage pockets as compared to 6 - 8.8 mg/L in the upstream and downstream pockets might have come from anaerobic biodegradation of the organic matter and conversion of sulphates to sulphides in acidic (low pH) conditions, especially in the focused stretch of the underground sewer line accompanied with inadequate slime stripping, long detention and insufficient design planning of the sewer line. A similar pattern of concentrations was observed for chlorides, in the relevant pockets.
3. Iron in particle/powder form probably enters in the sewer system from the cottage industry operating in the area engaged in machining processes like buffing, polishing,

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nut-bolt making, drilling and wire drawing industry. The iron so entered in the waste stream got accumulated in the affected pocket due to reasons of sludge settling or some other similar reasons. High concentrations of iron in the range 989-1459 mg/L in the affected sewerage pockets as compared to 291 - 333 mg/L in the upstream and downstream pockets might have come due to solubility of the metal in the acidic conditions converting metal particles to the dissolved aqueous form. Results dated 1.5.2023 of adjoining streets suggest low concentration of iron contents upto a range of 9 ppm compared to high concentration of iron observed in affected areas also indicates accumulation of iron and others in a particular stretch. High TDS (19426mg/L) near the incident point and low TDS (1730 mg/L) upstream supports the above finding.

4. Presence of metals, especially iron, zinc, nickel, chrome or any other heavy metal in the sewerage sample cannot lead to the generation of H_2S. On the contrary, iron and other metals in the aqueous medium or iron salts would combine with sulphide ions (from H_2S or any other source of sulphide) to immediately convert to highly stable iron/metal sulphide through an irreversible reaction leading to the formation of respective metal sulphides. Hence, due to above property of metals, iron, nickel, zinc, chromiun etc. would never be a source of H_2S generation, rather are used as H_2S scavengers to remove sulphide from various streams likely to contain H_2S.
5. Moreover, due to the presence of heavy metals including iron, the low BOD is likely to be observed due to inhibition by these metal ions.
6. In case of a waste water stream in running condition with proper ventilation of sewerage network, the generation of H_2S at high concentrations are not possible, as there would not be anaerobic conditions developed in the sewerage line. However, when blockage is built up and anaerobic conditions prevail, only then biochemical degradation of organic matter would lead to the generation of gases including H_2S.
7. Meat/fish slaughtering cluster on the upstream and unauthorized eateries in front of the incident point contributes to high organic load and might have added to the H_2S generation under anaerobic conditions in the sewer line.
8. Possibility of accidental inoculation with any unknown chemical or material in the affected stretch of the sewer line could also have triggered generation of any poisonous gas leading to causalities.

Susheel Mittal

Dr. Susheel Mittal 25.5.23
Vice Chancellor, SBS State University, Gurdaspur
(Former Registrar & Sr Prof. Chemistry at TIET, Patiala)

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HYDROGEN SULPHIDE GAS IN SEWERS – THE CHALLENGES OF ODOUR AND CORROSION

Paper Presented by:

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39th Annual WIOA
Queensland Water Industry Operations Conference and Exhibition
Logan Metro Indoor Sports Centre, Logan
3 to 5 June, 2014

HYDROGEN SULPHIDE GAS IN SEWERS – THE CHALLENGES OF ODOUR AND CORROSION

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ABSTRACT

The presence of Hydrogen Sulphide gas (H_2S) in sewers can result in hazardous work environments, odour complaints and accelerated corrosion of assets. In the water industry, we are all familiar with the impacts of H_2S gas in sewers, pump station wells, discharge manholes and treatment plants.

H_2S gas problems generally occur after the infrastructure has been built. Therefore, operators are typically the front line when odour complaints are received or H_2S gas is detected.

This paper discusses the challenges operators face due to H_2S gas, how it is generated, how H_2S gas corrodes our assets, odour and corrosion examples, accepted removal/treatment technologies, what can be done to reduce H_2S gas generation and typical repair techniques.

Controlling H_2S gas and repairing corroded infrastructure is achieved by the combined efforts of operators and engineers. Treatment and reduction options can be developed by knowing how much and how often the H_2S gas occurs. Examples of H_2S gas management are presented. Practical, low cost strategies in reducing H_2S gas are also discussed.

1.0 INTRODUCTION

Once released from the sewage (i.e. the liquid phase), H_2S gas can be toxic to sewer workers, even at low concentrations, and cause nuisance odours. Under certain conditions H_2S gas can be converted to sulphuric acid which can corrode the internal walls of sewers, manholes, pump stations and other concrete and steel structures.

H_2S gas impacts include:

- Release from the sewage at manholes, vents, pump stations and channels into the atmosphere, resulting in odour problems
- H_2S gas is denser than air so it may sit at the bottom of maintenance structures such as tanks, wells, enclosures, pits, buildings, storage areas etc.
- H_2S gas can be oxidised within the sewer headspace on the sewer pipe wall resulting in the generation of sulphuric acid, which is corrosive, especially to concrete or concrete lined pipe.

Practice has shown that very low concentrations of H_2S gas in solution, for example 1mg/L, can produce a concentration of hundreds of ppm by volume in air. This has been observed in sewer 'headspaces' and wet wells.

The whole of life cost of corroded sewer assets has been estimated at many thousands of dollars per km resulting from H_2S gas. Cesca et al. state that "*The cost associated with premature deterioration of sewer assets has been estimated at over $12,000 per km for a hydrogen sulphide concentration of 100 ppm in a 300 mm diameter sewer*".

2.1 How is H_2S Gas Generated

The following describes the H_2S gas generation process:

"Hydrogen sulphide is formed under anaerobic conditions at low flow velocities and warm temperatures. The rate of release is increased at points of high turbulence and at the outlets of inverted syphons and pressure mains."(H_2S Control Manual, Water Services Association of Australia)

Inputs to H_2S gas generation include available oxygen, suphates, organic matter, inadequate slime stripping velocities, detention time, temperature (e.g. tradewastes versus domestic sewage) and insufficient planning (e.g. catchment growth outstripping hydraulic capacity)

Mechanisms for the creation and release of H_2S gas occur when sulphate or oxygen is used/depleted to produce sulphide. The resulting hydrogen sulphide gas can remain in solution or under certain conditions can be released to the atmosphere.

2.2 How is H_2S Gas Measured

H_2S gas can be measured using the following methods:

- OU's – Odour Units (i.e. refer AS/NZS 4623) – odour sample needs to be captured and scientifically tested. Reported as OU/m^3
- ppmV – the volume of H_2S gas in proportion to the total air volume in parts per million. H_2S gas loggers and proprietry software are available for logging and analysing data
- Sulphide concentration modelling (i.e. predictive only):

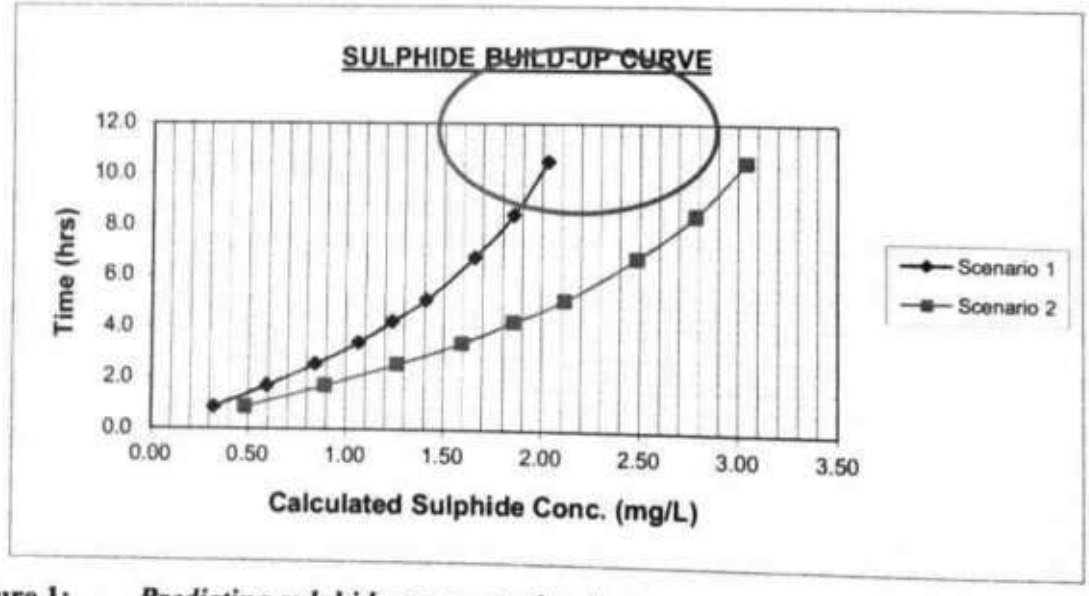

Figure 1: ***Predicting sulphide concentration in a sewer***

- H_2S gas dispersion modelling (i.e. predictive only) – assumed or measured concentrations are predicted from environmental inputs using proprietry software.

Health Effects of H_2S Gas

Tables 1 & 2 show the health effects and recommended limits for H_2S gas exposure

Table 1: ***H_2S gas levels and impacts***

Level in air (ppm)	Impacts & Health Effects
0.008	Odour threshold (with some individual variability)
>0.008	Increasing possibility of annoyance and headache, nausea, fatigue
2	Bronchial restriction in some asthmatics
4	Increased eye complaints
5-10	Minor metabolic effects
20	Neurological effects including memory loss and dizziness

Table 2: ***Exposure limits***

Limit (ppm)	Exposure Time
2	30 minutes
0.1	24 hours
0.014	90 days

(*Hydrogen Sulpide and Public Health*, Department of Health, WA Government, 2009)

Concentrations of H_2S gas greater than 150 ppm become undetectable to the olfactory system. Concentrations greater than 300 ppm can cause loss of consciousness and death. Very high concentrations greater than 1000 ppm can result in immediate collapse after a single breath (Wikipedia, search: sewer gas, March 2014, http://en.wikipedia.org/wiki/Sewer_gas).

2.4 Removal of H_2S Gas

H_2S gas reduction or removal usually depends on where in the sewerage system the appropriate method can be applied. The H_2S gas problem can be attacked in the dissolved or undissolved form:

Liquid phase:

- Dosing to precipitate out the sulphur containing compounds. For example, dosing ferric chloride, where H_2S gas will react with metal ions in the liquid to produce metal sulfides that are not water soluble
- Dosing for biological and/or chemical conversion/capture, for example, the addition of microbes that consume enzymes, oxygen injection, pH adjustment (e.g. magnesium hydroxide)
- Masking agents/deodorising

Gas phase:

- Sealing the system – usually silicon based products such as Sikaflex™
- Ventilation – induct/educt of air (i.e. dilution over time)
- Extraction - wind assisted or fan extracted
- Adsorption – activated carbon (usually impregnated for H2S gas removal), other media types include plastics, coconut husks, timber mulch
- Biological and/or chemical conversion/capture
- Burning off.

In more recent times, the following reduction methods have been found to be the most effective, based on longevity and not necessarily cost.

Table 3: ***Accepted H_2S gas reduction methods***

Prevention	Containment	Treatment
Calcium nitrate	Magnesium hydroxide	Carbon filters
Ferric nitrate	Sodium hydroxide	Bio-filters
Oxygen injection	Ferric chloride	Chemical scrubbers

Reducing H_2S Gas Generation

Some practical H_2S gas reduction methods include:

- Reduce turbulence in MH's and inlet structures
- Venting – designed induct and educt ideally
- Increase pumping frequency and/or flow
- Improve slime stripping velocities
- Submerge inlets where possible – discharge MH's and wet well inlets
- Vent outlets at high points
- Flush mains with long detention times or low velocities
- Reduce fats, oils and greases in wet wells
- Choose materials to suit the amount of potential H_2S gas e.g. high CAC cement lining, HDPE pipe and liners, epoxy liners
- Saw tooth rising mains:
  - Automatic air release valves on high points
  - Monitor long 'falling main' sections
  - Condition inspection – wall thickness, non-destruction or coupon/cut-out sampling and testing to track deterioration (N.B. testing can be expensive); hardness testing; cover tests; chemical or physical analysis
  - Where possible, don't build them
- Improve quality by reducing H_2S gas producing tradewastes – high BOD, high temperature, high sulphur containing wastes e.g. food manufacturers
- Monitor and track H_2S gas concentrations at critical points e.g. pump stations, discharge MH's, inlet structures, pressure mains
- Map odour complaints versus seasonal changes.

In practice even retic gravity sewers or small diameter rising mains have the potential to generate high H_2S gas concentrations, usually due to long detention times. But how can we vent sewers near houses and businesses without adversely affecting customers? Some form of treatment combined with dispersion is usually required. Figures 2 and 3 show some relatively low cost treatment and dispersion options.

Figure 2: ***Typical AC filter & vent***

Figure 3: ***Biotrickling filter***

Figure 4: ***Chemical scrubber***

When H_2S gas is converted by microbes to sulphuric acid (e.g. on the pipe wall), its corrosive effects can cause long term loss of wall thickness or even complete failure/collapse.

The extent of corrosion depends on the asset type, materials, system design and operational decisions. Examples of H_2S gas corrosion include:

- Concrete – microbial induced corrosion via acid attack (refer figure 5)
- Asbestos cement pipe – lime leaching making pipe susceptable to cyclic failure (refer Figure 6)
- Ferrous – found in older pipes and fittings, knifegate valves, penstocks, inlets etc.
- Plastic – not likely but some evidence of pock-marks in HDPE pipe

Figure 5: *Corroded concrete pipe*

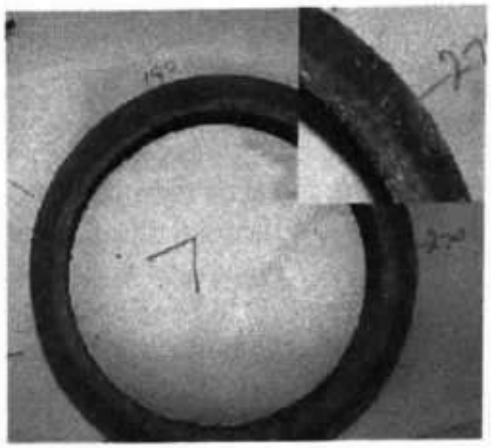

Figure 6: *AC Sewer rising main-internal leaching due to H_2S gas*

2.6.1 H_2S gas Corrosion Protection

Protective coatings are the most common H_2S gas prevention technique. Some typical coatings used in the water industry include:

- Cement mortar – trowelable or spray-on
- Epoxy spray-on
- HDPE liner
- Cement-based spray-on liner e.g. gunite

It should be noted that the success of protective coatings is dependent on the material type, surface integrity and preparation.

2.6.2 Repair Techniques

Some proven H_2S gas corrosion repair techniques include:

- Pipe relining – CIP liners, spiral liners, structural liners
- Patching/clamping (small dia.) – internal or external (e.g. pressure main repair bands)
- Patching (large dia.) – reline shorts for large pipe
- Repair wraps e.g. resin-soaked fibreglass bandage
- Sand blasting, priming and re-coating

Renewal or complete replacement as a result of H_2S gas corrosion are generally an expensive exercise that may have been avoided if monitoring and adequate repairs were in place. At the very least, a successful repair will afford time to determine the most cost effect renewal as well as time to procure the specialist contractors that are usually required.

3.0 CONCLUSION

The role of the operator in managing the challenges of H_2S gas includes:

- Ensuring that operating and maintenance work is conducted safely when H_2S gas has the potential to exist
- Note any conditions or changes that may increase the likelihood of H_2S gas generation
- Identify and report H_2S gas and corroded assets
- Implement a repair solution that will maintain service until rehab/renewal is done.

Key messages for the operator to consider:

- How is H_2S gas generated
- What are the conditions that may increase H_2S gas
- How is H_2S gas concentration measured and what units are used
- What are the exposure levels and relative health impacts
- What are some proven treatment and removal techniques
- What actions can be taken to reduce the likelihood of H_2S gas generation
- What are the typical forms of corrosion
- What are some typical repair techniques

4.0 ACKNOWLEDGEMENTS

I wish to acknowledge the assistance of David Jobberns and Noel Southern from McBerns for their valuable input.

5.0 REFERENCES

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ANNEXURE-

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Sodium Chlorite
Hydrogen Sulfide Control in Wastewater Collection Systems

Introduction
Hydrogen sulfide (H_2S) is a dense, colorless, strongly odorous toxic gas that corrodes infrastructures and impairs the performance of wastewater treatment operations.

Hydrogen sulfide is naturally converted to sulfuric acid, which is corrosive towards steel and concrete. Control of H_2S will result in increased life and lower maintenance cost for facilities and piping. In addition, worker safety is of concern as hydrogen sulfide is extremely toxic at levels above 500 ppm, which can be reached in confined spaces.

A number of sulfide control strategies are available depending on the system design and treatment goal.

Application Description
Sulfide exists in wastewater in three forms: hydrogen sulfide gas (H_2S), non-volatile ionic species hydrogen sulfide (HS^-) and sulfide (S^{2-}). The ratio of each of the three species H_2S, HS^- and S^{2-} is dependent on the pH. At pH 6, 90% of the sulfide will be present as H_2S, and the higher the H_2S concentration the greater the tendency for it to volatilize. Conversely, at pH 10, 100% of the sulfide will be present as S^{2-}.
Hydrogen sulfide occurs naturally through the anaerobic decay of organic matter and recognized by its characteristic rotten egg odor. In typical domestic wastewater, microbial reduction of the sulfate ion is the dominant mechanism for sulfide formation. In the absence of dissolved oxygen (DO) and in the presence of soluble Biological Oxygen Demand (BOD), *Desulfovibrio desulfuricans* (SRB) and other sulfate-reducing bacteria (SRB's) convert the sulfate ion to sulfide.

$$SO_4^{2-} + \text{Organic matter} \xrightarrow[(\text{no D.O})]{\text{Anaerobic Microorganisms}} H_2S + CO_2$$

Hydrogen sulfide formation in wastewater systems occurs primarily in the gelatinous slime layer that accumulates on pipe walls and in the sludge blankets of clarifiers and other solids processing units. The rate of sulfide production is dependent upon the concentrations of sulfate ions, organic matter, and dissolved oxygen, as well as other factors such as pH, temperature, retention time, stream velocity, and surface area.

Treatment Alternatives
There are two basic ways to control hydrogen sulfide:
- Prevent sulfide formation
- Remove the sulfide after its formed

Preventing Sulfide Formation
Inhibiting bacterial action or moderating the variables affecting hydrogen sulfide generation is often the basis for controlling hydrogen sulfide in wastewater treatment systems. Treatment options include the following chemicals: Chlorine dioxide and Nitrate.

Chlorine dioxide (ClO_2) is applied at or near the source of hydrogen sulfide. Chlorine dioxide, when fed at doses higher than the minimum required to destroy hydrogen sulfide will remove the biofilm layer, which contains the bacteria creating the sulfide. Chlorine dioxide

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reacts more rapidly and completely than other available oxidizers and does not form colloidal sulfur.

Sodium nitrate ($NaNO_3$) is applied to retard septicity and promote bio-oxidation of organic odors in systems with a retention time greater than four hours. Sodium nitrate is a biological approach to controlling odors in wastewater, providing naturally occurring facultative anaerobic denitrifying bacteria with a source of bound oxygen, which is metabolized preferentially over other sources of oxygen like sulfate. This results in the production of nitrogen gas via intermediates like nitrite (NO_2^-), nitric oxide (NO), nitrous oxide (N_2O) and other metabolic byproducts rather than sulfide.

$$BOD + NO_3^- \xrightarrow[\text{(no D O)}]{\text{Anaerobic Microorganisms}} N_2 + CO_2 + \text{Biomass}$$

Typical field applications require a minimum of 1.5 pounds of nitrogen-oxygen (N-O) per pound of BOD.

Removing Sulfide After its Formation

Removing the sulfide after it has been formed can be achieved using a variety of chemicals either alone or in combination. The treatment mechanism generally employed is oxidation of the hydrogen sulfide to either sulfur or the sulfate ion. In some cases, the chemical treatment program also promotes bio-oxidation of organic odors. Common treatment options include: Nitrates, Sodium chlorite, Hydrogen peroxide, and Iron Salts

Nitrate (NO_3) may also be effective for the removal of existing sulfide in the presence of bacteria that can utilize the nitrate for the oxidation of sulfide to sulfur or sulfate. Examples of such bacteria include *Thiabacillus denitrificans*, *Thiomicrospira denitrificans* and *Thiosphera pantotropha*[1]. Bacteria able to utilize nitrate for the bio-oxidation of sulfide are naturally present in sewage systems.

Sodium chlorite ($NaClO_2$) is applied at or near the source of hydrogen sulfide. It is also applied in wastewater systems where a retention time of greater than 3 hours is encountered, such as remote sites for long duration control. Sodium chlorite selectively oxidizes sulfide and related organic odors. Unlike hypochlorite, sodium chlorite does not react with ammonia, and does not form chlorinated organics.

$$2H_2S + NaClO_2 \rightarrow 2S^0 + 2H_2O + NaCl$$

Typical field applications require a minimum of 3 mg/L of sodium chlorite per 1 mg/L of sulfide.

Hydrogen peroxide (H_2O_2) is applied to the wastewater system usually where there is a retention time of less than 5 hours and at least 30 minutes prior to the point where the hydrogen sulfide is released. Hydrogen peroxide is a stronger oxidant than either chlorine or potassium permanganate. Hydrogen peroxide will oxidize the hydrogen sulfide present and promote bio-oxidation of organic odors. Hydrogen peroxide decomposes into oxygen and water, environmentally harmless byproducts.

$$H_2S + H_2O_2 \rightarrow S^0 + 2H_2O \quad (pH < 8.5)$$

$$H_2S + 4H_2O_2 \rightarrow SO_4^{2-} + 2H_2O \quad (pH > 8.5)$$

Typical field applications require 1 to 3 mg/L hydrogen peroxide per 1 mg/L sulfide. The reaction with sulfide is rapid with 90% of the hydrogen peroxide typically consumed within 10 to 15 minutes.

Iron Salts are applied to wastewater systems for long-duration control. Both ferrous and ferric salts react with dissolved sulfide to form metal sulfide precipitates that are removed at the treatment plant.

Ferrous Salts: $Fe^{2+} + HS^- \rightarrow FeS + H^+$
Ferric Salts: $2Fe^{3+} + 3HS^- \rightarrow Fe_2S_3 + 3H^+$

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Typical field applications require 3-5 mg/L as Fe per 1 mg/L of sulfide.

Further Information

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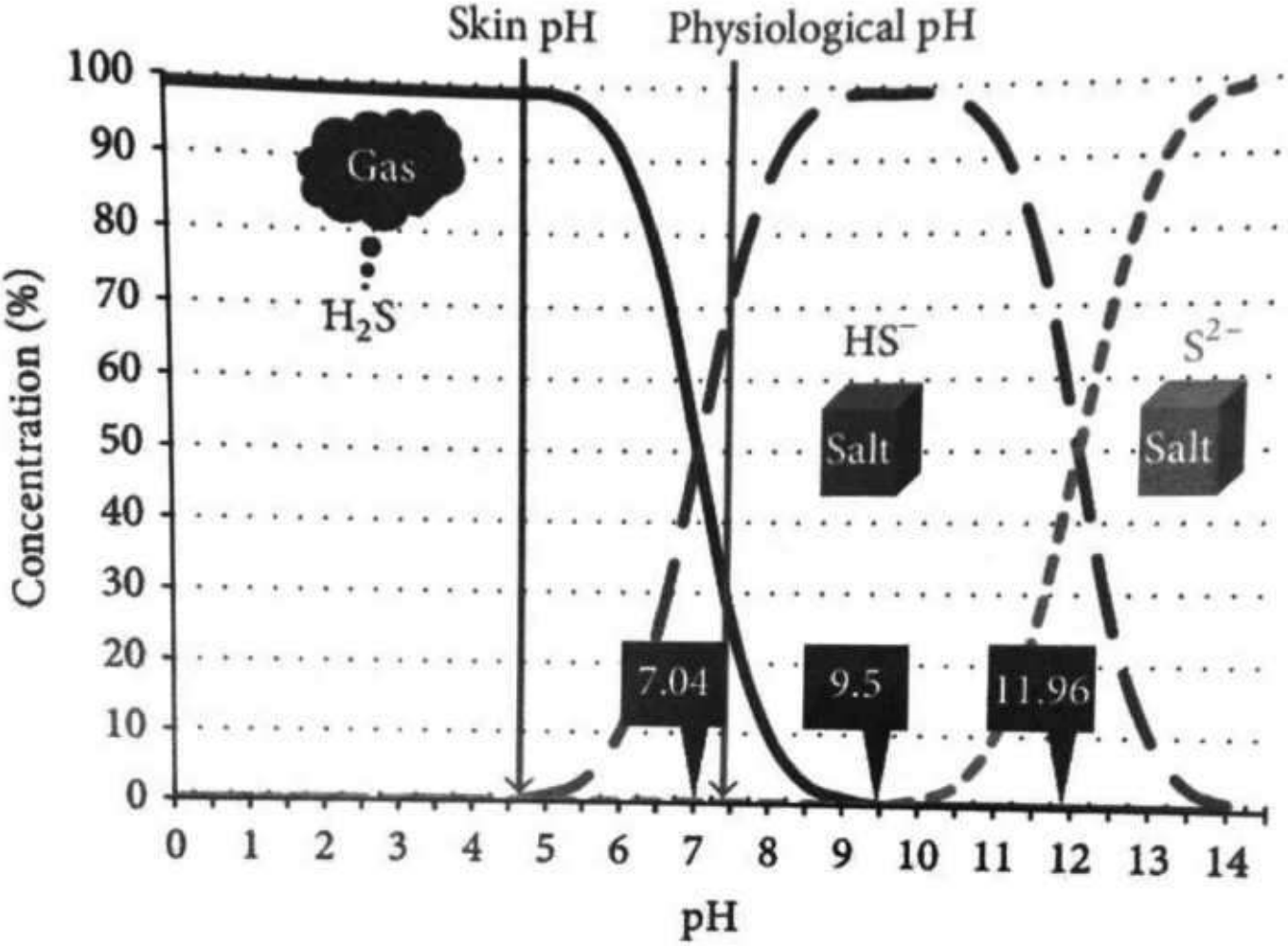
Skin pH
Physiological pH
Gas
H_2S
HS^-
S^{2-}
Salt
Salt
7.04
9.5
11.96
Concentration (%)
pH
100
90
80
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

TECHNICAL INFORMATION FROM THE CONCRETE PIPE ASSOCIATION OF AUSTRALASIA

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BIOGENIC SULPHURIC ACID ATTACK ON CONCRETE PIPE

In concrete pipes carrying aged sewage, in warm climates, the interior surface above the effluent level is subject to attack by sulfuric acid generated by bacterial action at the pipe wall, making use of hydrogen sulfide gas in the sewer atmosphere. The production of hydrogen sulphide and the consequential deterioration of concrete sewer pipes is first and foremost a function of sewer design and environmental factors. This process, known as "H_2S attack", can lead to very rapid deterioration.

Biogenic sulphiric acid (BSA) attack is regarded as one of the most aggressive forms of attack on concrete sewer infrastructure. This has been studied since 1945 when it was discovered that bacteria are responsible for the attack mechanism. Colonisation of the concrete surfaces is progressive with various strains of the same family, Thiobacilli, thriving at different pH levels. The final stage is the most aggressive, with acid producing bacteria thriving at pH levels less than 2 and being capable of generating sufficient acid to reduce the pH to 1, which is highly aggressive to all cementitious materials.

The mechanism for this type of attack on concrete is summarised below:

Step 1: Newly installed concrete pipe has a highly alkaline surface pH of approximately 12-13. In the wastewater, sulphate reducing bacteria (SRB) reside which utilise sulphates present in the wastewater as an oxygen source, reducing them to produce hydrogen sulphide (H_2S) and CO_2.

Step 2: If there is sufficient oxygen, nutrients and moisture present, colonisation of neutrophilic bacteria, can cause oxidisation of H_2S to create sulphuric acid (H_2SO_4). The acid reacts with the concrete pipe obvert and walls, and further lowers the pH. This facilitates colonisation by new strains, adapted for lower pH conditions, and so the pH gradually decreases.

Step 3: When the pH of the concrete falls to around 4, colonisation by aggressive acidophilic bacteria occurs. These bacteria are capable of generating enough sulphuric acid to reduce the surface pH to 1-2 which is considered highly aggressive to all cementitious materials.

Step 4: The corrosion process now results in concrete mass loss. The sulphuric acid first reacts with the calcium hydroxide ($CaOH_2$) in the concrete to form gypsum. The formation of gypsum is associated with an increase in volume by a factor of 1.2 to 2. Furthermore, the reaction between gypsum and tri-calcium aluminate (C_3A) with the formation of ettringite causes an even larger volume expansion, which leads to increase of internal pressure and deterioration of the concrete matrix.

The factors that influence this type of attack to occur include:

- Hydrogen sulphide being generated
- The release of H_2S from a water phase to a gaseous phase
- Biological oxidisation of H_2S to sulphuric acid above the wastewater surface
- Acid attack on the damp surfaces of the exposed interior surface of the concrete pipe

However, not all concrete pipes will be affected by hydrogen sulphide problem. The physical factors that that may impact on the affect sulphide generation and corrosion include:

- Concentration of organic material and nutrients in the sewerage.
- Sulfate concentrations.
- Dissolved oxygen level in the sewerage.
- Temperature (i.e. higher temperature increase likelihood of bacterial growth rate).
- Relative humidity (corrosion requires moisture on the pipe wall).
- Stream velocity, surface area to volume ratio, vertical drop points, detention time.
- Level of construction, grit and debris, surcharging.
- Turbulence (at the point of turbulence, the water surface area for gas transfer increases often leading to a dramatic release of H_2S to the gaseous phase)

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Whilst all these factors have an important role in contributing to the corrosion impact on concrete pipe in sewerage wastewater, good design, specification and manufacture, can help to mitigate the onset and the severity of sewer corrosion.

Extensive field and laboratory research has shown that corrosion is significantly reduced under the following operating conditions:

- High slopes in the network
- High dissolved oxygen content
- High wastewater pH
- Surcharging of sewer networks
- Short sewer reaches
- High concrete alkalinity
- Moderate operating temperatures

Over the years considerable efforts have been dedicated to the understanding of the corrosion process, and how to better deal with this form of corrosion. BSA is a complex process and there is much conjecture in the literature surrounding the critical level of H_2S concentration required to start the process, and significant knowledge gaps appear to exist particularly concerning concrete mix design. The test methods and parameters used have varied considerably.

It is generally well known that blended cements containing slag (GBS), fly ash, Microsilica or silica fume, provide improved durability and increased resistance to chemical attack. In the late 1990's CPAA member companies along with BRANZ and Auckland University developed a laboratory based sulphuric acid (inorganic or mineral) methodology to measure the relative laboratory attack rates on various Portland cement mixes. This research work was completed in 2001 and indicated a superior laboratory performance of GBS blends.

More recent research started in 2001, and still ongoing, is indicating that BSA attack is much more aggressive than chemical sulphuric acid generally used in laboratory testing. This research indicates that relative lab mineral acid resistance of various cement blends is not a reliable indicator of field performance under field biogenic conditions, with the environment determined by the cement structure being considered to be an important parameter. The BSA mechanism reduces the pH level down to severe levels with some cements and blends allowing different critical levels and acid production rates. The result is that all cements and blends are equally vulnerable to rapid corrosion.

Recommendations

There are many factors that come in to play when determining how severe the internal exposure conditions of concrete sewer pipes will be. It is vitally important that designer understand what level of performance they are expecting from the concrete, and how best to adapt the product to the conditions.

Recent research has indicated that there is no recognised cement blend (slag, silica fume, etc.) that can effectively resist biogenic sulfuric acid attack particularly when extremely high acidic environments (pH < 1.0) develop inside a concrete sewer pipeline.

However, blended cements can be an excellent mechanism to provide durability provision against sulfate attack (as opposed to sulfuric acid attack), chloride exposure, or acidic effluent, for external pipe wall protection.

It is recommended by the CPAA that when designing concrete sewers to resist severe H_2S attack mechanism, that designers consider alternative solutions for the interior of the pipe to deal with the aggressive nature of this environment. This can include utilising the following durability provisions:

- Increasing the total alkalinity of the concrete using appropriate materials
- Increasing the cover of the concrete pipe, or including a sacrificial layer of concrete that won't impact on the structural or durability design requirements over time.
- Specifying a keyed-in plastic liner over the interior surface of the pipe to protect it from H_2S attack.
- Using concrete made with antimicrobial additives

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The rapid chemically induced corrosion of concrete sewers at high H2S concentration

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The rapid chemically induced corrosion of concrete sewers at high H2S concentration

Abstract

Concrete corrosion in sewers is primarily caused by H2S in sewer atmosphere. H2S concentration can vary from several ppm to hundreds of ppm in real sewers. Our understanding of sewer corrosion has increased dramatically in recent years, however, there is limited knowledge of the concrete corrosion at high H2S levels. This study examined the corrosion development in sewers with high H2S concentrations. Fresh concrete coupons, manufactured according to sewer pipe standards, were exposed to corrosive conditions in a pilot-scale gravity sewer system with gaseous H2S at 1100 ± 100 ppm. The corrosion process was continuously monitored by measuring the surface pH, corrosion product composition, corrosion loss and the microbial community. The surface pH of concrete was reduced from 10.5 ± 0.3 to 3.1 ± 0.5 within 20 days and this coincided with a rapid corrosion rate of 3.5 ± 0.3 mm year −1. Microbial community analysis based on 16S rRNA gene sequencing indicated the absence of sulfide-oxidizing microorganisms in the corrosion layer. The chemical analysis of corrosion products supported the reaction of cement with sulfuric acid formed by the chemical oxidation of H2S. The rapid corrosion of concrete in the gravity pipe was confirmed to be caused by the chemical oxidation of hydrogen sulfide at high concentrations. This is in contrast to the conventional knowledge that is focused on microbially induced corrosion. This first-ever systematic investigation shows that chemically induced oxidation of H2S leads to the rapid corrosion of new concrete sewers within a few weeks. These findings contribute novel understanding of in-sewer corrosion processes and hold profound implications for sewer operation and corrosion management.

Keywords

h2sconcentration, induced, corrosion, concrete, rapid, sewers, chemically, high

Disciplines

Engineering | Science and Technology Studies

Publication Details

Li, X., O'Moore, L., Song, Y., Bond, P. L., Yuan, Z., Wilkie, S., Hanzic, L. & Jiang, G. (2019). The rapid chemically induced corrosion of concrete sewers at high H2S concentration. Water Research, 162 95-104.

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The Rapid Chemically Induced Corrosion of Concrete Sewers at High H_2S Concentration

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Highlights:

- The first report of chemically induced concrete corrosion in sewers
- High concentration of H_2S can be chemically oxidized into sulfuric acid at sewer crown

Abstract:

Concrete corrosion in sewers is primarily caused by H_2S in sewer atmosphere. H_2S concentration can vary from several ppm to hundreds of ppm in real sewers. Our understanding of sewer corrosion has increased dramatically in recent years, however, there is limited knowledge of the concrete corrosion at high H_2S levels. This study examined the corrosion development in sewers with high H_2S concentrations. Fresh concrete coupons, manufactured according to sewer pipe standards, were exposed to corrosive conditions in a pilot-scale gravity sewer system with gaseous H_2S at 1100±100 ppm. The corrosion process was continuously monitored by measuring the surface pH, corrosion product composition, corrosion loss and the microbial community. The surface pH of concrete was reduced from 10.5 ± 0.3 to 3.1 ± 0.5 within 20 days and this coincided with a rapid corrosion rate of 3.5 ± 0.3 mm year $^{-1}$. Microbial community analysis based on 16S rRNA gene sequencing indicated the absence of sulfide-oxidizing microorganisms in the corrosion layer. The chemical analysis of corrosion products supported the reaction of cement with sulfuric acid formed by the chemical oxidation of H_2S. The rapid corrosion of concrete in the gravity pipe was confirmed to be caused by the chemical oxidation of hydrogen sulfide at high concentrations. This is in contrast to the conventional knowledge that is focused on microbially induced corrosion. This first-ever systematic investigation shows that chemically induced oxidation of H_2S leads to the rapid corrosion of new concrete sewers within a few weeks. These findings contribute novel understanding of in-sewer corrosion processes and hold profound implications for sewer operation and corrosion management.

Key words: Sewer, Corrosion, Concrete, Hydrogen sulfide, Chemically Induced Corrosion

1. Introduction

As one of the most critical components of the urban infrastructure in modern societies, sewer networks collect and transport sewage to treatment plants, preventing human exposure to unhygienic sewage and related sewage-borne diseases. The prevalence of concrete corrosion weakens the structural strength of sewers and leads to early collapse of pipes (Zhang et al. 2008). The damage inflicted on many sewer networks and the cost of preventive measures is a significant world-wide economic problem (Alexander et al. 2013, Jiang et al. 2016a, Jiang et al. 2015a). In addition to enormous sewer remediation expenditure, the structural failure also poses potential issues of odor emission and public safety (Jiang et al. 2017).

The corrosion of concrete pipes is mainly a result of hydrogen sulfide (H_2S). H_2S is formed by sulfate-reducing bacteria (SRB) in the anaerobic sewer biofilms/sediments. From the sewage, H_2S is emitted to the sewer air, part of which is absorbed/adsorbed into the moisture layer on the concrete walls exposed to air, here it is oxidized to sulfuric acid and causes corrosion (Li et al. 2017). H_2S is ubiquitous in sewer systems, although the concentrations differ temporally and spatially from a few ppm to several hundred ppm (Jiang et al. 2014, Wells and Melchers 2015).

Sewer concrete corrosion is a relatively slow process that may take years or decades to occur (Joseph et al. 2012). A three-stage concept proposed by Islander et al. (1991) is widely adopted to describe the corrosion development. In the initiation stage, the surface pH of the concrete is reduced from c.a.13 to c.a. 9 by carbonation and H_2S dissolution. This leads to the later stages where the pH of the concrete surface is conducive for microorganisms to colonize. Depending on the pH, both neutrophilic and acidophilic sulfide oxidizing microorganisms will biologically oxidize sulfur compounds to sulfuric acid. The reaction between cementitious material and sulfuric acid produces corrosion products like gypsum ($CaSO_4$), resulting in the structural

70 weakening of concrete sewers (Davis et al. 1998, Harrison Jr 1984, Islander et al. 1991, Nica
71 et al. 2000, Parker 1947). Since the biological oxidation rate is much higher than the chemical
72 oxidation rate, microbial induced sulfuric acid production is regarded as the main cause for the
73 sewer concrete corrosion (Hvitved-Jacobsen et al. 2013).

74 Current strategies for controlling sewer corrosion are targeted to: (1) prevent H_2S production
75 and its partition from the sewer liquid phase through the dosing of antimicrobials, iron salts,
76 pH elevating compounds and oxidants to the sewage; (2) reduce the H_2S concentration in sewer
77 air through forced ventilation; (3) applying surface treatment on concrete sewers (Jiang et al.
78 2015a). Corrosion resistant materials like antimicrobials, silver-loaded zeolite, and polymers
79 coatings are widely used to mitigate the corrosion of sewers (Berndt 2011, De Muynck et al.
80 2009, Haile and Nakhla 2010, Sun et al. 2015).

81 With the increased use of corrosion-resistant materials and surface treatments in sewers,
82 instead of reacting with concrete, the H_2S in sewer air can accumulate to very high
83 concentrations. In real sewers, H_2S concentrations of over 800 ppm are observed in a gravity
84 pipe (Wells and Melchers 2015). Furthermore, various factors such as high wastewater sulfate
85 concentrations, and extended hydraulic retention times can lead to high sewer H_2S
86 concentrations (Lahav et al. 2004, Sharma et al. 2008).

87 To date, microbially induced sulfuric acid generation from H_2S is considered as the major
88 contributing cause of sewer mass loss and structure failure.

89 The observed rapid corrosion and the formation of sulfate as the main corrosion products
90 cannot be explained by either the three-stage corrosion development model (Islander et al. 1991)
91 or the previous theory describing the initiation of corrosion (Jiang et al. 2015b, Joseph et al.
92 2012). The short exposure time suggests that there was likely no development of any sulfide

95 *3.2. Microbial community in the corrosion layer*

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96 In microbial induced concrete corrosion, once the pH is reduced to lower than 4, due to the
97 sulfide oxidation and acid production, acidophilic microbes usually become the dominant
98 species (>50%). The most typical genus of acidophilic microorganisms associated with
99 biogenic acid production is *Acidithiobacillus* including *A. ferrooxidans*, *A. thiooxidans*, and *A.*
100 *caldus* (Davis et al. 1998, Harrison Jr 1984, Islander et al. 1991, Jiang et al. 2016b, Parker
101 1945b). In addition to *Acidithiobacillus spp.*, *Acidiphilium spp.*, *Mycobacterium spp.*,
102 *Xanthomonadales spp.* are often detected as abundant in acidophilic communities of sewer
103 corrosion layers (Cayford et al. 2017, Jiang et al. 2016b, Li et al. 2017, Okabe et al. 2007,
104 Pagaling et al. 2014). None of these typical acidophilic sulfur-oxidizing microorganisms was
105 detected in the corrosion products collected from the concrete samples in this study. Therefore,
106 it is highly likely that biological sulfide oxidation was not playing a major role in the rapid
107 corrosion observed in the presence of high H_2S levels.

3.3. Sulfide oxidation rates of the concrete coupons after exposure

The SOR of the coupons prior to and after sterilization were quite similar for H_2S concentrations up to 200 ppm (Figure 6). It shows clearly that sterilization of the concrete did not have any impact on the SOR and it confirms that the microbes on the concrete had negligible role in H_2S oxidation. Together with the absence of sulfide oxidizing microbes in the corrosion layer (Section 3.2), it clearly suggests that biological sulfide oxidation is not the cause of the concrete corrosion and thus the SOR observed were mainly due to chemical oxidation of sulfide.

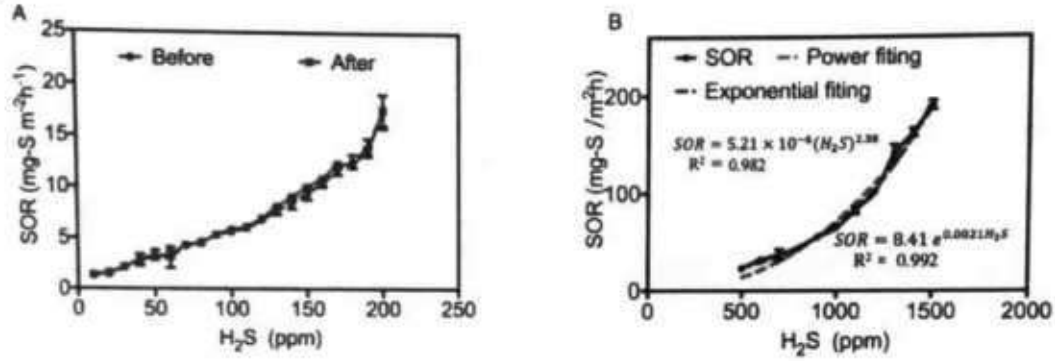

Figure 6. Sulfide oxidation rates of concrete coupons before and after sterilization under 10-200 ppm H_2S (A), and the sulfide oxidation rates of concrete coupons under 500-1500 ppm H_2S (B).

The SOR of both coupons were below 25 mg-S m^{-2} h^{-1} under 10-200 ppm H_2S and increased to around 200 mg-S m^{-2} h^{-1} at approximately 1500 ppm H_2S. The SOR observed for the chemical oxidation process is comparable to the sulfide uptake rate (SUR). SUR is usually used as a good indicator for the development and activity of sulfide oxidizing bacteria in microbial induced concrete corrosion. The SUR of 250 ± 5 mg-S m^{-2} h^{-1} was reported for microbial induced corrosion after 33 months exposure to H_2S at 50 ppm (Sun et al. 2014) and around 100 mg-S m^{-2} h^{-1} for coupons after 17 months exposure under 25 ppm H_2S (Jiang et al. 2016b). At the exposure of 1000 ppm of H_2S, a rapid consumption of H_2S, 3600 mg-S m^{-2} h^{-1} was

127 observed in a pipe section after several months (Vollertsen et al. 2008). Under the same H_2S
128 concentration, the SOR measured in this study was relatively lower compared with previous
129 studies reported for microbially induced corrosion. However, the SOR at above 1000 ppm H_2S
130 of this study were comparable to the uptake rate of microbes under 50 ppm (Sun et al. 2014),
131 which could lead to similar magnitudes of corrosion.

132 Under the high levels of H_2S (500ppm-1500ppm), the SOR increased significantly along with
133 the increase of H_2S concentration (Figure 6B). Kinetic models (i.e. exponential, power), have
134 been previously used to describe the oxidation rate of sulfide in microbially induced concrete
135 corrosion (Æsøy et al. 2002, Sun et al. 2014). Fitting SOR results into exponential kinetics, the
136 exponent showed a positive value (0.0021) (Figure 6B), which is contrary to the negative value
137 previous reported for microbial corrosion (-0.0135) (Sun et al. 2014). In power kinetic models,
138 the reaction order for sulfide oxidation in this study was estimated to be 2.4, which is higher
139 than the reaction order (1.5) previously reported for chemical dominated sulfide oxidation on
140 concrete surfaces and also higher than that reported for microbial induced sulfide oxidation on
141 corroding concrete surfaces (0.45-0.7) (Satoh et al. 2009, Vollertsen et al. 2008). With the
142 highest R^2 (0.995) and lowest sum of residual squares (323.2), exponential kinetics best
143 described the chemical sulfide oxidation on the concrete surface in this study (Table S2). The
144 kinetic analysis suggested that chemical sulfide oxidation is different to the biological sulfide
145 oxidation and that the SOR increases exponentially with H_2S concentration, implicating that
146 chemically induced corrosion will be more severe in sewers with higher H_2S concentrations.

147 Therefore, with sulfuric acid as the main product, chemically induced corrosion of concrete

sewers was investigated. Different from previous studies, which mainly focus on microbially induced corrosion of concrete sewers, this was the first-ever report of chemically induced corrosion. This has resulted in the following key findings:

- Hydrogen sulfide of around 1000 ppm led to fast concrete corrosion within one month, this was characterized by a surface pH around 3 and a corrosion rate around 3 mm $year^{-1}$.

- The fast corrosion of concrete with high levels of H_2S in the sewer was mainly due to the chemical oxidation of hydrogen sulfide to sulfuric acid.
- The rate of chemical sulfide oxidation increased exponentially with hydrogen sulfide concentrations and this could induce potentially high corrosion rates.
- These novel findings of in-sewer corrosion processes hold profound implications for sewer operation and corrosion management. The chemically induced corrosion of newly manufactured concrete sewers would be critical when high H_2S concentrations occur in the sewer atmosphere, especially at certain corrosion hot spots.

Acknowledgements:

The authors acknowledge the financial support provided by the Australian Research Council and the following partners: Gold Coast Water and Waste, District of Columbia Water and Sewer Authority, South East Water for their support through the Australian Research Council Linkage Project LP150101337. Dr Guangming Jiang is the recipient of an Australian Research Council DECRA Fellowship (DE170100694). Xuan Li acknowledges the Chinese Scholarship Council for providing the Living Allowance Scholarship.

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686

Iron Salts (Ferric and Ferrous)

Iron Salt Applications

Iron salts are a proven technology for long-duration hydrogen sulfide control in collection system gravity and forcemains, solids processing units, solids transfer lines and anaerobic digesters. They have been used for over 30 years in hydrogen sulfide control applications and are a well understood technology.

Depending on the wastewater plant unit process configuration, iron salts may also provide improvements in clarification, phosphate removal, struvite control, solids dewatering and anaerobic digester performance. Iron salt performance is not impacted by oxygen uptake rates but they do remove dissolved oxygen from the water.

Iron Salt Properties and Dosing

Iron salts are supplied as liquid solutions containing 5-13% ferrous or ferric iron as either a chloride or sulfate salt. They are supplied in containers of 55 or 300 gallons, or in bulk shipments of 4,000 - 20,000 gallons.

Experiences with iron chloride dosing to control sulfide-induced corrosion problems in sewers

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Abstract:

Dosing iron salts is one way of dealing with sulfide-induced corrosion problems in sewers. By dosing iron salts such as $FeCl_2$ and $FeCl_3$, the dissolved sulfide molecules present in the wastewater chemically react with $Fe^{++(+)}$ to form elemental sulfur (S^0) and iron sulfide (FeS). These products precipitate and thereby the amount of sulfide available for release to the sewer atmosphere decreases.

After a test phase *on-site*, this control measure was implemented in full-scale to deal with sulfide-induced corrosion problems that had been observed at a pumping station in the vicinity of Antwerp, Belgium. This contribution describes Aquafin's experiences with this control measure and elaborates on how the effectiveness was tested and evaluated prior to a full-scale application. Further, it describes how the dosage was implemented in full-scale and presents the results obtained so far. To conclude, the pros and cons of this control measure are discussed based on our experiences so far.

Keywords: hydrogen sulfide, biogenic sulfuric acid corrosion, sewer, iron chloride dosing

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Introduction

Aquafin was established in 1990 by the Flemish government and is responsible for the design, construction, operation and pre-financing of the supra-municipal wastewater treatment infrastructure of Flanders, which is the northern part of Belgium residing approximately six million inhabitants. Basically, this means that cities and municipalities are responsible for their own sewer systems, but their sewer networks connect to Aquafin's collector (or interceptor) sewers that transport the wastewater to the wastewater treatment plant.

Anno 2011, Aquafin's assets include 247 wastewater treatment plants, 1174 pumping stations and approximately 4735 km of collector sewers. The wastewater collection system, which covers the majority of Aquafin's assets and still expands at a rate of approximately one km per day, is the main focus of this paper. More precisely, this paper deals with the problems wastewater service providers around the world are facing that can be appointed to the presence of hydrogen sulfide in the wastewater collection system.

To introduce the terminology used in this paper, the different parts of a conventional wastewater collection system are shown schematically in Figure 1. Wastewater from the households is mainly and preferably transported through gravity sewers, but it is often not possible to reach the wastewater treatment plant in this manner. Therefore, pumping stations are needed, where the

wastewater is collected in a wet well which is equipped with level measurement instruments that monitor the amount of wastewater present. When full, the wastewater is pumped to a higher level through a force main (or pressure main or rising main) and discharged in an inspection chamber or manhole from which the wastewater continues its path through gravity sewers. This is typically repeated until eventually the wastewater arrives at the wastewater treatment plant. Needless to say that the sewer system is hardly ever a linear system, and often many sewer pipes are connected with each other to form a complex network with many branches.

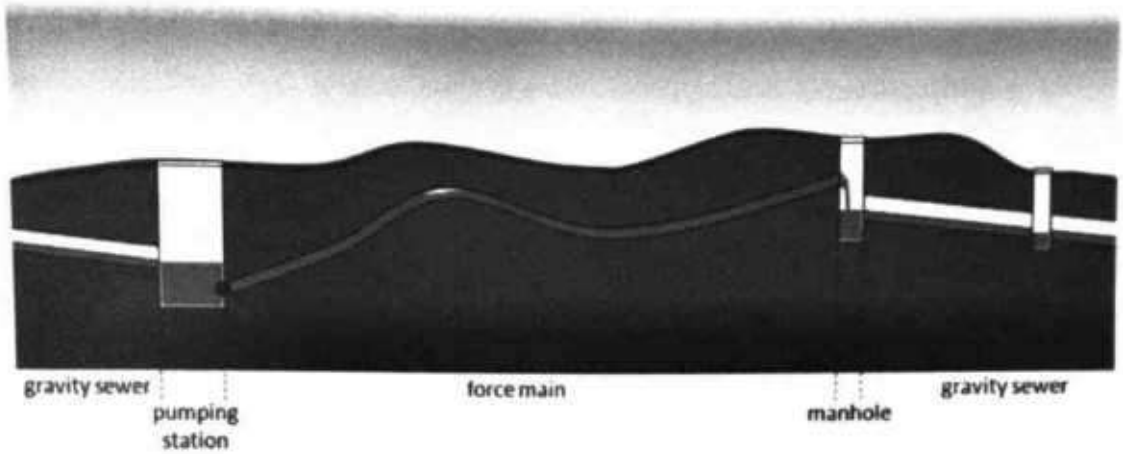

Figure 1: Schematic representation of a simplified, conventional wastewater collection system, illustrating its most common constituents.

As stated above, some problems that arise in the sewer infrastructure are caused by the presence of hydrogen sulfide (H_2S). Sulfides are formed under anaerobic conditions, which in this context can be interpreted as conditions where oxygen is absent (sewage does typically not contain nitrate). Anaerobic conditions can occur at different places in the sewer infrastructure (Figure 1 and Figure 2), such as:

- force mains;
- inverted siphons;
- gravity sewers with high filling degree;
- slow-flowing, partially filled gravity sewers;
- biofilm and sediment layers found in gravity sewers;
- wet well of pumping stations and other places where the wastewater stands still for a significant amount of time.

After being emitted to the sewer atmosphere, hydrogen sulfide will initiate a process called biogenic sulfuric acid corrosion. The concrete sewer pipes corrode and lose their mechanical strength. In addition, malodorous compounds are typically formed under the same anaerobic conditions as hydrogen sulfide and the latter thus contributes to odor nuisance. In this paper, however, only corrosion problems are dealt with.

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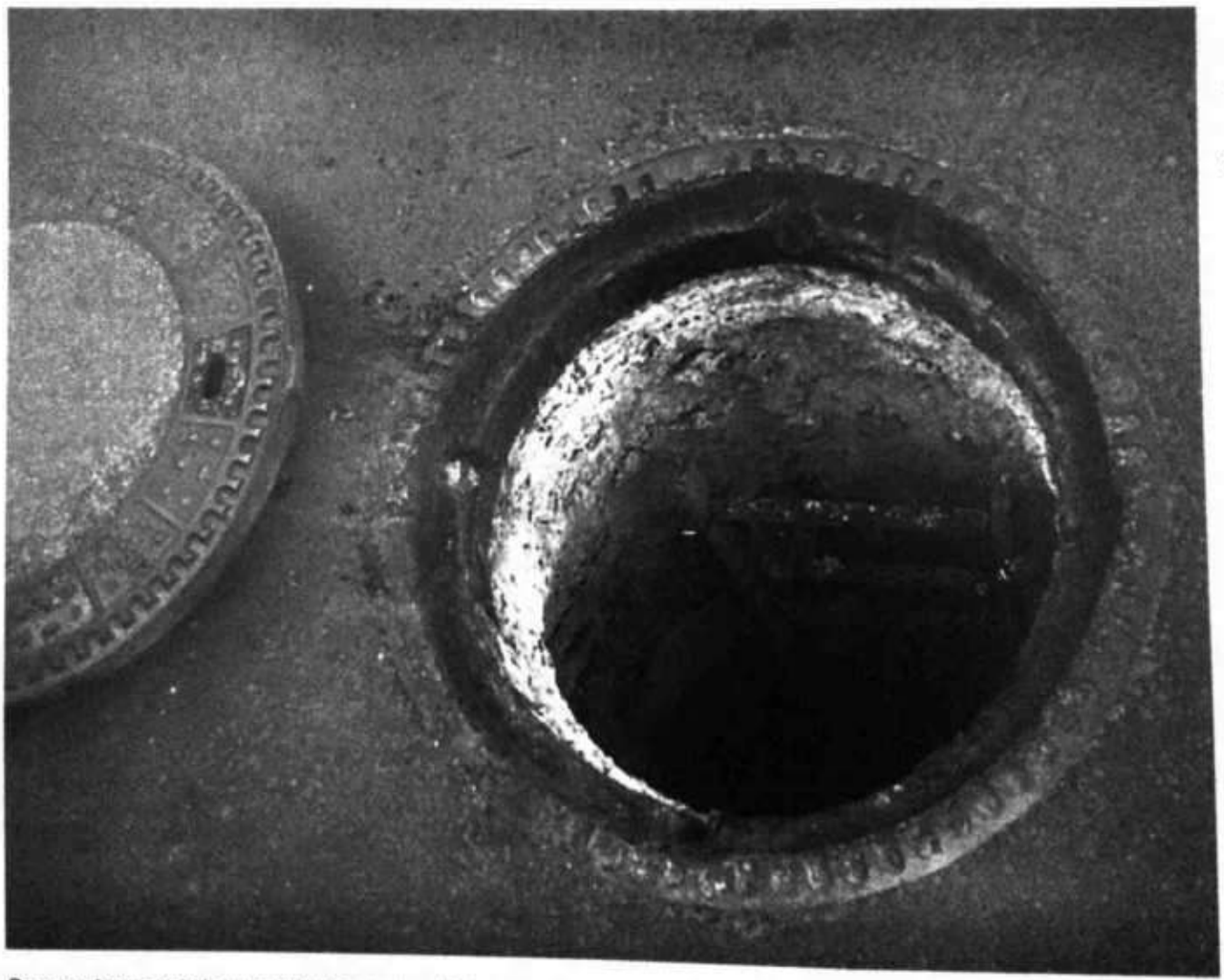
Technical Information 3.09

Elimination of Hydrogen Sulfide from Wastewater Collectors using Iron Salts

The occurrence of hydrogen sulfide (H_2S) in sewers is a commonly known problem. This foul-smelling, acidic gas is produced by the biogenic decomposition of sulfurous organic and inorganic constituents under anaerobic conditions. Hydrogen sulfide can particularly be expected to form in combination with long flow times, high temperatures and especially in pressure pipelines.



Damage in a manhole caused by biogenic sulfuric acid corrosion (BSC)

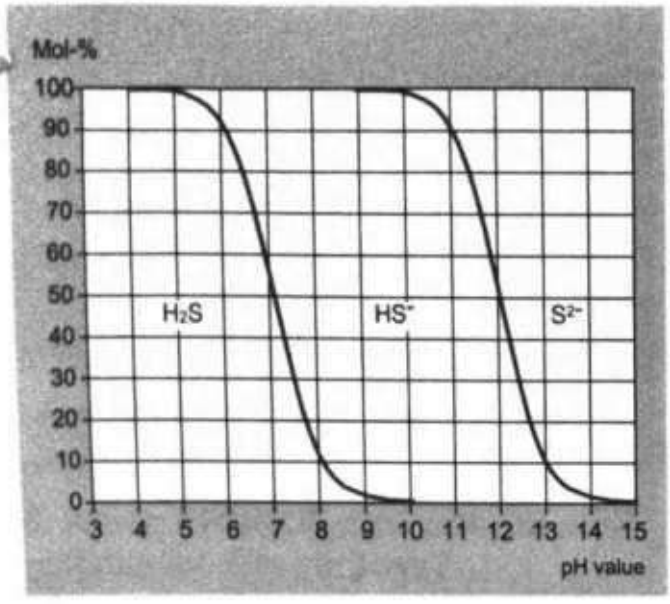


Fig. 1: Hydrogen sulfide – bisulfide – sulfide equilibrium as a function of pH value

Beer	160 mg S/kg
Whey	250 mg S/kg
Potatoes	340 mg S/kg
Onions	510 mg S/kg
Coffee, instant	600 mg S/kg
Maize	800 mg S/kg
Rice	1,000 mg S/kg
Fish	2,300 mg S/kg
Yeast	3,000 mg S/kg

Table 1: Sulfur content of several foods

1. What leads to the formation of hydrogen sulfide?

The hydrogen sulfide and other sulfides initially exist in dissolved – relatively harmless – form as H_2S, HS^- or S^{2-} depending on the pH value of the wastewater (Fig. 1). The more acidic the environment, the more the equilibrium shifts towards hydrogen sulfide (H_2S), which then escapes from the water phase in the form of a gas. In principle, hydrogen sulfide can form in any kind of wastewater. The main source of sulfur in the formation of H_2S in an anaerobic environment are the sulfate ions that enter the municipal sewage flow in high concentrations from tap water (desulfurication). In addition, wastewater with a high protein content, such as occurs in the food industry, for example, tends towards rapid decomposition and strong H_2S evolution (desulfuration). Table 1 lists the typical sulfur content of several foods.

2. Why is hydrogen sulfide so dangerous?

- Even in very low concentrations (< 0.2 ppm), H_2S can be detected by its "smell of rotten eggs", causing severe odour problems.
- At higher concentrations, the gas becomes an increasing threat to health, and at upwards of about 300 ppm has a potentially lethal effect.
- Hydrogen sulfide leads to corrosion in the sewer system and causes high repair costs (cover photo). Its severely corrosive effect – especially on concrete – results from the fact that the hydrogen sulfide oxidises on the surface of the components exposed to the sewer atmosphere to form sulfuric acid.
- Hydrogen sulfide or the sulfide ions can have a negative impact on the process of biological wastewater treatment.

3. How can the formation of hydrogen sulfide be prevented?

Because hydrogen sulfide only forms under strictly anaerobic conditions, changing the environment by any kind of oxygen supply would, in principle, be a method for preventing sulfide formation. However, it must always be ensured in such cases that an adequate oxygen supply is also guaranteed at the end of the line.

Since the biogenic formation of H_2S often cannot be prevented – even when using oxidative control measures – it is necessary to apply elimination methods, including targeted precipitation of the sulfides using iron salts.

4. Why are iron salts so well-suited to eliminating hydrogen sulfide?

Bonding H_2S with iron salts is based on the high affinity of iron for sulfides. Regardless of the compound form or valence of the iron, iron sulfide always forms in the presence of sulfides (FeS; Table 2). On account of the extremely low solubility of FeS, competitive reactions with other constituents in the water can be ruled out.

$Fe^{2+} + S^{2-}$	$\rightarrow FeS\downarrow$
$2\,Fe^{3+} + 3\,S^{2-}$	$\rightarrow 2\,FeS\downarrow + S$
$2\,Fe(OH)_3 + H_2S$	$\rightarrow S + 2\,Fe(OH)_2 + 2\,H_2O$ (Reaction 1)
$Fe(OH)_2 + H_2S$	$\rightarrow FeS\downarrow + 2\,H_2O$ (Reaction 2)

Table 2: Reaction equations for sulfide precipitation

5. Which KRONOS products are most suitable for this purpose?

In principle, all KRONOS iron salts are suitable for hydrogen sulfide elimination. The question as to which product should be given preference is primarily governed by local conditions with regard to logistics and handling.

The primary candidates are:

1. KRONOFLOC ferrous chloride solution as a ready-to-use liquid precipitant with 8.7% Fe^{2+}.

The product is delivered in 60 l canisters, 200 l drums, 1 m³ containers or in bulk in road tankers. If only small quantities are required, the product can be metered directly from its original container. TI 2.03 provides information on the transport, storage and metering of KRONOFLOC delivered in bulk.

2. FERRIFLOC ferric chloride sulfate solution with 12.3% Fe^{3+}.

Delivery and storage are the same as for KRONOFLOC.

3. QUICKFLOC ferrous sulfate as a solid precipitant with 17.8% Fe^{2+}.

The product is delivered in 25 kg bags on 1 t pallets. The QUICKSOLV metering station is available for storing, dissolving and metering. This system is described in detail in TI 2.01.1.

It occasionally is claimed that it is impossible to eliminate hydrogen sulfide using iron salts containing sulfate. This argument seems plausible at first, but naturally is false. The reason is that the sulfate concentration in the wastewater is not the minimizing factor in the biogenic formation of H_2S.

This means that a major surplus of sulfates is present in virtually all types of wastewater, enabling the formation of hydrogen sulfide, and that any additional contribution from the precipitant is irrelevant. The question of how much sulfide can be formed in a given type of wastewater is essentially governed by the temperature, the volume of wastewater, the hydraulic and design-related parameters, as well as the concentration of simple organic compounds, such as organic acids and alcohols (similar to denitrification).

6. Where should the precipitant be added?

The effect of the iron salts is based on the precipitation of the dissolved sulfides in the water phase. This must occur at an early stage, before the hydrogen sulfide enters the gas phase and becomes perceptible. Points where the following requirements can be met are suitable as metering points in the sewer system:

- Delivery by road tanker
- Safe storage
- Safe handling of chemicals

Fig. 2: Underground tank at a pumping station with catch basin

Fig. 3: Metering station in a manhole

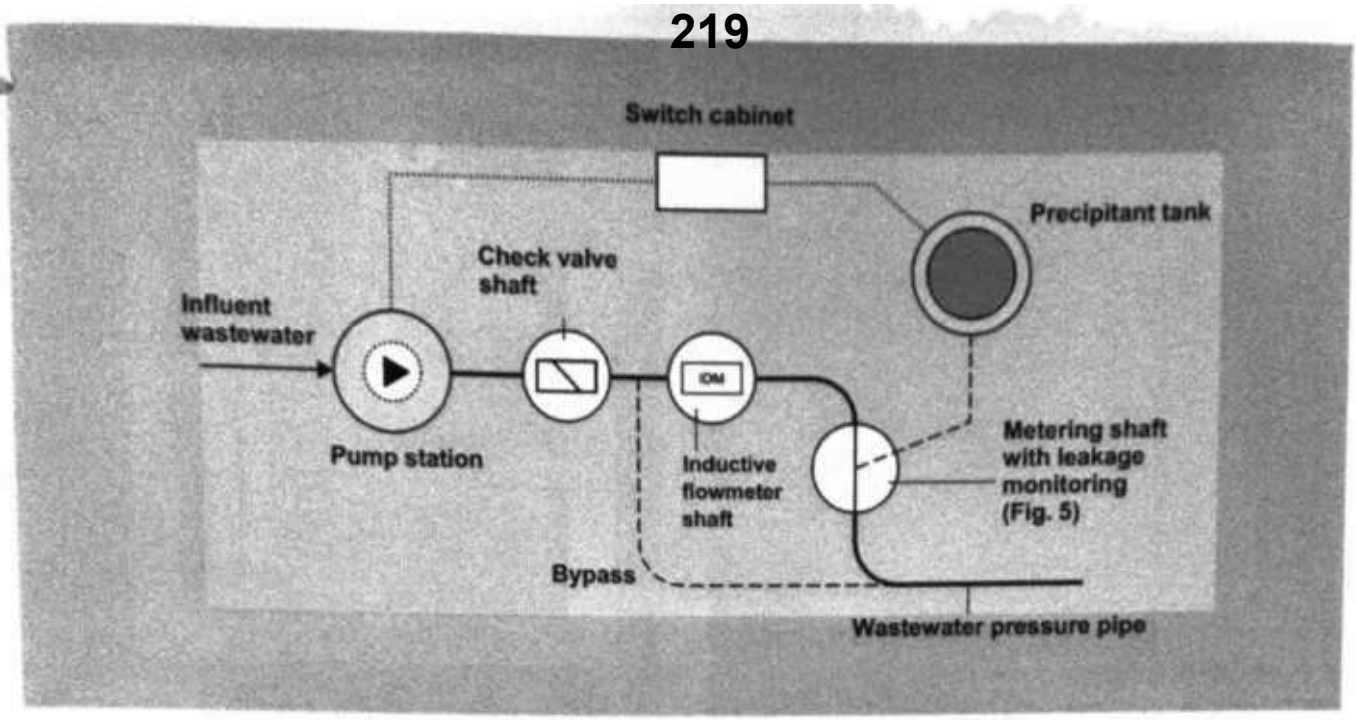


Fig. 4: Arrangement for preventive metering

The high speed of reaction of sulfate precipitation with iron salts supports two metering options:

a) Preventive metering (Fig. 4):

The iron salt is added at the start of a problematic section, i.e. at a point where no degradation processes have yet begun. It has proven effective in the case of wastewater pressure lines to add the iron salt directly to the pressure line via a seeding point (e.g. tapping sleeve, Fig. 5).

Acid-proof diaphragm pumps are used to meter the product (TI 2.3). To adapt the added quantities to the rate of sulfide generation, we recommend using the pipeline dimensions and the wastewater volume generated to calculate the dwell time of the wastewater between inflow and outflow. The quantity of iron salt added is preferably adapted to the expected sulfide concentration by a measurement curve controller (e.g. PLC). If necessary, the system should also account for rain events.

Premature addition need not be feared, since the products of hydrolysis (hydroxides) of the iron can also bond the hydrogen sulfide (Table 2).

b) Addition upstream of the emission point:

The spontaneous reaction between the dissolved iron and the dissolved sulfides takes only a few seconds, but can be observed by watching the wastewater rapidly turn black. For this reason, it is also effective to add the iron salts a short distance upstream of the emission point – i.e. into wastewater that has already begun to degrade. Basically, any turbulent outflow of anaerobic wastewater at the end point of pressure lines, for example, should be avoided. In practice, this can be achieved by shifting the pressure line outlet to below the water level while at the same time adding iron salt just upstream from the end of the wastewater line or into the wastewater pumping station.

An arrangement of this kind makes it possible to establish a controlled section for sulfide precipitation, similar to online phosphate precipitation. Continuously monitoring H_2S emissions by connecting an online H_2S sensor to the metering pump can help to reliably maintain target values, e.g. a maximum allowed workplace concentration (MAC) of 10 ppm in the coarse and fine screening building (Fig. 6).

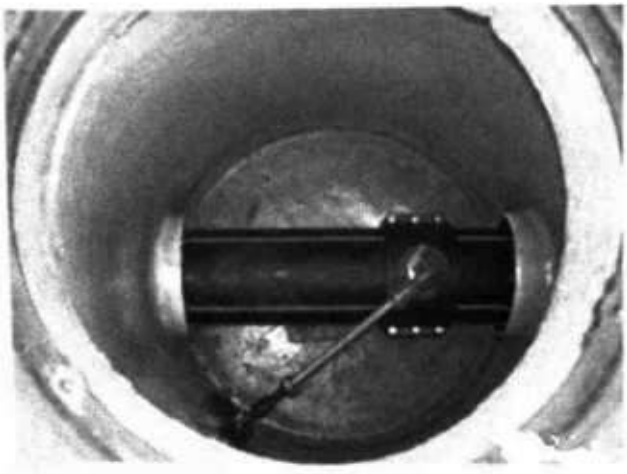


Fig. 5: Addition directly into the pressure pipeline via a seeding point.

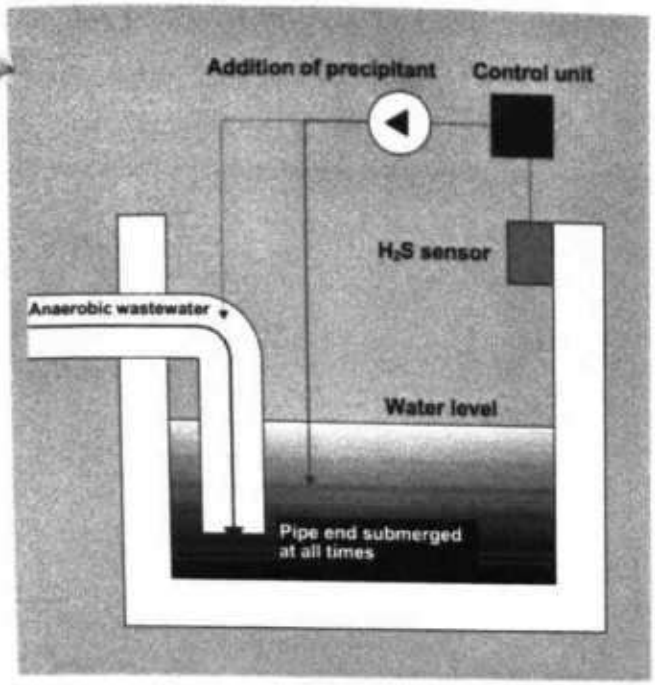


Fig. 6: Online addition upstream of the emission point

Existing or expected sulfide concentration	4 mg S^{2-}/l
in the problematic area of the collector	· 4 g S^{2-}/m³
Wastewater inflow (e.g. wastewater pump capacity)	50 m³/h
Iron concentration in the precipitant (KRONOFLOC)	8.7 % Fe^{2+}
Density of KRONOFLOC	1.37 g/cm³
Molar mass sulfur	32.06
Molar mass iron	55.85

$$\frac{0.004 \cdot 55.85 \cdot 50}{32.06 \cdot 0.087 \cdot 1.37} = 3.0 \text{ l KRONOFLOC/h}$$

Table 3: Sample calculation for determining quantities to be added

7. How much has to be added?

a) Theory:

The dissolved sulfides in the wastewater can be determined analytically as S^{2-} e.g. according to DIN EN 38 405.

If data on the concentration of dissolved sulfides in the wastewater are available, and the wastewater flow rate is known, a simple calculation can be used to determine the quantity to be added (Table 3).

b) Practice:

In practice, however, data are usually only available for the hydrogen sulfide concentration in the gas phase. But even these values support a fairly good estimation of the required quantities. The actual quantities required can then be determined empirically.

The following, pragmatic procedure has proven successful in practice:

1. The H_2S content in the collector air is measured at neuralgic problem points over several days.
2. The iron salt solution is added at suitable dosing points upstream of the measurement points, using a typical standard quantity of 15 g Fe/m³ wastewater.
3. The quantity added is adapted in accordance with the results of gas analysis, based on the residual H_2S content in the collector air. In this context, the added quantities may have to be adapted to the flow and dwell times in the sewer system.
4. When adding quantities online, the times at which the metering pumps are switched on and off, and the steepness of the metering curve, must be adapted to the target value.

8. What happens to the precipitated sulfides??

The virtually insoluble iron sulfide is a very fine solid with poor sedimentation properties. In other words, iron sulfide does not settle in the sewer, but passes into the treatment plant with the wastewater flow. As a rule, this dark-black wastewater also passes through the primary sedimentation stage; only in the biological stage of the treatment plant is it oxidised, thus being made available for simultaneous phosphate precipitation. This double precipitation effect is illustrated schematically in Fig. 7.

The black discoloration of the treated wastewater inflow provides clear, visual proof that H_2S elimination has taken place. The iron method is not well accepted by receiving treatment plants that have no biological stage, i.e. no oxidative decolouration.

On account of the high buffer capacity in the untreated wastewater, this condition is never reached as a rule when using common added quantities.

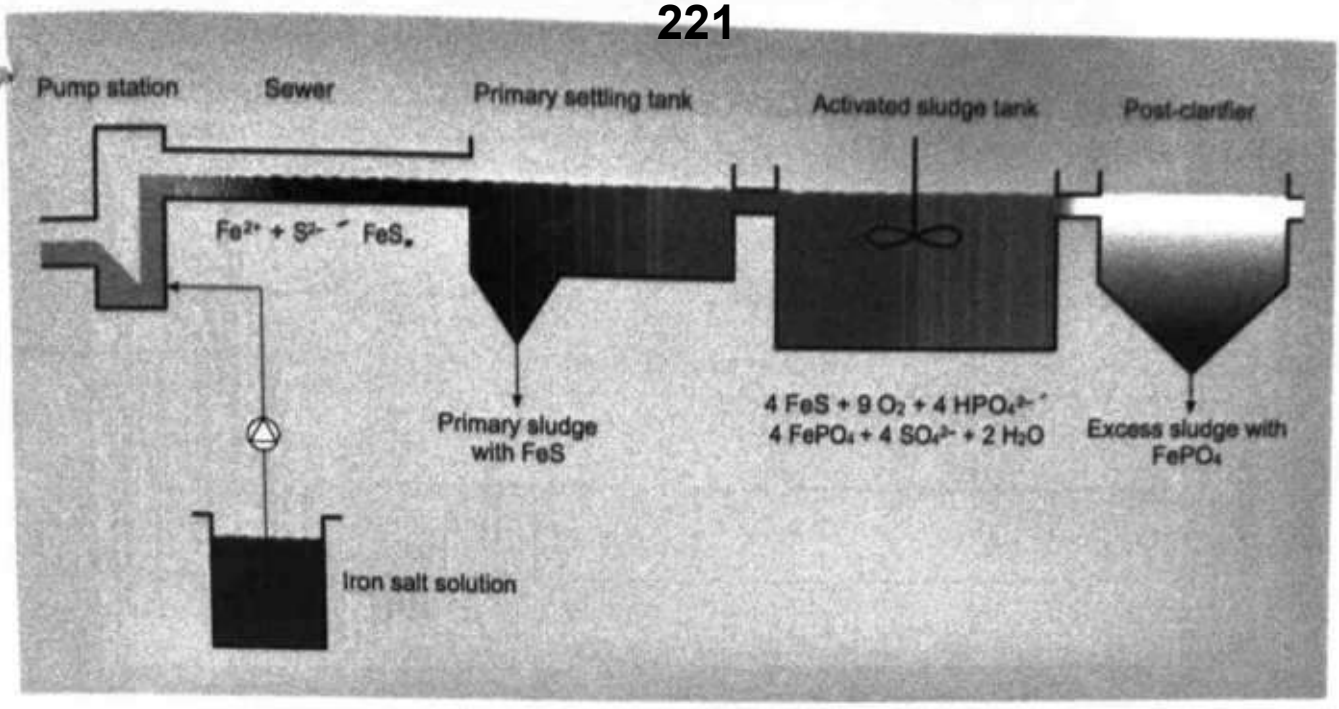


Fig. 7: Hydrogen sulfide elimination with sulfide and phosphate precipitation

9. What else needs to be considered for the successful implementation of hydrogen sulfide elimination?

Using iron salts to precipitate the sulfides dissolved in wastewater is a very reliable elimination process. The special feature of this method is that the iron salt must be added at a point where no hydrogen sulfide is yet present. Therefore, selecting a suitable dosing point is of fundamental importance for the applicability and success of the method.

In addition to being located upstream of the problem area, the dosing point must also offer the technical means for safe storage and handling of the precipitants. Several metering points are often required, depending on the design of the collector system and the affected sewer sections.

The efficiency of the process ultimately depends on how successfully the quantity of iron salt added can be adapted to the various sulfide loads.

10. What results are available??

The effectiveness of H_2S elimination with iron salts is illustrated below on the basis of two practical examples.

1. Use of KRONOFLOC in a 5 km pressure pipeline.

To avoid H_2S emissions, KRONOFLOC is added at the inlet of a pressure pipeline as a preventive measure (Fig. 9).

2. Use of KRONOFLOC to maintain the MAC in a grit chamber.

The signal from an H_2S sensor supports the establishment of a controlled section and activates the dosing pumps as needed (Fig. 8). The steepness of the rise or fall in H_2S concentration determines the added quantity.

Phases with low H_2S loads (e.g. rainy weather) are detected and the required quantity of precipitant automatically reduced (Fig. 10).

Fig. 8: An H_2S sensor takes continuous readings in the grit chamber. The signal is processed and the KRONOFLOC metering pumps activated. The results are illustrated in Fig. 10.

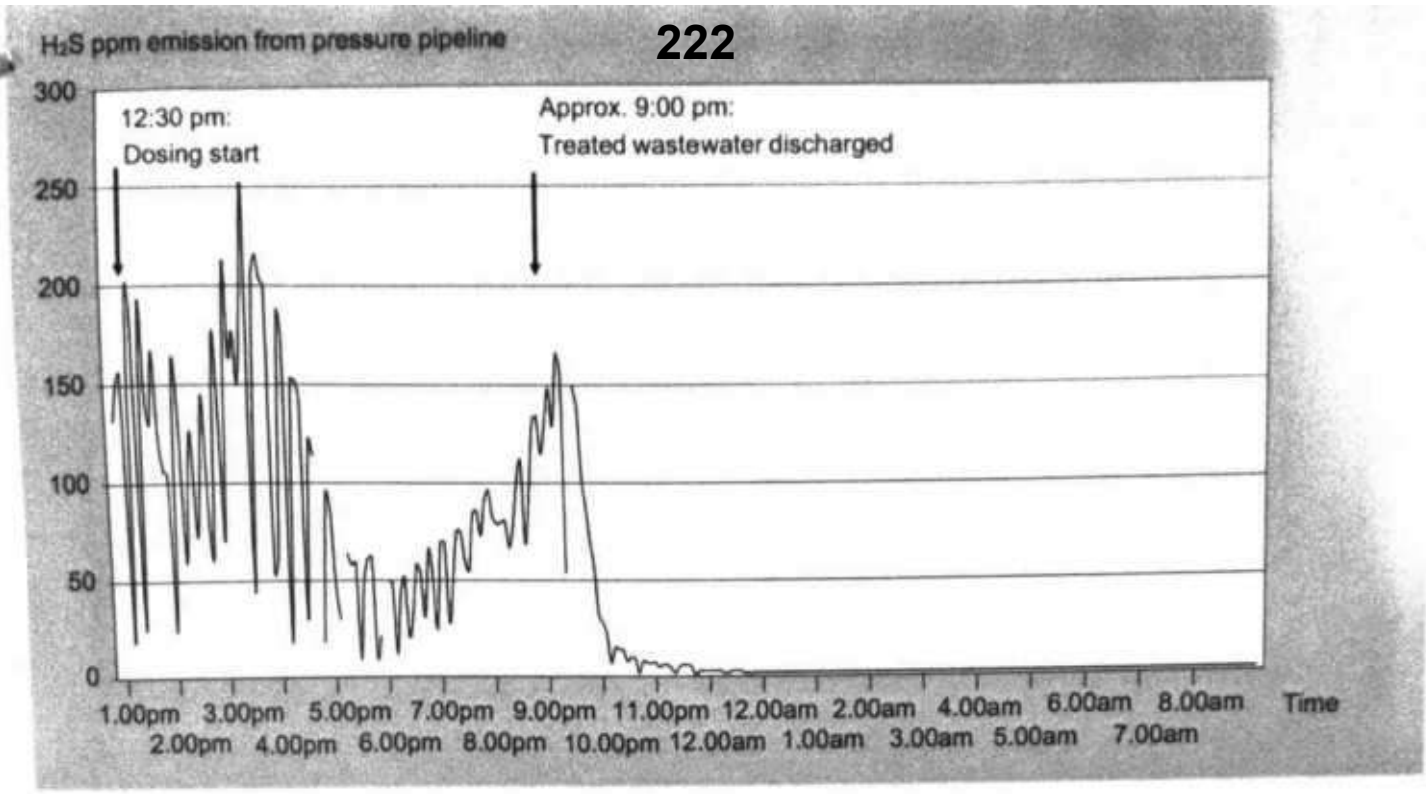


Fig. 9: Effect of KRONOFLOC addition as a preventive measure

Pressure pipeline data (Fig. 9)	
Dimensions	DN 250
Volume	Approx. 245 m^3
Wastewater volume, Q_{TW}	Approx. 570 m^3/day
Wastewater dwell time in the pressure pipeline	9 – 14 hours
Average added quantity	30 g Fe^{II}/m^3

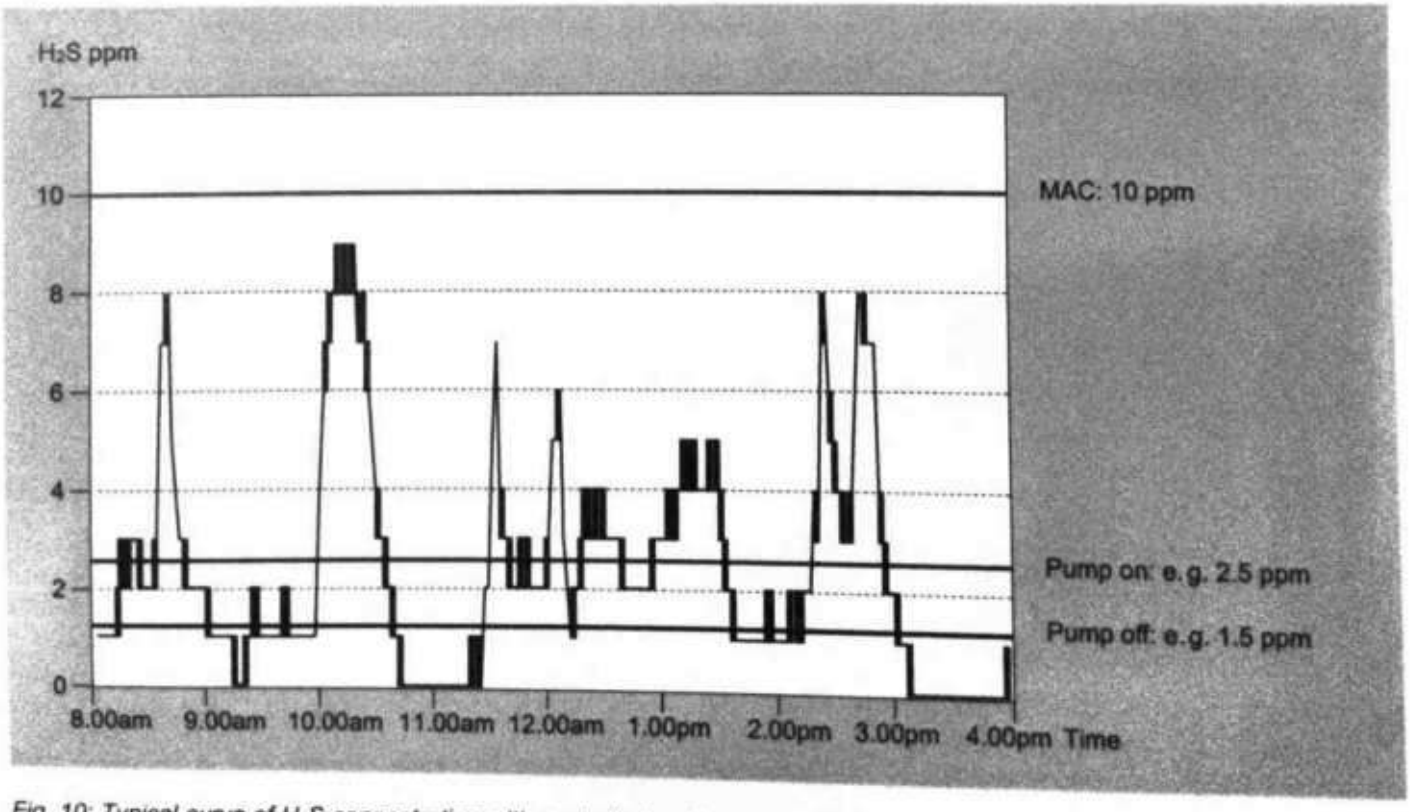


Fig. 10: Typical curve of H_2S concentration with controlled, online addition of iron salts to maintain the MAC value in a grit chamber

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ANNEXURE-[redacted]J
SDM Nest for consideration in Magisterial enquiry

Report on Ludhiana gas poisoning accident

A gas poisoning accident that occurred on the morning of 30.04.2023 at Giaspura area in Ludhiana city, in which eleven persons died instantly was covered by TV news and reported in national dailies the next day.

In view of the above, a team of CPCB officers visited Ludhiana on 03.05.2023, interacted with the officers of Punjab Pollution Control Board , and also visited the site of accident at Giaspura, Ludhiana.

As per various media reports regarding observations of various agencies involved in investigations immediately after the accident and the discussions held by CPCB team with the Chief Environmental Engineer of PPCB, the cause of deaths has been linked to release of sewer gas through the manholes in the connecting branch sewers at two places and exposure of the eleven deceased persons to **H_2S** in very high concentration, leading to their immediate collapse and death.

At the accident site, it was observed that there are branch sewer lines / sewer connections from the two nearby houses where the deaths occurred that join the main sewer line that runs below the main road in front of these houses. The analysis report of the main sewer water collected by PPCBfew hours after the accident from the manhole near the point of accident indicated pH of the sewer as highly acidic and ranging between 2.5 and 2.6. It was also reported that main sewer line near the point where this incident happened was found filled/chocked.

Presence of sulphide in sewer water as **H_2S** is due to biochemical reduction of the sulphate present in water. The ratio of Sulphur (S), Hydrosulphide (HS) and H_2S in sewer water at any point of time depends on the pH of sewer water at that time. Intermittent discharge of acidic effluents from industries in mixed sewers acts as an agent for shifting the equilibrium. Acidic effluents are also a source of sulphate (due to sulphuric acid), which ultimately forms sulphide.

Further, if industrial effluents containing metals and heavy metals are discharged in the sewers, the metals are precipitated as metal sulphides in the sewer lines. These metal sulphides. in the presence of acids/acid effluents containing H_2SO_4 and/or HCl, end up generating hydrogen sulphide (H2S) gas.

Therefore, it can be concluded that intermittent discharge of acidic and metallic industrial effluent/waste into mixed sewers can be a source of sudden release of **H_2S** gas in very high concentration from such sewers.

It is relevant to mention that H_2S is a diprotic weak acid and even a saturated solution of H_2S is not expected to have a pH less than 4.0. Therefore, it may be concluded that pH level of 2.5-2.6 as reported in main sewer water near the houses where deaths occurred is a result of acidic industrial effluent discharge.

The above facts strongly point towards the discharge of industrial effluent as the cause of highly acidic water in the main sewer in the area and the also the cause of release of **H_2S** in the sewer line in high concentration, leading to immediate collapse and death of eleven persons.

Fwd: Submission of reports/documents to the "Fact Finding Joint Committee" constituted by Hon'ble NGT in OA No. 327/2023 in Ludhiana Gas Leak Incident.

From : ngtgasleakffjc@gmail.com Thu, Jun 22, 2023 06:13 PM

Subject : Fwd: Submission of reports/documents to the "Fact Finding Joint Committee" constituted by Hon'ble NGT in OA No. 327/2023 in Ludhiana Gas Leak Incident. 2 attachments

To : gurnam <gurnamsingh.cpcb@nic.in>, rpbd@iitrindia.org, director@iitrindia.org, Sheelendra Pratap Singh <sheelendra@iitr.res.in>, PGIMER Chandigarh <pgimer@chd.nic.in>, pvm lakshmi <pvm_lakshmi@yahoo.com>, dg ndrf <dg.ndrf@nic.in>, uttamchand2115@gmail.com, Surabhi Malik <dc.ldh@punjab.gov.in>, commissionermcl@gmail.com, msppcb@gmail.com

Cc : ceeludhiana@yahoo.com, ppcbzo1ldh@gmail.com, seezo2ldhppcb@yahoo.com, chairmanppcb@yahoo.co.in

The mail is forwarded in reference to Letter no. 14223-29 dated 20.06.2023 and email dated 22.06.2023

---------- Forwarded message ---------
From: **gurnam** <gurnamsingh.cpcb@nic.in>
Date: Mon, May 22, 2023 at 1:32 PM
Subject: Re: Submission of reports/documents to the "Fact Finding Joint Committee" constituted by Hon'ble NGT in OA No. 327/2023 in Ludhiana Gas Leak Incident.
To: <ngtgasleakffjc@gmail.com>
Cc: <ceeludhiana@yahoo.com>, <ppcbzo1ldh@gmail.com>, <seezo2ldhppcb@yahoo.com>, <chairmanppcb@yahoo.co.in>, <msppcb@gmail.com>

Sir,

The brief report of CPCB is attached. The view of CPCB report may be taken into consideration for further investigation in the matter.

Regards,
Gurnam Singh
Regional Director
Central Pollution Control Board,
RD Chandigarh

From: ngtgasleakffjc@gmail.com
To: "gurnam" <gurnamsingh.cpcb@nic.in>
Cc: ceeludhiana@yahoo.com, ppcbzo1ldh@gmail.com, seezo2ldhppcb@yahoo.com, chairmanppcb@yahoo.co.in, msppcb@gmail.com, ngtgasleakffjc@gmail.com
Sent: Monday, May 22, 2023 10:31:29 AM
Subject: Submission of reports/documents to the "Fact Finding Joint Committee" constituted by Hon'ble NGT in OA No. 327/2023 in Ludhiana Gas Leak Incident.

Dear Sir,

Please download the attachment for necessary action.
Regards,

Prof. (Dr.) Adarsh Pal Vig
Chairman,
Fact Finding Joint Committee

Report on Ludhiana gas Poisoning accident.pdf
834 KB

As per recent media reports and the discussion held with Chief Environmental Engineer, PPCB, the industries in Ludhiana use both Hydrochloric acid and Sulphuric acid. It was also reported that few industries in Giaspura area have acid pickling step in their manufacturing process. The chloride content in the main sewer water near the accident was found higher in comparison to distant points (both upstream and downstream) which may be due to use of hydrochloric acid in the area. These facts also indicate that industrial discharge is a key factor in releasing of **H_2S** in high concentrations.

The details of sewer network of Giaspura area were not available with officers of Municipal Corporation, who were present at the site during the visit. All the industries located along the sewer network are required to be surveyed by local authorities to identify the possible sources of acidic and metals, heavy metals and sulphide containing industrial effluent/waste.

Further, Hon'ble National Green Tribunal, Principal Bench has constituted a Joint Committee with members from various agencies including CPCB to investigate the matter, arrive at a conclusion and take remedial measures to prevent such accidents in future.

G. Rambabu, Scientist 'D'

Kamlesh Singh, Scientist 'E'

Dr. Narender Sharma, Scientist 'E'

Nazimuddin, Scientist 'F'

Home Trending New Cricket Nation Chandigarh Punjab

No relief from choked sewerage in Giaspura

LUDHIANA: Learning no lessons from diarrhoea outbreak in different parts of Giaspura last year, the Municipal Corporation (MC) has failed to [illegible] sanitary conditions in the area.

Home Trending New Cricket Nation Chandigarh Punjab

Choked sewers Giaspura's bane

LUDHIANA: Even after cleaning sewers with a super suction machine, the problem of choked sewers was again witnessed at Sua Road, Giaspura.

Giaspura c habituate in poor co

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Saturday | 28th April, 2018

Ludh

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Gmail

ANNEXURE - 15'

SDM LDH <sdmldhwest@gmail.com>

Fwd: Sheelendra_General Brief report about H2S formation

1 message

Sheelendra Singh <shilu1july@gmail.com>
To: sdmldhwest@gmail.com

Fri, Jun 23, 2023 at 7:49 PM

---------- Forwarded message ---------
From: **Sheelendra Singh** <shilu1july@gmail.com>
Date: Fri, 23 Jun 2023, 19:03
Subject: Sheelendra_General Brief report about H2S formation
To: <ngtgasleakffjc@gmail.com>

Please find the attached general brief report from my side.

Thanks and regards
Sheelendra Pratap Singh

---------- Forwarded message ---------
From: **Sheelendra Singh** <shilu1july@gmail.com>
Date: Fri, 23 Jun 2023, 18:53
Subject:
To: Sheelendra Singh <shilu1july@gmail.com>

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Sheelendra Pratap Singh (M. Pharm, Ph.D.)/शीलेन्द्र प्रताप सिंह

JSPS Fellow I Member INYAS/जेएसपीएस फैलो। मेम्बर इनयास

Principal Scientist/प्रधान वैज्ञानिक

Toxicokinetics Laboratory/टॉक्सिकोकाइनेटिक्स प्रयोगशाला

Regulatory Toxicology Group/विनियामक विषविज्ञान ग्रुप

CSIR - Indian Institute of Toxicology Research/ सीएसआईआर-भारतीय विषविज्ञान अनुसंधान संस्थान

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ई-मेल/Alt Email ID: shilu1july@gmail.com

Website: www.iitrindia.org

https://scholar.google.com/citations?user=KY9j7-kAAAAJ

Content H2S.pdf
40K

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ANNEXURE-B-2

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Sent
Drafts 1
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Labels

Fwd: Sheelendra_General Brief report about H2S formation

Sheelendra Singh <shilu1uby@gmail.com> Fri, Jun 23, 7:50 PM (15 hours ago)
to me

---------- Forwarded message ---------
From: **Sheelendra Singh** <shilu1uby@gmail.com>
Date: Fri, 23 Jun 2023, 19:03
Subject: Sheelendra_General Brief report about H2S formation
To: <[redacted]@gmail.com>

Please find the attached general brief report from my side.

Thanks and regards
Sheelendra Pratap Singh

---------- Forwarded message ---------
From: **Sheelendra Singh** <shilu1uby@gmail.com>
Date: Fri, 23 Jun 2023, 18:53

- Hydrogen sulfide (H2S) is a dangerous and colorless gas that can be produced when organic matter decomposes, such as in rotting vegetation or wastewater in a sewer system. It is highly toxic, ranking second in workplace fatalities due to gas inhalation after carbon monoxide and is often recognized by its foul smell, similar to rotten eggs.

- In the case of domestic wastewater, the main process responsible for the formation of hydrogen sulfide is the microbial reduction of sulfate ions. When there is a lack of dissolved oxygen and the presence of soluble Biological Oxygen Demand (BOD), bacteria like Desulfovibrio desulfuricans (SRB) and other sulfate-reducing bacteria (SRBs) convert sulfate ions into sulfide. This occurs in the absence of oxygen and the presence of organic matter, such as sludges.

- Hydrogen sulfide tends to accumulate in confined and poorly ventilated areas where there are sewage holding tanks or other parts of sewage systems. If the system is damaged, malfunctioning, or there are loose connections, gas can escape. This can happen when organic matter or sludges are disturbed, such as during the addition or discharge of effluent material into a compromised system. Sewage holding tanks that receive galley waste on vessels are particularly prone to the formation of a greasy sludge film, which further promotes the production of hydrogen sulfide. Additionally, blockages in ventilation components increase the risk of hydrogen sulfide back-venting, allowing the gas to escape into toilet and other confined spaces through the sewerage pipe network.

- A sewer main can contain significant amounts of undetected dissolved H2S in the wastewater. When the water is disturbed, such as when pumps are activated, this dissolved gas can rapidly turn into toxic gas clouds due to the "soda-can effect." This effect occurs when the disturbed water releases the

dissolved gas, resulting in sudden and dangerous concentrations of hydrogen sulfide.

- Due to its density, hydrogen sulfide is slightly heavier than air, causing it to accumulate in subsurface spaces such as basements, underground chambers, or sewer systems. This makes these areas particularly susceptible to high concentrations of hydrogen sulfide gas

- During heavy rainfall, organic matter such as decaying vegetation, animal waste, and other debris can be washed into the sewer system. This influx of organic material provides a rich food source for bacteria, including SRBs. As the organic matter decomposes, SRBs metabolize sulfate ions present in the wastewater, resulting in the production of H2S.

- Heavy rainfall can cause turbulent flow in sewer systems, leading to the disturbance of settled sediments. Sewer sediments often contain accumulated organic matter and sludges that serve as a nutrient source for SRBs. When these sediments are stirred up, it can promote increased bacterial activity and H2S production.

- The increased H2S production during heavy rainfall can raise the likelihood of H2S leakage and exposure in sewer systems. If the sewer infrastructure is damaged, malfunctioning, or not properly sealed, the H2S gas can escape into confined spaces, nearby buildings, or even the atmosphere. This poses significant health risks to workers and the public due to the toxic and potentially lethal effects of H2S inhalation.

- Meat shops often generate a significant amount of organic waste, including trimmings, blood, and other byproducts. These organic materials are rich in proteins and can contribute to the production of H2S when they undergo decomposition. If a meat shop is located in close proximity to a sewer system, the organic waste from the shop can enter the sewer lines, providing a readily

available food source for sulfur-reducing bacteria. This can enhance the microbial activity responsible for the conversion of sulfate ions to sulfide, thereby increasing the potential for H2S formation.

- When heavy rainfall combines with the organic waste from a nearby meat shop, it can result in increased organic loading and nutrient availability within the sewer system. This can create favorable conditions for the growth and activity of sulfate-reducing bacteria, such as Desulfovibrio desulfuricans and other sulfur-reducing bacteria. As these bacteria thrive and consume the organic matter, they produce H2S as a metabolic byproduct.

- The combined effect of heavy rainfall and the presence of a nearby meat shop can lead to an elevated risk of H2S formation in the sewer system. It is important to monitor and manage these factors effectively to prevent the accumulation of H2S gas, which can pose significant health hazards to workers and the surrounding environment. Implementing proper waste management practices, ensuring proper ventilation, and conducting regular maintenance and inspections can help mitigate the risks associated with H2S in such scenario.

- Both COD and BOD serve as indicators of the potential for H2S production in wastewater systems. Higher levels of organic matter, as indicated by elevated COD and BOD, create more favorable conditions for the growth and metabolic activity of SRBs. These bacteria thrive in the absence of oxygen and utilize sulfate ions, ultimately leading to the production of H2S gas. Effective management of COD and BOD levels through proper wastewater treatment processes, such as aerobic treatment or chemical precipitation, can help control the formation of H2S and mitigate associated risks in sewer systems.

- To prevent hydrogen sulfide (H2S) leakage and ensure safety in environments where H2S may be present, several precautions should be taken. Here are some important measures:

- Ventilation: Adequate ventilation is crucial in areas where H2S may accumulate, such as confined spaces, sewer systems, or wastewater treatment plants. Properly designed and functioning ventilation systems should be installed to ensure the continuous exchange of air, preventing the buildup of H2S gas.
- Monitoring: Implement a comprehensive monitoring system to continuously measure H2S levels in relevant areas. This can involve the use of gas detectors or sensors that provide real-time data on gas concentrations. Regular monitoring allows for the early detection of H2S leaks and timely response to mitigate risks.
- Maintenance and Inspection: Regular maintenance and inspection of sewer systems, wastewater treatment facilities, and associated equipment are critical to identify and address potential sources of H2S leakage. This includes checking for damage, loose connections, or blockages that can contribute to gas escape.
- Proper Waste Management: Effective waste management practices can help minimize H2S formation. This includes preventing the buildup of organic matter, controlling BOD and COD levels, and implementing strategies to reduce the entry of organic waste into sewer systems.

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- Proper Waste Management: Effective waste management practices can help minimize H2S formation. This includes preventing the buildup of organic matter, controlling BOD and COD levels, and implementing strategies to reduce the entry of organic waste into sewer systems.

D. Singh

Dr. Shailendra Pratap Singh
Principal Scientist
CSIR-IITR Lucknow

ਸੇਵਾ ਵਿਖੇ,

ਉਪ ਮੰਡਲ ਮੈਜਿਸਟਰੇਟ

ਲੁਧਿਆਣਾ (ਪੱਛਮੀ)।

ਨੰ: Spl.1 ਮਿੱਤੀ: 01.05.2023

ਵਿਸ਼ਾ:- ਮਿੱਤੀ 30/04/2023 ਨੂੰ ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੂਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ, ਗਿਆਸਪੁਰਾ ਵਿੱਚ ਗੈਸ ਲੀਕ ਹੋਣ ਕਾਰਨ ਹੋਏ ਹਾਦਸੇ ਸਬੰਧੀ।

ਹਵਾਲਾ:- ਆਪ ਜੀ ਦਾ ਪੱਤਰ ਨੰ: 1/Special ਮਿੱਤੀ 01.05.2023

ਉਪਰੋਕਤ ਵਿਸ਼ੇ ਅਧੀਨ ਹਵਾਲਾ ਪੱਤਰ ਸਬੰਧੀ ਲਿਖਿਆ ਜਾਂਦਾ ਹੈ ਕਿ ਮਿੱਤੀ 30/04/2023 ਨੂੰ ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਨਗਰ, ਸੂਆ ਰੋਡ, ਨੇੜੇ ਇੰਦਰਾ ਕਲੋਨੀ, ਗਿਆਸਪੁਰਾ ਵਿੱਚ ਗੈਸ ਲੀਕ ਸਬੰਧੀ ਹਾਦਸਾ ਕਿਸੇ ਫੈਕਟਰੀ ਵਿੱਚ ਨਹੀ ਵਾਪਰਿਆ ਹੈ, ਜਿਸ ਕਰਕੇ ਫੈਕਟਰੀਜ਼ ਐਕਟ 1948 ਅਧੀਨ ਬੰਧ ਅਤੇ ਉਪਬੰਧ ਲਾਗੂ ਨਹੀ ਹੁੰਦੇ ਹਨ। ਇਸ ਲਈ ਇਸ ਦਫਤਰ ਵੱਲੋਂ ਇਸ ਸਬੰਧੀ ਕੋਈ ਕਾਰਵਾਈ ਨਹੀ ਕਰਨੀ ਬਣਦੀ ਹੈ ਜੀ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਸੁਚਿਤ ਕੀਤਾ ਜਾਂਦਾ ਹੈ ਕਿ ਇਹ ਮਾਰੂ ਹਾਦਸਾ ਸੀਵਰੇਜ ਵਿੱਚ ਕਿਸੇ ਜਹਿਰਿਲੀ ਗੈਸ ਦੇ ਬਣਨ ਕਰਕੇ ਵਾਪਰਿਆ ਜਾਪਦਾ ਹੈ ਜੀ। ਇਹ ਆਪ ਜੀ ਦੀ ਸੂਚਨਾ ਅਤੇ ਅਗਲੀ ਕਾਰਵਾਈ ਹਿਤ ਹੈ ਜੀ।

(ਗੌਰਵ ਪੁਰੀ)

ਡਿਪਟੀ ਡਾਇਰੈਕਟਰ ਆਫ ਫੈਕਟਰੀਜ਼

ਸਰਕਲ ਨੰ 1, ਲੁਧਿਆਣਾ।

Annex

What happened on the fateful day

7:30 AM, 30/04/2023

Gas Leak reported by PCR to PS Sahnewal, in Sua Road, Giaspura

1

Police Response

- Ambulance and Police team find 7 peop unconscious by the roadside
- Immediately taken to hospital; informs adm a appx 8 am

2

3

Emergency Response activated

District Administration, MC Officials, Medical Teams, Forensic experts, NDRF 13th Battalion (Ludhiana) rush to spot

4

Source Identification

- Forensic experts suggest H_2S presence based on condition of victims
- NDRF detects same in manholes and ambient air using sensors; Samples taken by NDRF, PPCB

6

Mitigation - Decontamination

MC, on expert advice, sprayed solution of diluted Caustic soda to neutralize H_2S

7

5

More Support

Battalion NDRF (hinda) joins at 11:15 AM handheld sensors

Evacuation & Cordoning

rea sealed off
Residents evacuated
Electricity supply cut off, local dhabas asked to turn gas off
NDRF scours area for source of leakage

Annexure-B

Office of Sub Divisional Magistrate, Ludhiana (West).

To

The Deputy Commissioner,
Ludhiana.

No.:- 3237 Date :- 12/7/23

Subject: Regarding payment of compensation in lieu of the deceased and injured persons in Ludhiana Gyaspura Gas Leak Tragedy occured on 30.04.2023

With regard to subject mentioned above, it is submitted that 11 persons lost their lives in Gyaspura Gas Leak tragedy. Out of the 11 victims, the compensation to the next of kin of the eight deceased persons to the tune of 20 lac rupees per victim has been disbursed and compensation to the tune of Rs. 1 lac(Rs. 50,000 from CMRF and Rs. 50,000 from PMRF) has been paid to the 4 persons injured in the tragedy (detail of which is attached), out of which Rs.50,000/- has been paid by this office and Rs. 50,000/- has been transferred directly in the beneficiary's bank account. Out of the amount of compensation of Rs. 20 Lac (payable in case of each deceased), Rs. 18 Lac has been disbursed by this office from Chief Minister Relief Fund and balance amount of Rs. 2 Lac (in case of each deceased) has been transferred directly to the next of kin's account by PMO.

The detail of deceased persons and their next kin and breakup of amount of compensation and the detail of injured persons is as under :-

Sr	Name of Deceased	Name of Next of Kin	Amount of compensation	Bank Details
1.	1)Kavilash S/o Jhalak Deo Prasad Yadav 2) Kumari Anula w/o Kavilash 3) Kalpana D/o Kavilash 4) Abhey S/o Kavilash 5) Aryan s/o Kavilash	Manorama w/o Jhalak Deo Prasad Yadav(Mother of Kavilash)	**CM Relief Fund Rs. 90 Lac** i) Rs 10 Lac vide cheque no.882614 dt 04-05-2023 ii) Rs. 80 Lac vide bill no.230600037610049 dt. 8-7-2023 **PM Relief Fund Rs. 10 Lac** iii) Rs. 10 Lac **Total Paid to Manorama Rs. 1 Crore.**	Bank Name :- Madhya Bihar Gramin Bank, Branch Name Konch, Gaya, Account No. 72440100141891 IFSC PUNB0MBGB06
2.	6) Navneet Kumar s/o Kumod Kumar 7) Neetu Devi w/o Navneet Kumar	i)Nandini d/o Navneet Kumar & Neetu Devi	**CM Relief Fund Rs. 18 Lac** i) Rs. 2 Lakh vide cheque no. 882616 dt. 04-05-23 ii) Rs. 16 lac vide bill no.230600037610049dt. 8-7-2023 **CM Relief Fund Rs. 2 Lac** iii) Rs. 2 lac PMRF **Total paid to Nandini Rs.20 Lac**	Name Nandini Bank: SBI, Branch Vaishali A/c No. 41890060832 IFSC SBIN0017445
		ii) Krishna Devi mother of Navneet Kumar	**CM Relief Fund Rs. 18 Lac** (i) Rs. 2 Lakh vide cheque no. 882617 dt. 04-05-23 ii) Rs. 16 lac vide bill no.230600037610049 dt. 8-7-2023 **PM Relief Fund Rs. 2 Lac** iii) Rs. 2 lac PMRF. **Total Paid to Krishna Rs. 20 Lac**	Name : Krishna Devi Bank: Punjab National Bank Branch Malahi Akbar Sarai A/c No. 7302000100078077 IFSC PUNB0730200

Note :- After the death of Navneet Kumar and his wife Neetu Devi, the amount of compensation has been disbursed in 1/2 share in favour of each of his two heirs i.e. Krishna Devi(mother) @ Rs. 20 Lac, and Nandini(Daughter) @ Rs. 20 Lac.

3.	8) Amit Kumar S/o Hari Om	i)Chander Kala Devi (mother) ii) Muskan Gupta(Wife) iii) Yashika (Daughter)	**CM Relief Fund Rs. 5,99,999.99 Lac** (i) Rs. 66,666.66 paisa vide cheque no. 882638 dt. 28-6-23 (ii) Rs. 5,33,333.33 vide bill no.230600037610049 dt. 8-7-2023 **PM Relief Fund Rs. 66,666.66 Lac** iii)Rs. 66,666.66/- PMRF **Total Paid to Chander Kala Devi Rs. 6,66,666.65/-**	Name Chander Kala Devi Bank Indian Bank Branch Aligarh IFSC IDIB000A566 A/c No. 20311324366
			CM Relief Fund Rs. 5,99,999.99 Lac (i) Rs. 66,666.66 paisa vide cheque no. 882619 dt. 04-05-23 (ii) Rs. 5,33,333.33 vide bill no.230600037610049 dt. 8-7-2023 **PM Relief Fund Rs. 66,666.66 Lac** iii) Rs. 66,666.66 through PMRF. **Total Paid to Muskan Rs. 6,66,666.65/-**	Name Muskan Gupta Bank Punjab National Bank Branch Civil Lines Aligarh IFSC Code PUNB0051100 A/c No. 0511000100349721
			CM Relief Fund Rs. 5,99,999.99 Lac (i) Rs.66,666.66/- through F.D.R. (ii) Rs.5,33,333.33/-through F.D.R. (under process) **PM Relief Fund Rs. 66,666.66 Lac** iii) Rs. 66,666.66/- through PMRF. **Total Paid to Yashika Rs. 6,66,666.65/-**	Name Yashika (Minor) Bank State bank of India Branch New Courts Ludhiana IFSC Code SBIN0003629 A/C no. 42060517628

Note :- After the death of deceased Amit Kumar, the amount of compensation has been disbursed in 1/3 share in favour of each of his three heirs i.e. Chander Kala Devi (mother) @ Rs. 6,66,666.65/-, Muskan Gupta(Wife) @ Rs.6,66,666.65/-and Yashika(Daughter) @ Rs.6,66,666.66/-. As Yashika is minor, the amount of compensation i.e. Rs. 6,66,666.66/- is liable to be deposited in her name in shape of F.D.R with condition that the F.D.R must be matured at the age of attaning of majority of Yashika. Out of the above amount, F.D.R. amounting to Rs. 5,99,999.99/- has been issued in the name of Yashika. The balance amount of compensation i.e Rs. 66,666.66/- has been processed through PMRF.

Detail of Injured:-

Sr. No.	Name of injured	Bank Details	Amt of compensation
1.	Nitin Kumar S/o Kumod Kumar	Bank Name ICICI Bank Branch Name Hazipur Bihar IFSC ICIC0001339 Acount No. 050801539031	Rs. 50,000 vide cheque no. 882610 dt. 03-05-2023 from CMRF & Rs. 50,000/- from PMRF.
2.	Gaurav Goyal S/o Ashok Kumar Goyal	Bank Name State Bank of India Branch Name Giaspura Famez Tower Ludhiana IFSC SBIN0050925 A/c No. 55145950540	Rs. 50,000 vide cheque no. 882611 dt. 03-05-2023 & Rs. 50,000/- from PMRF.
3.	Rajesh Kumar S/o Sagar Prasad	Bank Name Punjab National Bank Branch Name Kalsi Nagar, Ludiana	Rs. 50,000 vide cheque no. 882612 dt. 03-05-2023 & Rs. 50,000/- from PMRF.
4.	Ruby Devi w/o Hari Chander Shah	Bank Name Punjab National Bank Branch Name Samastipur IFSC PUNB0126310 A/C no. 1263100100004295	Rs. 50,000 vide cheque no. 882613 dt. 03-05-2023 & Rs. 50,000/- from PMRF.

Detail of Deceased, in whose case, compensation is yet to be paid partially

Sr	Name of Deceased	Name of Next of Kin	Amount of compensation	Bank Details
1.	1) Saurav Goyal s/o Ashok Goyal 2) Preeti Goyal w/o Sourav Goyal	i)Yug s/o Saurav Goyal and Preeti Goyal	**F.D.R. PENDING**	Account detail of Yug is not available
	3) Kamlesh Goyal w/oAshok Goyal	Gourav Goyal (son)	**CM Relief Fund Rs. 9 Lac** i) Rs.1 Lakh vide cheque no. 882615 dt. 4-5-2023 ii) Rs. 8 Lakh vide bill no. 230600037610049 dt. 8-7-2023 **PM Relief Fund Rs. 1 Lac** iii) Rs. 1 lac **Total Paid to Gaurav Rs. 10 Lac** Compensation of deceased Saurav Goyal and Preeti Goyal i.e. Rs. 40 Lac and half share of deceased Kamlesh Goyal i.e. Rs. 10 Lac (Total Payable to Yug Rs. 50 Lac) is pending because next of kin Yug is minor and there is no natural guardian alive and bank details are not available as per the requirement of Bank.	**Gourav Goyal** Bank Name State Bank of India, Branch Name Giaspura famez Tower Ludhiana IFSC Code SBIN0050925 acount no. 55145950540

It is worth mentioning here that after the death of Saurav Goyal and his wife Preeti Goyal, their son Yug is the only heir. So, the amount of compensation of Rs.40 lac (Rs.20 lac each) is was to be disbursed to the son Yug in shape of F.D.R as he is minor.

Besides, after the death of Kamlesh Goyal w/o Ashok Goyal, both the sons namely Sourav Goyal (deceased) and Gourav Goyal are the heirs of deceased Kamlesh Goyal and the amount of compensation in lieu of deceased Kamlesh Goyal is liable to be disbursed amongst her both sons in equal share i.e. Rs.10 Lac each. Since her son Sourav Goyal and daughter in law Preeti w/o Saurav have also expired in this tragedy, Yug s/o Sourav and Preeti becomes the heir of deceased Kamlesh Goyal in place of deceased Sourav Goyal. So, the amont of compensation @ Rs. 10 lac has been paid to Gourav Goyal (Son) and Rs. 10 lac is yet to be paid to Yug (Grandson). Thus, Rs. 10 Lac has been paid to Gourav Goyal and Rs. 50 Lac (Rs. 40 lac on acount of death of his parents Sourav Goyal and Preeti Goyal and Rs. 10 lac on account of death of his Grandmother Kamlesh Goyal) is liable to be paid to Yug. As Yug is minor, the amount of compensation i.e. Rs. 50 Lac is liable to be deposited in his name in shape of F.D.R with condition that the F.D.R must be matured at the age of attaning of majority of Yug. The process of opening bank account and deciding legal guardian is under process. The procees will be completed at the earliest. Hence it is requested that a time of 2 months be granted to this office to finally release the compensation amount to be paid to Yug.

Report is submitted for further necessary action please.

Sub Divisional Magistrate,
Ludhiana West.