NOTED 4925
Page No. 01 To 17
Date 29/6/21

**BEFORE THE NATIONAL GREEN TRIBUNAL,**
**PRINCIPAL BENCH AT NEW DELHI**

**O.A. No. 64 of 2016 (WZ)**

Akhil Bhartiya Mangela Samaj Parishad ..... Applicant

**V/S.**

Maharashtra Pollution Control Board & Ors ..... Respondents

**REJOINDER AFFIDAVIT**
**TIMA'S OBJECTIONS TO COMMITTEE'S REPLY**
**FILED IN M.A. NO. 02 OF 2021**
(Pursuant to Order dated 07.06.2021)

I, Shivranjan Gupta, Age-63 years, Hon. Secretary of Tarapur Industrial Manufacturers Association (**TIMA**) **i.e., Respondent No. 9** in Original Application (OA) No. 64 of 2016 and the Applicant in M.A. No. 02 of 2021 filed in the said OA, having registered office at P-14, Recreation Centre, Navapur Road, Tarapur Industrial Area, MIDC-Tarapur, Boisar West, Dist-Palghar, do hereby solemnly affirm and state as under: -

I SAY THAT

1. Pursuant to leave granted by this Hon'ble Tribunal vide Order dated 07.06.2021, TIMA is submitting its Rejoinder/ Objections to the Reply dated 13.05.2021 filed by Expert Committee in M.A. no. 02 of 2021.

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2. It is submitted that three comments / admissions on part of the Committee effectively render its own Report nugatory and liable for a complete re-assessment:

   a. At pg. 6, it has been noted that there are multiple methods to assess the compensation, one of which is the PPP method. Under this method, the total amount has been assessed at Rs. 27.04 crores whereas the MER method adopted by the Committee results at an amount of Rs. 85.042 crores. No specific reason has been assigned as to why the higher of the two amounts has been adopted. On the other hand, TIMA has already submitted in its objections that the MER method is based upon a Spanish study of 2010, which cannot be made applicable under Indian situation. Keeping in mind the purchasing of power in India, it is the PPP method, which alone may be adopted for the present case and therefore, without admitting liability and without prejudice to its other objections raised in M.A. No. 02 of 2021, TIMA states that the total compensation would reduce substantially.

   b. At pg. 13 of the Committee's Reply, it has been admitted that the concept of 'Super Fund' is a novel concept for the Indian environmental statutory regime. It is submitted that any compensation towards restitution of environment (as in the present case) is regulated by sections 15 to 17 of the NGT Act read with Rules 35 to 37 of the NGT (Practice and Procedure) Rules, 2011. Since these provisions do not provide for a fund like 'Super Fund', the same cannot be introduced by the Committee. It is submitted that

Super Fund assessment at Rs. 75 crores, having no statutory basis, is liable to be deducted from the overall assessment.

c. At pg. 23 of the Committee's Reply, it has been suggested that MPCB may re-examine cases of individual units for errors with regard to apportionment of liability. Since grave errors have been shown by TIMA in this regard, the exercise by MPCB is extremely relevant. This Hon'ble Tribunal, vide order dated 07.06.2021, directed the MPCB as under:

> "... ... *It is further pointed out by learned counsel that the revised estimate on compensation is to be worked out by Maharashtra State PCB. The Committee may provide its response, if an, on this aspect before the next date.*"

It is submitted that so far the Committee has nt responded on this issue. TIMA however understands from its member industries that, MPCB has undertaken the exercise of verifying the records and re-apportionment of liability after correcting errors with regard to individual units as detailed in the objections filed on behalf of TIMA/ TEPS.

**3. Objection to PART – I of Committee's Reply are as under: -**

a. As regards **para 1 to 4 of Committee's reply** to para (A) 1 (a) to (f), the Committee has merely reiterated contents of its Reports in so far as process of identification of polluting units and period of violation. The Committee has again referred to its observation and recommendation

given under Ch- 5 at page 59 – 64 of the Report, which in-fact are vehemently challenged and disputed by TIMA on various grounds as stated in its point wise objections. There is no specific denial or reply filed by the Committee about the objections so raised by TIMA on following aspects –

i. Report prepared on basis of past / historic records.
ii. Non-availability of records with MPCB resulting in penalizing only those units who in good faith submitted all their records.
iii. Blanket Exemption to SSI and ZLD units, without assigning proper reasoning.
iv. Non-consideration of papers and details submitted by various units during hearing meetings called by the Committee in the month of November/ December 2019.

In fact, in its Reply as well as the Report, the Committee has confirmed about various discrepancies in the MPCB data and reports. There is also a confirmation from the Committee that there are incidences of SSI units discharging into CETP in excess of their prescribed norms but such units being given blanket exemption only for the reason that their discharge was within prescribed inlet standards of CETP. It may also be seen at page 70 para 2 of the Report that Committee had left it to the discretion of MPCB to examine the matter and take appropriate decision in exempting such exceedance cases of SSI units. It is matter of record that there is no formal decision on this aspect from MPCB and as such the

process of identifying and targeting 103 units and putting entire burden of alleged environmental damage, restoration costs and alleged Super Fund on such few units is neither legal nor logical and the same is against principle of equality and natural justice. Expert Committee's recommendation that CETP be held responsible for violations of such SSI units is certainly violation of established principles of environmental law, including Polluter Pays principle. Hence criterions at point (i), (ii) and (iv) on page 71 of the Report are required to be judicially examined and struck down by this Hon'ble Tribunal. There is no justification provided by the Committee of its selection process except for referring to discretion used by MPCB, which is in fact one of the contesting Respondents in the main O.A. Though point (iii) at said page 71 of the Report is a correct proposition, yet TIMA has separately pointed out that, in many cases where the alleged violation is not related to water pollution and only relating to non-providing of bank guarantee or fitting of certain mechanical equipment or implementing recommended process etc., are in-fact considered by the Committee (just for sake of MPCB's reporting) as cases of violation and such units are improperly included in the list of polluting units.

TIMA refers to Para 11 appearing on page 23 of Committee's reply about factual errors, where the Committee has pointed fingers at MPCB, which cannot

be considered as a tenable response to factual errors and disputes raised by each individual unit.

TIMA further refers to and relies upon para 12 of the Committee's Reply page 23, wherein, the Committee has accepted a scope and need for re-examination and correction of tables including need for correction of DRC factors in order to ascertain damage recovery cost for the polluting units. This Hon'ble Tribunal may therefore consider issuing necessary directions to the Committee in-response to above.

b. As regards **para 1 to 3 of Committee's reply** to para (B) (1) to (3) (a) to (h) of the TIMA objections, the Committee has admitted that by applying PPP index the environmental damage cost would substantially come down. However, Committee out of nowhere suggested CoT method and shown equivalent figures. While doing so Committee has conveniently excluded treatment cost incurred by CETP i.e., M/s TEPS which runs its operations from treatment charges levied on member industries. It also transpires that the said CoT method is focused on finding cost of treatment of the effluent which in-fact is not relatable to the exercise of identifying and ascertaining an actual environmental damage, if any. It is further surprising to note that, the Committee has admittedly linke use of the said MER, PPP, CoT formulae to provide avenues of improvement of environmental infrastructure in Tarapur Region and have further suggested that, funds collected through such

compensation be used for carrying out infrastructural projects. This proposition is not legal and is in-fact contrary to Sec.15 to 17 of NGT Act r/w. Rules framed under the Act related to recovery of environmental damages.

The references given at the bottom of said para 1 to 3 are not applicable to be utilized for the present case. TIMA reiterates its objections as regards use of Spanish formula dated 2010.

c. It is further respectfully submitted that, in a case of more serious nature, in O.A. No. 22 of 2020 where this Hon'ble Tribunal was pleased to appoint an Expert Committee under the Chairmanship of Justice B. C. Patel, Former Chief Justice of Delhi High Court, assisted by various scientists and expert institutes like NEERI, IIT and for which CPCB was appointed as a nodal agency. In an Additional Report dated September 2020, the said Committee has very clearly mentioned use of PPP adjustment factor while doing economic valuation through Value Transfer Method (VTM). In the said Report while deriving values for certain air pollutants, UK-Defra values were adopted for calculating monetary value of damages. However, suitable econometric conversions including purchasing power parity (PPP) and inflation rate (IR) have been used to convert UK defra values to Indian values. The Indian values so arrived are used for valuation of damages. There is a detailed discussion in the said Report in so far as how the damage

valuation has been arrived at for each pollutant after applying appropriate conversion formulae for Indian context. TIMA, without admitting any liability and without prejudice to its other contentions/ objections, places its reliance on the said Report in O.A. No. 22 of 2020 (also filed by an expert committee constituted by this Hon'ble Tribunal with CPCB acting as its nodal agency) for limited extent of showing how PPP and IR are factors considered relevant by the experts from the field for assessment of environmental damage. Reference to the said report is also relevant to consider bringing in parity and standardization of formulae adopted for assessment of environmental damage at polluted sites. Copy of the order of this Hon'ble Tribunal dated 08.06.2020 and Copy of the Additional Repot dated September 2020 as submitted by the Expert Committee in the said matter are produced herewith as ***Annexure A*** and ***Annexure B***.



d. As regards issue of **wetland** dealt in para 4 to 7 on page 7 and 8 of Committee's reply, TIMA reiterates its stand that there is no notified wetland in Tarapur MIDC or at any of the discharge points examined by the committee. Since there are different parameters for assessing damage to the wetland and those applicable to sea and creek area, damage calculations substantially differ. Also, it is specifically denied that the discharge points are in any eco-sensitive zone. It is further denied that, there is any adverse impact on mangroves or other water bodies viz. creek, intertidal zone, CRZ etc. There has been admission

on part of Committee that there is no baseline data available for assessing the damage, if any, to such water bodies. In this regard TIMA further states and submits that, laying of effluent carrying pipelines, maintaining discharge of effluent at a safe distance inside the sea and ensuring protection of coastal areas is specific duty and responsibility of MIDC.

Hence, exorbitant claim of about 79 Crores raised by the expert committee on account of alleged damage to the wetland is denied by TIMA and the same needs to be omitted from the damage calculations.

e. As regards issue of **multiple objections to data inadequacy** dealt in para 8 to 13 on page 8 and 9 of Committee's reply, TIMA states that, the CEPI score of Tarapur MIDC of 2018 is not admitted. Current CEPI score of Tarapur MIDC is 53.60 which is substantial improvement achieved by the concerned stakeholders including the industries and M/s. TEPS run CETP for their constant efforts towards environment protection efforts and implementation of new technologies. Action plan for Tarapur Industrial Cluster dated Feb 2019, as published by MPCB is produced as ***Annexure C*** to this Rejoinder. Page 43 to 49 of the said Action Plan are relevant for finding correct CEPI score values for Tarapur. Report also acknowledges efforts of various member industries and TEPS-CETP which has resulted in improvement of environment of Tarapur.

TIMA further states that, the results of random sampling at Tarapur MIDC as given in the Committee's Report do not suggest any irreparable damage to the water bodies. In-fact a comparative study with remote location of Edvan beach at 85 km away in-fact suggests that the levels found at Tarapur MIDC or adjoining areas are not very different than the said non-industrial beach location.

TIMA further objects to alleged reference and reliance of the Committee upon satellite imagery, to conclude about level of pollution. TIMA has time and again pointed out that, there are domestic untreated effluents which are far in excess of the industrial treated effluents passing through the same storm water bodies meeting at the same discharge point. TIMA has also informed about existence of a government run Tarapur Atomic Power Station in its vicinity operational since 1969, and also human establishments in adjoining areas, which are equally contributing to the discharge in the coastal zone near Tarapur. Hence TIMA stand-alone does not accept liability being imposed on only select few member units. The entire exercise of expert Committee needs to be redone by identifying all possible sources of pollution existing as on today and hen suggesting remedial action plan. Under pretext of precautionary principle, such ad-hoc damage assessment and apportionment of liability only on select few units while ignoring all other possible sources of pollution should not be validated by this Hon'ble Tribunal.

f. As regards issue of **error by duplication and overlapping of BOD and COD** dealt in para 14 to 18 on page 9 and 10 of Committee's reply, TIMA states that, the Committee has given no specific reply on the point of duplication of damage. It is therefore stated that, alleged excess discharge cannot be treated simultaneously as being discharged into sea and creek. The Committee has repeatedly admitted lack of scientific and baseline data. Thus, imposing penalties by duplicating damages should be judicially examined and be struck down. Further it be noted that the 25 MLD of effluent is a treated effluent. There are no specific figures about alleged excess discharge quantities in sea and creek.

It is further submitted that, the alleged statement that the present estimate of damages is only a conservative one and may further increase after a comprehensive study is a vague and unacceptable proposition, since this will always keep a hanging sword of further claims being made against the industries under one pretext or the other. TIMA has time and again stated that, in absence of any definitive action plan and well identified project costs, there is no question of any claims or demands that this Hon'ble Tribunal should accept and enforce against the member industries. There is no provision in the current Indian Environment Law regime akin to imposing of tax on industrial units for carrying out future environmental projects by the regulatory authorities.

g. For the reasons stated herein before TIMA strongly objects to the **concept of Super Fund**, admittedly being introduced by the Expert Committee. Para nos.1 to 3 as appearing between page 10 to 12 of Committee's reply are vehemently denied and opposed by TIMA.

TIMA states that, the Committee has indicated that it has only done a prima facie examination and study and that quantification of pollution including delineation of the contaminated areas and areas needing remediation; detailed site investigation & characterization; risk assessment studies & identification of remediation goals/objectives and preparation of remediation plans thereof; selection of remediation criteria; outlining remediation options and preparation of detailed technical document with specifications for the selected remediation option; are subsequent steps in scientific management of contaminated sites. As part of restoration measures, the Committee has recommended Phase-I work which includes the said activities by preparing Detailed Project Report (DPR) followed by execution of the selected remediation plan as Phase-II work. However, nowhere in the entire Report or in their say to the objections that Committee has sufficiently explained calculation of Rs. 75 Crores as a Super Fund. There are no estimates or any project details whatsoever and hence such recommendation of collecting huge sums of money from the industries on an ad-hoc basis is completely illegal and baseless and should accordingly be dealt by this Hon'ble Tribunal while considering the Report. For the same

reason para 1 to 8 appearing on page 13 to 15 of Committee's reply is hereby challenged. In para 4 there is admission on part of Committee that the concept of Super Fund is alien to the Indian environmental statutory regime. It is further surprising to note that a huge amount of Rs. 75 crores which the Committee trying to justify as a financial resource for the government bodies to implement remedial action plan, is being also treated as an initial amount. Such casual attitude in recommending collection of such huge amounts of money, without providing any calculations whatsoever, certainly needs to be discarded by this Hon'ble Tribunal.

h. On the issue of **Ground Water contamination** (on Pg. 12 and 13 of the Committee's Reply), TIMA on behalf of its member industries categorically denies that the same is being caused for their fault. It is further categorically denied that the samples and study of the Committee is more comprehensive than the MPCB study etc as alleged. It is denied that the locations from where samples are collected by the Committee are recognised sources of drinking water for the population in the vicinity. TIMA states and submits that the adjoining villages have a regular water supply from local government, which is sourced from Surya river, far away from any of the said locations of sample collection.

Be that as it may, TIMA has time and again invited attention of this Hon'ble Tribunal to the issue of breach by MIDC of its duties to maintain in proper condition, all

the infrastructure and pipelines for carrying and safely disposing the treated effluent into the sea. TIMA states that there are numerous instances every month reported by MIDC itself about damage or leakages in the effluent carrying pipeline network which is under control and management of MIDC. This has over a period of last many years, resulted in certain effluents mixing with storm water drains and resultantly to some extent in the ground water. TIMA has therefore being consistently demanding appropriate directions against MIDC including the directions sought by M/s. TEPS in M.A. No. 375 of 2017 filed in the present OA.

Notwithstanding above, TIMA through its member industries and TEPS-CETP are taking all appropriate measures and following directions of the regulatory bodies for protections of ground water in Tarapur MIDC area. TIMA hereby assures this Hon'ble Tribunal that it shall through its member industries will work in collaboration with the Committee and other Regulatory bodies for restoration of the ground water wherever it is found to be not potable and the cause is directly linked to the effluents generated from Tarapur MIDC.

i. TIMA objects to the reply of the Committee on the point of **Fiscal Discounting** (Pg. 16 and 17 of the Committee's Reply), which is an outright refusal to consider discounting stating that the Committee has only considered Assessment Period and current scenario damages. Committee has in fact admitted in Para 2, Page

16 of their Reply that the discounting needs to be used whenever long term impact needs to be assessed. Tarapur MIDC has been in operation since year 1983 and if any alleged environment damage is reported, the same is not due to any short term activity or attributable solely to the industrial cluster. Other contributary factors including domestic waste and untreated sewage which is one of the major causes of pollution has to be factored in and discounting needs to be worked out accordingly. TIMA adopts other objections on this issue raised in M.A. No. 02 in response to Committee's Reply on this issue

j. As regards Reply on the point of **factual errors and erroneous methods, calculation of number of violation days etc.** as stated by the Committee in Para 1 to 10 appearing on Page 17 to 22 of their Reply, TIMA states that the Reply is repetition of reasoning as given in the original Report, which is vehemently being challenged. Be that as it may, in Para 11 and 12 appearing on Pg. 23 of the Report, the Committee has shown its willingness to reconsider all the cases. To the knowledge of the TIMA, MPCB officials are already carrying out the said exercise of reassessment, since certain glaring defects and errors are admitted by MPCB, which have also hampered the correctness of the Committee's Report.

k. Reply of the Committee as appearing on Pg. 24 and 25 on the **issue of apportionment of liability and MIDC's responsibility**, the logic described by the Committee is not rational and not tenable according to established

principles of law. TIMA in their objections (M.A. No. 02 of 2021) as well as TEPS (Respondent No.3) in its own point wise objections submitted under M.A. No. 01 of 2021 have provided a details of effluent management system at Tarapur, how it functions, what are roles and responsibilities of MPCB and MIDC as regulators, about limitation of powers and authority with CETP management etc. Committee in their Reply have conveniently ignored the said details and have been covered-up various defaults and breaches of MIDC. It is pertinent to note that the original Applicant had sought majority prayers against the MPCB and MIDC, who are contesting respondents. It also may be noted that MIDC has remained absent throughout the final hearing stage and also has neither been called by the Committee to provide any details nor are they held accountable for over supply of water, or various reported leakages in the effluent carrying pipelines under MIDC's management and control. Committee has further ignored the tasks which Committee had itself assigned to the MIDC as part of immediate restoration / correction plan, even which remain unfulfilled by MIDC. TIMA thus invites attention of this Hon'ble Tribunal on this important issue, which if not addressed now, will perpetually adversely impact any restoration plan or environment protection measures implemented by the other stakeholders.

4. As regards other **Reply statements appearing on Page 25 and 26 of the Committee's Reply**, Part-A have no merit and they stand sufficiently rebutted as per the original

objections as well as rejoinder reply given hereinbefore. Issue of Bank Guarantee, needs a specific reply from MPCB, who have collected and/or forfeited the said amounts. If the penalty was for the same violation, there can not be double penalty, now under the present OA. This Hon'ble Tribunal may also consider giving due weightage to the huge amounts spent by the industry on implementing SCADA system as well as costs incurred for construction of new 50 MLD plant which are to be treated as part of environment protection infrastructure being developed by the industries in collaboration with M/s. TEPS.

5. TIMA shall deal in further details, with each and every Reply Statement of the Committee, at the time of hearing and the above Rejoinder may please be read as highlights of TIMAs objections to the Committee Reply dated 13.05.2021.

WHATEVER STATED BY ME IN PARA 1 TO 5 HEREINABOVE IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF AND AS PER THE RECORDS AVAILABLE WITH THE RESPONDENT NO. 9 AND IN WITNESS WHEREOF I HAVE SIGNED HEREUNDER ON THIS DAY OF JUNE 2021 AT TARAPUR, DIST-PALGHAR

I KNOW THE DEPONENT
WHO SIGNED BEFORE ME
Witness as to Signature only
Document(s) not prepare
Reviewed of Advice upon
BEFORE ME

MR. HEMANT R. PATIL
29/6/2021
ADVOCATE & NOTARY
(GOVT. OF INDIA)
Off. Ostwal. Empire, Boisar,
Sundaram Apt., Bldg. No. L/4,
Gala No. 4, Boisar, Tal. Palghar,
Dist. Palghar, Maharashtra-401501.

AFFIANT

For TARAPUR INDL. MNFRS. ASSOCIATION (TIMA)

HON. SECRETARY

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भारत सरकार
Government of India

शिवरंजन कैलासचंद्र गुप्ता
Shivranjan Kailashchandra Gupta
जन्म तारीख / DOB : 04/08/1958
पुरुष / Male

9453 6649 0258

# आधार - सामान्य माणसाचा अधिकार

स्थाई लेखा संख्या /PERMANENT ACCOUNT NUMBER

ABJPG6152F

नाम /NAME

SHIVRANJAN KAILASHCHANDRA GUPTA

पिता का नाम /FATHER'S NAME

KAILASHCHANDRA GUPTA

जन्म तिथि /DATE OF BIRTH

04-08-1958

हस्ताक्षर /SIGNATURE

आयकर आयुक्त-I, पुणे
Commissioner of Income-tax I, Pune

# Annexure - A

**Corrected order**
**Uploaded on 15.06.2020**

Item No. 01 Court No. 1

**BEFORE THE NATIONAL GREEN TRIBUNAL**
**PRINCIPAL BENCH, NEW DELHI**

(By Video Conferencing)

Original Application No. 22/2020 (WZ)

Aryavart Foundation through its President Applicant(s)

Versus

Yashyashvi Rasayan Pvt. Ltd. & Anr. Respondent(s)

Date of hearing: 08.06.2020

**CORAM:** **HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON**
**HON'BLE MR. JUSTICE S.P. WANGDI, JUDICIAL MEMBER**
**HON'BLE DR. SATYAWAN SINGH GARBYAL, EXPERT MEMBER**

For Applicant(s): Mr. Raj Panjwani, Senior Advocate with Dr. S.S. Hooda, Advocate

For Respondent(s): Mr. Saurabh Kulkarni, Advocate for R-1
Ms. Ruchi Kohli and Ms. Nidhi Jaswal, Advocates for GPCB
Mr. Raj Kumar, Advocate for CPCB

**ORDER**

1. Proceedings in this matter arise out of an incident dated 03.06.2020 at Dahej, District Bharuch, Gujarat which has been widely reported in the media. A massive blast took place in a chemical factory run by respondent No.1, Yashyashvi Rasayan Pvt. Ltd. ("The Company"). On account of a fire in the storage tank of the factory, manufacturing several chemicals including Methanol and Xylene which find mention in the Schedule to the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 (The 1989 Rules). On account of the said incident, eight (08) workers were killed and atleast 50 injured. Bodies

of some of the workers inside the factory were charred beyond recognition. We have seen some of the telling photographs during the hearing. About 4800 inhabitants of the nearby villages had to be moved to safer place[1] on account of the incident. The company has revenue in the range of Rs. 100 crores for the year ending 31.03.2018.[2] According to Mr. Panjwani, learned Senior Counsel appearing the applicant, the Company is owned by the Patel Group having large financial resources.

2. This application has been filed by an NGO located at Surat mentioning the above facts based on newspaper reports. The applicant has also referred to another recent shocking incident of 07.05.2020 in the factory of L.G. Polymers India at Vishakhapatnam where 12 persons died and several others were injured. It is stated that on 08.05.2020, the Central Pollution Control Board (CPCB) issued a circular requiring all the State PCBs to undertake safety audit of industries before they reopened after the COVID-19 situation. The industries dealing with hazardous chemicals were required to ensure that all safety protocols are followed and requisite equipment is operationalized and manpower is duly trained for handling such chemicals. On 11.05.2020, Maharashtra State PCB issued an identical circular specifically requiring the hazardous and chemical handling units to provide information with regard to onsite and off-site emergency plans, safety audit reports and action taken in pursuance of such report. It is stated that the company failed to follow requisite precautions and safety protocols. The company is thus strictly and absolutely liable for the damage caused to the human lives, human health, property and the environment in

[1] https://indianexpress.com/article/cities/ahmedabad/gujarat-dahej-chemical-factory-fire-deaths-6441590/
[2] https://www.tofler.in/yashashvi-rasayan-private-limited/company/U24119GJ2003PTC041827

violation of environmental norms, particularly the mandate of the 1989 Rules, the Chemical Accidents (Emergency, Planning, Preparedness and Response) Rules, 1996(the 1996 Rules) and the circular issued by the CPCB.

3. Advance notice of the application was served on the Company, the GPCB and the CPCB. We have heard Shri Raj Panjwani, Senior Advocate appearing for the applicant, Shri Saurabh Kulkarni, Advocate appearing for the company, Ms. Ruchi Kohli, Advocate appearing for the GPCB and Mr. Raj Kumar, Advocate appearing for the CPCB.

4. It is undisputed during the hearing that the company is engaged in the manufacture of hazardous chemicals and is covered by the 1989 Rules and the 1996 Rules. It has to prepare and follow onsite and off-site emergency plan which is required to be duly audited and overseen by the statutory authorities including the Chief Inspector of Factories (CIFs), Department of Industries, the District Magistrate, the State PCB and the Petroleum and Explosives Safety Organization (PESO). Overall regulatory framework is under the Ministry of Environment, Forest and Climate Change (MoEF&CC). Liability of the Company is strict and absolute for the loss caused by its activities. Dependents/heirs of the deceased as well as the injured persons, the persons displaced on account of the incident have to be duly compensated. The company has also to bear the cost of restoration of the environment.

5. We may also have to examine the failure of the concerned statutory authorities in taking necessary preventive and safety measures.

6. While the company and other concerned have to be given due opportunity, an interim direction for compensation on the basis of available material cannot brook any delay. Interim compensation can be awarded on conservative subject to final compensation being determined later. While no compensation for death or injury or displacement may be adequate and environment is priceless, having regard to facts and circumstances and on ad hoc basis, we assess interim compensation for death to be 15 lacs each (taking into account multiplier of around 16 and loss of earning of about one lac a year, taking the minimum wage, apart from conventional sums), for grievous injury Rs. 5 lac per person, for other injuries of persons hospitalized Rs. 2.5 lac per person and for displacement at Rs. 25000/- per person. The company may make an interim deposit of Rs. 25 Crores excluding the deposit/payment already made in pursuance of order of the GPCB or otherwise or under the Workmen's Compensation Act, 1923 or any other statutory provisions or *ex gratia* in relation to the present incident. Disbursement may be made by preparing an appropriate plan by the District Magistrate in consultation with the District Legal Service Authority, Bharuch to be overseen by the Member Secretary, State Legal Service Authority. The amount may be deposited within 10 days from today. Disbursement may be made within one month thereafter. If the company fails to make the deposit, the State will be at liberty to recover the same by coercive methods but the disbursement may in such case be made out of the State funds within one month with right of the State to recover the amount from the company.

7. We may note that by our order dated 08.05.2020 in O.A. No. 73/2020, while dealing with the incident of gas leak at

Visakhapatnam, where 12 persons died, about 100 persons were hospitalized (out of which 25 were serious) and 1000 persons were reported to be sick, a six-member Committee headed by Justice B. Seshasayana Reddy, former Judge, A.P. High Court was constituted to enquire into the following issues:

a. The sequence of events;

b. Causes of failure and persons and authorities responsible therefor;

c. Extent of damage to life, human and non-human; public health; and environment – including, water, soil, air;

d. Steps to be taken for compensation of victims and restitution of the damaged property and environment, and the cost involved;

e. Remedial measures to prevent recurrence;

f. Any other incidental or allied issues found relevant.

8. The Committee gave its report making certain suggestions as mentioned in further order dated 1.6.2020, including the following, in relevant part:

***"g) Remedial measures to prevent recurrence;***

*1) Hazard identification and evaluation in a local community, Preparation of Guiding Principles for Accident Prevention, Preparedness and Response for onsite and offsite emergency plans has to be reviewed.*

*2) A detailed study of the risk assessment and disaster management studies to he carried out by the industry*

*...*

*7) Installation of the automatic siren when any parameter goes out of control. The siren needs to be done within and outside the industry so that the villages around are alarmed about the same*

*8) Emergency ambulance services to be arranged in the industry premises along with an experienced doctor.*

*9) Awareness campaigns in the villages around the industry to make them aware of the measures to be taken in case of any accident/ damage from the industry to the area around the industry.*

*10) Readymade PPE to be placed at the emergency points in case of any accident.*

*11) Separate safety manual to be prepared for each equipment along with the accidental management plan.*

*12) Periodic inspection by Department of Factories & Safety to assess the safety measures and documents maintained by the industry. If failed, necessary action shall be initiated against the industry.*

*...*

*I8) The administrative failures such as not obtaining Environmental Clearance from MoEF&CC. not implementing the recommendations of APPCB and factories of inspectors in time (based on inspection reports), failure of replacing the old storage tanks and having no safety measures for temperature recordings, no safety audit reports are to be further investigated.*

*19) The role of factories and inspectors to be specified and their inspection protocol are to be assessed Pan-India. Since safety aspects are part of their mandate an independent audit is required in the light of many accidents reported due to failure of safety measures and lack of training.*

*20) In order to prevent such accidents, a District Crisis Group (DCG) needs to be established under the chairmanship of District Collector. This group has to meet every 45 days to review the safety and hazard issues of each and every industry. Similarly, State Crisis Group (SCG) needs to be established under Chief Secretary. This committee should meet every 3 months and review the onsite/offsite District emergency plan prepared by DCG and suggest the measures to be taken to minimize the accidents. Both DCG and SCG should make plans to create awareness among the people living in the surrounding area of the industry about chemical hazards and measures to be taken for accidents.*

*21) It is suggested that each State shall take responsibility in implementing the Chemical Disasters Management, protocol (March 2009 publication) and NIHIDC remedial measures and submit Action taken Report.*

*22) Responsibility Matrices for Disaster Risk Mitigation as per National Disaster Management Plan (May 2016) has to be taken up and assess the implementation schedule by each States and UTs.*

***h) Any other incidental or allied issues found relevant;***

*...*

*The Committee has taken opinion of the participants by interacting with each and every individual, and the main observations of the participants are stated below.*

*2. The Company should conduct local public awareness campaigns about Do's/ Don'ts during, emergency.*

***3. Since the NEERI team have already conducted preliminary studies and a report has been prepared, it is suggested to engage the services of NEERI, for studies related to environment including water, soil and air.***

***6. All the affected families should be given identity cards and Health cards by the Government and the expenditure on medical bills shall be borne by the unit. District Administration shall make necessary instructions and coordination.***

*10. All factories should be monitored through C.0 cameras. The Companies as well as the Government neglected the Community Based Disaster Response system.*

***11. The Government should ensure that hereafter all companies should take precautions and not to repeat such incidents. Awareness programme should be conducted in the surrounding areas of the industry.***

**(emphasis supplied)**

9. The Tribunal also noted earlier orders pointing out deficiencies in the regulatory framework. The relevant observations are:

> *"37. Dealing with environmental issues, including unfortunate incidents, the Tribunal has found need to revamp the existing regulatory framework quantitatively and qualitatively. The Tribunal has noted the observations of the CAG and parliamentary Committees on the subject. Reference may be made to order dated 22.11.2019 in O.A. No. 837/2018, Sandeep Mittal vs. Ministry of Environment, Forests & Climate Change & Ors. after noting the status of current monitoring mechanism of the MoEF:*
>
> ***...***
>
> *6. We have considered the above averments as well as contents of annexures R-I and R-II giving data of the projects and 'six monthly action plan'. We are of the view that the mandate of law is not complied with by the above stand of the MoEF&CC.* ***It is well acknowledged that there is rampant violation of the Environmental Clearance (EC) conditions. This Tribunal has, in order dated 21.11.2019, noticed serious violations of EC conditions with respect to A Category 'housing projects' in Haryana and found monitoring of conditions of EC ineffective.[3] The said order also refers to earlier orders wherein similar serious violations have been noticed. The violations include absence of scientific management of sewage and solid waste, not having open spaces, illegal drawal of ground water, construction in excess of sanctioned plan etc. It is difficult to say such violations are limited to State of Haryana. In absence of adequate mechanism, such rampant violations are bound to***

[3] Order dated 21.11.2019, O.A. No. 506 / 2019, Mukund Dhote v. UOI & Ors.

***continue defeating the environmental principle of precautionary and sustainable development. In this regard, it is apt to note that this aspect was considered by the Hon'ble Supreme Court in T.N. Godavarman Thirumulpad Vs. Union of India & Ors. (2014) 4 SCC 61. Reference was made to the observations in Lafarge Umiam Mining Private Limited Vs. Union of India, (2011) 7 SCC 338 that power of the regulator under Section 3(3) of the Environment (Protection) Act, 1986 is coupled with duty and that the monitoring mechanism for the clearance conditions was not satisfactory. The Hon'ble Supreme Court also referred to a report on 'Scope, Structure and Processes of National Environment Assessment and Monitoring Authority (NEAMA)' for the Ministry of Environment and Forests, Government of India prepared by Department of Management Studies, Indian Institute of Technology, Delhi. Therein it was found that there are huge gaps in monitoring and enforcement of clearance conditions which defeats the purpose of Environmental Clearance process****. The said finding quoted in the judgment is as follows:*

> ***"Several studies have pointed toward the poor monitoring of the clearance conditions. Huge gaps in monitoring and enforcement of clearance conditions actually defeats the very purpose of grant of conditional environmental clearance."***[4]

7. ***We also note the observations from Report of the Comptroller and Auditor General of India on Environmental Clearance and Post Clearance Monitoring 2016 that there are shortfalls in monitoring of environmental parameters. Reasons for such shortfalls are inadequate staff, inadequate database, not assigning clear responsibility for post EC monitoring, absence of monitoring at regular intervals particularly for critically polluted areas****.*

8. ***Thus, there is dire need for revamping the monitoring mechanism by MoEF&CC as well as SEIAAs, CPCB and State PCBs Post EC monitoring processes need revamping in quantitative as well as qualitative terms. There is need to prioritize the projects where potential environmental degradation is high on account of nature of activity as well as area being ecologically sensitive. In respect of such projects and in such areas, monitoring may have to be more intensive and at higher frequency. In no case frequency of monitoring should be less than once in a year.***

9. ***The present scenario of monitoring once in 4.5 years and planned modification resulting in monitoring in 2.5 years is farce and does not meet the requirement***

[4] Para 10

***of law by any standards. As already observed monitoring has to be, as far as possible, quarterly and in no case less than twice a year.***

10. ***Data of environmental degradation in the form of air, water and soil pollution reflected in the form of 351 polluted river stretches, 122 non-attainment cities and 100 polluted industrial clusters is eloquent testimony of such degradation and failure of monitoring mechanism. Statistics of deaths and diseases on account of such degradation are well known and need not be elaborated here.***

11. ***On being asked, learned counsel for MoEF&CC is unable to even mention the percentage of compliance as according to him there is no such data available, which is shocking. With a view to plan such monitoring, the percentage of compliance must be ascertained. Trend over a period of time in terms of increase in compliance or otherwise must be studied so that there can be corresponding review of mechanism based on correct data. Experience so far shows that with the increasing developments, in absence of adequate monitoring mechanism it would be difficult to check such violations thereby defeating 'precautionary' principle.***

12. ***In view of the above, remedial action may be planned at the earliest. The plan should cover all the sub categories of projects, including B category. Monitoring mechanism needs also to be evolved for SEIAAs, regional offices of the MoEF&CC and the regional offices of CPCB. Since these steps are inalienable constitutional obligations, steps need to be taken to suitably augment the requisite manpower in these establishments for effective monitoring by MoEF&CC, CPCB and SEIAAs.***

13. ***There is no information about the result of steps taken in terms of 'six monthly action plan' so far. Making of such plan may be of no value unless it is resulting in improvement of the ground situation in terms of strengthening of monitoring, which is not shown to be happening. Expressing difficulties in improving the situation is not a solution. If there is an EC regime, compliance has to be monitored. The principle of Sustainable Development and the Precautionary principle, which have been held to be part of 'Right to Life' require that EC conditions are fully complied.***

14. ***No satisfactory mechanism exists at present, as shown by the above affidavit itself. It is stated that, at present, it takes 4.5 years for monitoring which means that for such long period the non-compliance continues making mockery of law. There has to be***

***speedy monitoring and speedy action, wherever necessary. There has to be a robust plan for the purpose which is the responsibility of the concerned Government Departments. We place on record our disapproval for the present sorry state-of-affairs and expect meaningful improvement.***

***15. We are, thus, of the view that for meaningful monitoring, all Category A projects are monitored not less than twice in a year and all Category projects are monitored not less than once in a year.***

*16. Let the Secretary, MoEF&CC and Chairman, CPCB hold a meeting with such other experts as may be found necessary and establish and/or augment the institutional setups in MoEF&CC, CPCB and SEIAAs for meaningful monitoring of Category A and B projects in the light of the above observations. Compliance report may be filed before this Tribunal by e-mail at judicial-ngt@gov.in by MoEF&CC and CPCB. The MoEF&CC may also furnish compliance status by SEIAAs.***"**

**(emphasis supplied)**

*"38. Similarly, vide order dated 11.01.2019 in O.A. No. 95/2018, Aryavart Foundation vs. M/s Vapi Green Enviro Ltd. & Ors., following observations may be noted:*

***"**37. ..The SPCB has not shown that it took any stringent action as required which can act as deterrent against violation of pollution norms. Simply issuing notice has not brought about the desired results. No closures have been ordered, nor prosecution launched nor other adequate preventive and remedial measures, including assessment and recovery of damages taken. In this respect, there is failure of GPCB. We may only observe that even a regulatory authority may be held accountable if it colludes with polluters by being required to pay damages or errant officers being held liable for action, including prosecution. **Frequent failures of regulatory bodies need to be remedied for meaningful enforcement of environmental norms.** This Tribunal in Threat to life arising out of coal mining in South Garo Hills district Vs. State of Meghalaya & Ors.[5], held that **State machinery is also required to compensate for their negligence and failure which may act as deterrent against the officers who neglected their basic duty of protecting the environment or colluded with the polluters and law violators. The polluters as well as colluding officers are to be made accountable not only by prosecution or closure of industry but also by assessing and recovering such damages for loss to the environment as it may not only compensate the environment or victims but also act as deterrent to prevent further damage**.*

[5] O.A. No. 110($T_{HC}$)/2012 Order dated 04.01.2019 para 28-29

*38. It is well acknowledged that there is serious threat to the environment in this country. Studies show huge number of pollution related deaths and diseases[6]. Any violation of laid down environmental norms has to be seriously viewed and sternly dealt with.*

*39. It was in the year 1974 that the Water (Prevention and Control of Pollution) Act, 1974 was enacted after noticing that problem of pollution of rivers and streams had assumed considerable importance and urgency on account of growth of industries, threatening the sources of drinking water, the aquatic life and sources of irrigation. After considering the Expert Committee reports on the subject, the statutory framework was adopted giving enormous powers to the Pollution Control Boards (PCBs) for closure, prohibition or regulation of any industries operation or process as well as filing of complaints for prosecution. Minimum sentences have been laid down for violation of the norms. Polluter Pays Principle is an accepted norm within the purview of regulatory regime. The statutory functions of the PCBs, include programs for prevention, abatement and control of pollution and exercise all incidental powers. The CPCB has powers to issue directions to the State Boards. Needless to say, that similar provisions have been made for protection of air quality under the Air (Prevention and Control of Pollution) Act, 1981 as well as for other environmental issues under the Environment (Protection) Act, 1986.*

*40. As already noted, the SPCB is equally accountable for its failure and in appropriate cases can be prosecuted for conspiracy or collusion with other offenders causing pollution. The pollution cannot be allowed to be profitable activity and deterrent action must be taken wherever pollution is found so as to render causing of pollution unprofitable and unacceptable to prevent damage to the health and lives of the citizens. Any polluter must be subjected to heavy and deterrent economic sanctions. Unfortunately, this is not happening as expected for which failure the regulatory authority cannot disown their responsibility.*

*41. **We note that the State of Environment in the country, even as per official figures, is alarming. As many as 351 river stretches have been declared to be polluted by the CPCB. Vide order dated 20.09.2018 in Original Application No. 673/2018, News item published in 'The Hindu' authored by Shri. Jacob Koshy Titled "More river stretches are now critically***

[6] https://niti.gov.in/writereaddata/files/new_initiatives/presentation-on-CWMI.pdf- India ranks 120th in 122 countries in Water Quality Index as per Niti Ayog Report, https://www.thehindu.com/sci-tech/energy-and-environment/india-ranked-no-1-in-pollution-related-deaths-report/article19887858.ece- Most pollution-linked deaths occur in India, https://www.hindustantimes.com/india-news/delhi-world-s-most-polluted-city-mumbai-worse-than-beijing-who/story-m4JFTO63r7x4Ti8ZbHF7mM.html- Delhi's most polluted city, Mumbai worse than Beijing as per WHO; http://www.un.org/waterforlifedecade/pdf/global_drinking_water_quality_index.pdf- WHO Water Quality Index.

***polluted: CPCB", this Tribunal considered the issue of such polluted stretches and noticed the directions of the Hon'ble Supreme Court from time to time for stopping discharge of untreated sewage and effluents in water bodies. Such discharge causes serious diseases, including Cholera and Typhoid. Sewage treatment capacity was disproportionate to the sewage generated. As per some studies noted in the order, 75 to 80% water is polluted in India. Pollution of River Yamuna[7], Ganga[8], Hindon[9], Ghaggar[10], Sutlej and Beas[11], Son[12], Subarnarekha[13], Ami[14] were also noted. The States were directed to prepare action plans to make the water of the polluted river stretches atleast fit for bathing within six months from the dates of preparation of approved action plans. When the matter was reviewed on 19.12.2018, it was found that only 16 States had prepared action plans, most of which were not complete. The direction was issued for payment of environmental compensation per month by every State/UT for failure to prepare action plan and also to furnish Performance Guarantees for execution of the action plans within the stipulated time.***

42. ***This Tribunal in News Item Published in "The Times of India' Authored by Shri Vishwa Mohan Titled "NCAP with Multiple timelines to Clear Air in 102 Cities to be released around August 15"[15] has dealt with the issue of 102 air polluted cities identified by the CPCB. Taking into account eminent threat to human health as a result of air pollution, this Tribunal directed all the States/UTs with non-attainment cities to prepare action plans for bringing down the standards of air quality within the prescribed norms within six months. The Tribunal further constituted the Air Quality Monitoring Committee to ensure implementation of such action plans. The CPCB and the SPCBs were entrusted with the responsibility to design a robust nation-wide ambient air quality monitoring program to strengthen the existing monitoring network.***

***43. In re: Compliance of Municipal Solid Waste Management Rules, 2016[16], the Tribunal directed preparation of action plans for solid waste management consistent with the Solid Waste***

[7] Manoj Mishra Vs. Union Of India O.A. No. 6/2012 order dated 26.07.2018
[8] M.C. Mehta vs. Union of India O.A. No. 200/2014 order dated 06.08.2018
[9] Doaba Paryavaran Samiti vs. State of U.P. and Ors. O. A. No. 231/2014 Order dated 08.08.2018
[10] Stench Grips Mansa's Sacred Ghaggar River (Suo-Motu Case) and Yogender Kumar O.A. No. 138/2016 Order dated 07.08.2018
[11] Sobha Singh and Ors. Vs. State of Punjab and Ors. O.A. No. 916/2018 Order dated 14.11.2018
[12] Amarshakti vs. State of Bihar and Ors. O.A. No. 596/2016 Order dated 24.08.2018
[13] Sudarsan das vs. State of West Bengal and Ors. O.A. No. 173/2018 Order dated 04.09.2018
[14] Meera Shukla vs. Municipal Corporation, Gorakhpur and Ors. O.A. No. 116/2014 Order dated 25.10.2018
[15] Original Application No. 681/2018 Order dated 08.10.2018
[16] Original Application No. 606/2018 Order dated 31.08.2018

***Management Rules, 2016 in view of the fact that as per annual report of the CPCB prepared in April 2018, most of the States were not complying with the statutory rules.***

***44. As already noted earlier, this Tribunal considered the matter of polluted industrial clusters in News Item published in "The Asian Age" Authored by Sanjay Kaw titled "CPCB to rank industrial units on pollution levels" vide order dated 13.12.2018. It was noted that 43 industrial clusters in 16 States were identified as Critically Polluted Areas and 32 industrial clusters were categorized as Seriously Polluted Areas. In 2017-18, the number of identified polluted industrial clusters went upto 100. Accordingly, the Tribunal directed the State Pollution Control Board to finalize time bound action plan to restore the environmental quality as per the norms laid down by the CPCB and directed CPCB and SPCBs to take coercive measures against the violators on the basis of 'Precautionary Principle' and 'Polluter Pays Principle'.***

***45. In Techi Tagi Tara Vs. Rajendra Singh Bhandari & Ors.[17], the Hon'ble Supreme Court noted that the State Pollution Control Boards (SPCBs) continued to be manned by persons not having expertise or professional experience. The State Governments were not able to appoint qualified, impartial, and politically neutral persons of high standing to the crucial regulatory posts. Political appointments were being made in blatant violation of Apex Court guidelines to debar favorable persons being appointed.[18] The appointments being made did not***

[17] (2018) 11 SCC 734 para 3-4, 28-34: The judgment takes into consideration various Committees appointed laying down guidelines for the functioning of SPCBs viz.,

(a) Bhattacharya Committee (1984) proposed that the structural organization of SPCBs should consist of technical services, scientific services, planning, legal services, administrative services, accounts, training cell and research and development.

(b) The Belliappa Committee (1990) - Recommended (i) introducing elaborate monitoring, reporting and organizational systems at the national level along with four regional centres and one training cell in each Board, (ii) effecting suitable changes in the Boards recruitment policy to enable them induct persons with suitable academic qualifications, and (iii) ensuring that the Chairman and Member-Secretary are appointed for a minimum of three years.

(c) The Administrative Staff College of India (1994) - Recommended, inter alia, that (i) the SPCBs be reoriented for implementing the instrument mix of legislation and regulation, fiscal incentives, voluntary agreements, information campaigns and educational programmes.

(d) The Menon Committee – Recommending that the State Governments should not interfere with recruitment policies of the SPCBs, especially where the Boards are making efforts to equip their institutions with more and better trained engineering and scientific staff.

[18] *Ibid.* The judgment notes the report of the Tata Institute of Social Sciences published in 2013 titled "Environmental Regulatory Authorities in India: An Assessment of State Pollution Control Boards" which stated about the appointments to the SPCBs that time and again across state governments have not been able to choose a qualified, impartial, and politically neutral person of high standing to this crucial regulatory post. The recent

appointments of chairpersons of various State Pollution Control Boards are in blatant violation of the Apex Court guidelines. The primary lacuna with this kind of appointment was that it did not evoke any trust in the people that decisions taken by an ex-official of the State or a former political leader, appointed to this regulatory post through what appeared to be a totally non-transparent unilateral decision. Many senior environmental scientists and other officers of various State Pollution Control Boards have expressed their concern for

***inspire the confidence of the people. The Hon'ble Supreme Court directed all the States to frame guidelines and recruitment rules within six months. It may be pertinent to lay emphasis on the following observations of the Hon'ble Supreme Court in the aforesaid judgment:***

> ***"Unless corrective measures are taken at the earliest, the State Governments should not be surprised if petitions are filed against the State for the issuance of a writ of quo warranto in respect of the appointment of the Chairperson and members of the SPCBs. We make it clear that it is left open to public spirited individuals to move the appropriate High Court for the issuance of a writ of quo warranto if any person who does not meet the statutory or constitutional requirements is appointed as a Chairperson or a member of any SPCB or is presently continuing as such."***

***46. In addition to this, the Parliamentary Standing Committee on Science and Technology, Environment and Forest, August 2012 in its recommendations on the working of the SPCBs was perturbed to note that the SPCBs were not performing their duties vigilantly and recommended that MoEF&CC must ensure proper and effective coordination between the CPCB and SPCBs and take necessary steps to make the Pollution Control Boards functional and ensure that the discharge their duties effectively and efficiently.[19]***

***47. During the hearing it was stated by the learned Counsel for the GPCB that guidelines in terms of Techi Tagi Tara (supra) have been issued and thus, the judgment has been complied with. However, he has not been able to dispute that the persons appointed are not having technical or professional qualifications or background as expected.***

*48. This Tribunal, on 20.07.2018, in Satish Kumar vs. U.O.I & Ors.[20] also observed that persons of judicial background may be required in key position in PCBs as several functions of the SPCBs are quasi-judicial.*

*49. The order of this Tribunal dated 07.08.2018 in Stench Grips Mansa's Sacred Ghaggar River (Suo-Moto Case)[21] noted that a task force must be constituted in every district and State*

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appointing bureaucrats and political leader as Chairpersons who they feel not able to create a favourable atmosphere and an effective work culture in the functioning of the Board.

[19] Accessible at: http://164.100.47.5/newcommittee/reports/EnglishCommittees/Committee%20on%20S%20and%20T,%20Env.%20and%20Forests/230.pdf

[20] O.A No. 56 (THC) of 2013

[21] O.A. No. 138/2016 ($T_{NHRC}$)

*to give reports on the environmental issues which should be published on the websites.*

50. ***The Tribunal in the order on 08.08.2018 in Doaba Paryavaran Samiti Vs. State of U.P. & Ors.[22] noted that statutory authorities had miserably failed and were required to be held accountable for their failure.***

51. *In view of the fact clean environment, apart from other statutory provisions, is a mandate of Article 21 of the Constitution, causing of pollution having serious implications on health of the citizens cannot be accepted and no responsible authority could simply throw its hands in despair.[23]*

52. *Thus, there being far from satisfactory governance on the part of the SPCBs, as depicted by the compiled data, resulting in large number of deaths and diseases in the country, remedial measures are required. Lack of effective governance in the present case is patent from absence of steps for prosecution of the guilty persons or recovery of damages for restoration of the environment which is primary responsibility of the SPCB. Appointment process does contribute to such ineffectiveness."*

**(emphasis supplied)**

*"39. Vide order dated 28.08.2019 in O.A. No. 95/2018, Aryavart Foundation vs. M/s Vapi Green Enviro Ltd. & Ors., following observations may be noted:*

*"13 ..... .....*

14. ***What is expected is performance audit on issues such as adequacy with regard to environmental monitoring, efficacy of regulatory setup/mechanisms, staffing both technical and scientific manpower, scientific equipments, logistics support, competence etc. rather than ranking the States. Let the same be done and state-wise reports submitted based on thorough analysis in terms of statutory functions. CPCB may devise an appropriate mechanism for the purpose. We also direct that all vacant positions in the SPCBs/PCCs may be filled up at the within four months and the Chief Secretaries of the States/UTs may ensure that there is no embargo in doing so, so that effective steps for protection of environment can be taken. It is also necessary to direct that the laboratories established by the SPCBs/PCCs, at headquarters as well as regional centers, are duly recognized for purposed of enforcement of environmental laws. The concerned authorities may take further steps accordingly. The CPCB may compile a report and file before the next date. SPCBs/PCCs may utilize the funds available with them, under***

[22] O.A. No. 231/2014
[23] *Supra* note 18

***EC/Consents or other heads instead of approaching other authorities and on that pretext not performing their essential function. The MoEF&CC may consider constituting an appropriate authority for the purpose with representatives from Central and State authorities on the pattern of Compensatory Afforestation Fund Management and Planning Authority (CAMPA) or otherwise. A compliance report be filed by the MoEF&CC before the next date.***

….. … ….

*Directions:*

*iii. Performance audit be done with reference to issues such as adequacy with regard to environmental monitoring, efficacy of regulatory setup/mechanisms, staffing both technical and scientific manpower, adequacy of laboratories and scientific equipments, logistics support, competence etc. rather than ranking the States and state-wise reports submitted along with recommendations based on thorough analysis in terms of statutory functions before the next date. CPCB may devise an appropriate mechanism for the purpose. CPCB and MoEF&CC may file a compliance report with reference to observations in para 14 above.***"**

**(emphasis supplied)**

10. The Tribunal also observed:

*"35. We are of the view that further remedial action needs to be taken in the matter of bringing to justice erring officers of authorities in the State of Andhra and liability of the State or officers being further gone into. There is also need for rehabilitation plan utilizing the interim and further compensation. Lastly regulatory framework needs to be reviewed and strengthened, apart from identifying steps to ensure compliance of laid down safety norms and laying down further norms and procedure to avoid recurrence of such failures in future.*

*36. Safety of citizens and environment are of prime concern. Any economic or industrial activity, however necessary, has to be consistent with the safety of human beings and the environment. The damage to human life, human health and environment has to be restored by applying the 'Sustainable Development' principle, of which 'Precautionary' and 'Polluter Pays' principles are part. In this regard, significant role has to be played by the statutory authorities constituted under the Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981 and the Environment (Protection) Act, 1986."*

11. Finally, vide order dated 01.06.2020, the Tribunal directed:

*"i. The amount of Rs. 50 crores deposited by the Company with the District Magistrate, Vishakhapatnam will stand appropriated towards part liability and interim compensation to be spent for restoration of the environment and compensation for victims in accordance with the restoration plan to be prepared.*

*ii. Restoration plan may be prepared by a Committee comprising two representatives each of MoEF&CC, CPCB and three representatives of State Government to be named by the Chief Secretary, including the District Magistrate, Vishakhapatnam and such other concerned Departments within two months from today. MoEF&CC will be the nodal agency for the purpose.*

*iii. Final quantification of compensation may be assessed by a Committee comprising representatives of MoEF&CC, CPCB and NEERI. The said Committee will be at liberty to associate/co-opt any other expert institution or individual. The Secretary, MoEF&CC may ensure constitution of such Committee within two weeks from today. The Committee may give its report within two months thereafter. MoEF&CC will be the nodal agency for the purpose.*

*iv. The Chief Secretary, Andhra Pradesh may identify and take appropriate action against persons responsible for failure of law in permitting the Company to operate without statutory clearances within two months and give a report to this Tribunal*

*v. In view of the stand of the State PCB and the Company that it will not recommence its operation without requisite statutory clearances, we direct that if any such statutory clearances are granted and the Company proposes to recommence, this aspect must be brought to the notice of this Tribunal so that compliance of law is ensured.*

*vi. The MoEF&CC may also constitute an Expert Committee to suggest ways and means to revamp monitoring mechanism to check and prevent violation of environmental norms and preventing any such recurrence in future in any of the establishments dealing with hazardous chemicals. A special drive may be initiated in this regard. An action taken report may be furnished within three months from today.*

*vii. This order will not prejudice any criminal or other statutory proceedings in accordance with law."*

12. Having regard to the facts and circumstances of the present case and in the light of material available on record and without prejudice to further opportunity being given to all concerned, we find it necessary to issue following directions:

a) The Company may deposit an amount of Rs. 25 crores, minus the statutory compensation/ex gratia payments already made to the victims, if any, with the District Magistrate, Bharuch within 10 days from today.

The amount may be disbursed by the District Magistrate by making disbursement plan in the manner already indicated above (Para 6). Disbursement plan may consider safeguards to ensure that amount reaches the beneficiaries and is not misappropriated by any intermediary.

b) We constitute a 6-member Committee comprising:

(i) Justice B.C. Patel, former Chief Justice, Delhi High Court and former Judge of the Gujarat High Court presently stationed at Ahmedabad - Chairman
(ii) Representative of MoEF&CC – Member
(iii) Representative of CPCB – Member
(iv) Head of the Chemical Engineering Department of the IIT Gandhinagar - Member
(v) Representative of NEERI - Member
(vi) Representative of National Institute of Disaster Management, IIPA Campus, New Delhi – Member

The District Magistrate, Bharuch and GPCB will provide logistic support to the Committee to enable their fact-finding and reporting. The Committee will be at liberty to take assistance of such experts, individuals and institutions as may be considered necessary

c) The Committee may visit and inspect the site within 7 days and give its report within one month thereafter via email judicial-ngt@gov.in, (preferably in the form of searchable/OCR PDF and not image PDF). The Committee may specifically report:

i. The sequence of events;

ii. Causes of failure and persons and authorities responsible therefor;

iii. Extent of damage to life, human and non-human; public health; and environment – including, water, soil, air;

iv. Steps to be taken for compensation of victims and restitution of the damaged property and environment, and the cost involved;

v. Remedial measures to prevent recurrence;

vi. Any other incidental or allied issues found relevant.

CPCB will be the nodal agency for coordination.

If any member is unable to visit physically, he may be associated online with the permission of the Chairman. The Committee may provide opportunity of being heard to the Company as well as any other member of the public.

A copy of the report may be uploaded on the website of the CPCB and also provided to the Company for its response.

d) It will be open to the concerned authorities to act on the recommendations of the Committee to the extent the authorities find viable in exercise of their statutory powers pending further orders of this Tribunal.

e) The Committee may as far as possible make final quantification of compensation and also prepare a restoration plan in association with the District Magistrate,

Bharuch. For the restoration plan, the nodal agency will be the representative of MoEF&CC.

f) The Chief Secretary, Gujarat may identify and take appropriate action against persons responsible for failure of law in permitting the Company to operate without statutory clearances within two months and give a report to this Tribunal.

g) In view of the stand of the State PCB that the order of closure has been passed, before recommencing any operations, the Company may bring it to the notice of this Tribunal, so that it can be ensured that there is no violation of statutory provisions and safety measures.

13. This order is without prejudice to any criminal or other statutory proceedings in accordance with law.

14. Since this tragedy follows so close on the heels of a similar one (in Vizag), it may be necessary to ensure that risk studies are duly undertaken by all industries in the country dealing with the hazardous chemicals and their on-site and off-site plans are operational and mock drills are carried out for testing the same. The State PCBs, concerned District Magistrates, CIFs of the Industries Departments may ensure the same and the nodal agency for the purpose will be the State PCBs, which may be monitored by the CPCB in an appropriate manner.

15. Since a direction has already been issued to the MoEF&CC to constitute an Expert Committee on the subject of revamping the monitoring mechanism to check and prevent violation of

environmental norms and occurrence of such incidents in future particularly in establishments dealing with hazardous chemicals and a special drive may be initiated, no separate direction is necessary but this incident may also be kept in mind by the Expert Committee constituted in pursuance of order dated 01.06.2020.

A copy of this order be sent to Justice B.C. Patel, former Chief Justice, Delhi High Court and former Judge of the Gujarat High Court, MoEF&CC, CPCB, Head of the Chemical Engineering Department of the IIT Gandhinagar, NEERI, National Institute of Disaster Management, IIPA Campus, New Delhi, GPCB and District Magistrate, Bharuch by e-mail.

The matter may be transferred to Court No. 1 of the Principal Bench and listed for further consideration on 03.11.2020 along with *O.A. No. 73/2020*.

Adarsh Kumar Goel, CP

S.P. Wangdi, JM

Dr. Satyawan Singh Garbyal, EM

June 8, 2020
O.A. No. 22/2020
DV

Annexure - B

# ADDITIONAL REPORT OF COMMITTEE ON ENVIRONMENT DAMAGE ASSESSMENT DUE TO AIR POLLUTION CAUSED ON ACCOUNT OF EXPLOSION & FIR AT M/S YASHASHVI RASAYAN PVT. LTD. DAHEJ, DISTRICT, BHARUCH, GUJARAT. IN COMPLIANCE OF AN ORDER MADE BY PRINCIPAL BENCH OF HON'BLE NATIONAL GREEN TRIBUNAL, ON 08.06.2020, AT NEW DELHI. IN THE MATTER OF OA NO. 22 Of 2020 (ARYAVART FOUNDATION V/s YASHASHVI RASAYAN PVT. LTD. & ANR)

**UNDER THE CHAIRMANSHIP OF JUSTICE B.C. PATEL, FORMER CHIEF JUSTICE, DELHI HIGH COURT.**

**Prepared By**

Ministry of Environment, Forest & Climate Change

**FOR SUBMISSION TO**

**HON'BLE NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH, NEW DELHI**

**SEPTEMBER 2020**

# ADDITIONAL REPORT OF COMMITTEE ON ENVIRONMENTAL DAMAGE ASSESSMENT DUE TO AIR POLLUTION CAUSED ON ACCOUNT OF EXPLOSION & FIR AT M/S YASHASHVI RASAYAN PVT. LTD. DAHEJ, DISTRICT, BHARUCH, GUJARAT IN COMPLIANCE OF AN ORDER MADE BY PRINCIPAL BENCH, HON'BLE NATIONAL GREEN TRIBUNAL, NEW DELHI ON 08.06.2020 IN THE MATTER OF OA NO. 22 Of 2020 (ARYAVART FOUNDATION V/s YASHYASHVI RASAYAN PVT. LTD. & ANR)

## COMMITTEE MEMBERS

| Name | Institute | Signature |
|---|---|---|
| Hon'ble Justice Shri B.C. Patel | Former Chief Justice, Delhi High Court and former Judge of the Gujarat High Court, Ahmedabad | |
| Shri Vishwa Bandhu Meena | Scientist 'C' Ministry of Environment, Forest & Climate Change, Regional Office, Bhopal | |
| Shri Pratik D. Bharne | Scientist 'E' Central Pollution Control Board (CPCB), Regional Directorate (West), Vadodara | |
| Prof. Chinmay Ghoroi | Professor of Chemical Engineering Indian Institute of Technology (IIT) Gandhinagar | |
| Dr. K V George | Senior Principal Scientist & Head, Air Pollution Control Division, NEERI, Nagpur | |
| Shri Ashish K Panda | Consultant, National Institute of Disaster Management (NIDM), New Delhi | |

# CONTENT

**ADDITIONAL REPORT OF COMMITTEE ON ENVIRONMENTAL DAMAGE ASSESSMENT DUE TO AIR POLLUTION CAUSED ON ACCOUNT OF EXPLOSION AT M/S YASHASHVI RASAYAN PVT. LTD. DAHEJ, DISTRICT, BHARUCH, GUJARAT IN COMPLIANCE OF AN ORDER MADE BY PRINCIPAL BENCH, HON'BLE NATIONAL GREEN TRIBUNAL, NEW DELHI ON 08.06.2020 IN THE MATTER OF OA NO. 22 Of 2020 (ARYAVART FOUNDATION V/s YASHASHVI RASAYAN PVT. LTD. & ANR)**

## 1.0 BACKGROUND:

The committee constituted as per order 08.06.2020 in the matter of OA NO. 22 Of 2020 (ARYAVART FOUNDATION V/s YASHASHVI RASAYAN PVT. LTD. & ANR) has submitted its report- **"REPORT OF COMMITTEE IN COMPLIANCE OF ORDER OF HON'BLE NGT, PRINCIPAL BENCH NEW DELHI IN THE MATTER OF OA NO. 22 Of 2020 (ARYAVART FOUNDATION V/s YASHYASHVI RASAYAN PVT. LTD. & ANR) WRT FATAL ACCIDENT AT M/S YASHYASHVI RASAYAN PVT. LTD. DAHEJ, GUJARAT (AUGUST 2020)**" on 07.08.2020 to Hon'ble NGT, Principal bench, New Delhi through e-mail – judicial-ngt@gov.in.

A request was made in the report that study on environmental damage assessment due to air pollution would require at least three weeks' time and therefore, request was made to grant additional time. Now the report is submitted by NEERI on environmental damage assessment due to air pollution and the same was deliberated amongst the members of the committee through video conferences, placed in subsequent sections.

# 2.0 ENVIRONMENT DAMAGE COST ASSESSMENT DUE TO AIR POLLUTION ON ACCOUNT OF EXPLOSION AND FIRE AT M/S. YASHASHVI RASAYAN PVT LTD., DAHEJ, DIST BHARUCH GUJARAT

## 2.1 Introduction

M/s. Yashashvi Rasayan Pvt Ltd, situated at, Plot No. Z/96/E, SEZ-II, Dahej, Taluka Vagra, District Bharuch, is engaged in manufacturing of varieties of chemicals /acids (Herbicides & intermediates) since 2017.

The unit is manufacturing (1) 3,6 Di Chloro 2 Methoxy Benzoic Acid 500 MT or (2) Di Potassium Salt of 3,6 Di Chloro Salicylic Acid 701.5 MT or (3) 2,5 Di Chloro Phenol 510.92 MT or (4) 2,5 Di Chloro Aniline 664.75 MT, (5) Nitrosyl Sulfuric Acid and other by-products.

The unit has 11 underground tanks for storage of Methanol, Xylene and Diesel. The unit has 14 tanks on ground to store Sulphuric acid, Sodium hydroxide, Potassium hydroxide, Nitric Acid, O.D.C.B., D.C.N.B., Di-chloro Aniline, Dimethyl Sulphate, Sulphur dioxide, Carbon Dioxide (Gas). A truck trailer full of Hydrogen cylinders was parked at the time of accident close to the tank farm area.

Due to mishandling of chemicals, explosion followed by fire that took place on June 3, 2020 at tank farm area resulting into emissions of combustion products spreading in prevailing wind direction (SE to NW) towards M/S LNG Patronet Ltd, Hindalco industries and Adani Petronet Port Ltd, as reported. Damage happened to storage tanks above ground only. There was no damage to underground storage tank. There was tyre

burning of the trailer, however, no impact on the hydrogen cylinders due to timely control of fire.

In the explosion following ground level tanks exploded releasing various air pollutants into the atmosphere:

**Table 1: Quantity of different raw materials in the above-ground Storage tanks (MT)**

| Tag No. of Tanks | Tank No. | Material | Capacity (Liters) | Density | MOC | Storage (MT) |
|---|---|---|---|---|---|---|
| ST-5101A | 2 | 2,5-Dichloro Aniline (2,5- DCA) | 150000 | 1.31 | SS 304L | 77.9 |
| ST-5101B | 3 | 2,5-Dichloro Nitrobenzene (2,5-DCNB) | 150000 | 1.423 | SS 304L | 99.6 |
| ST-5102A | 6 | 98% Sulphuric Acid | 50000 | 1.83 | CS | 30.4 |
| ST-5102B | 7 | 98% Sulphuric Acid | 50000 | 1.83 | CS | 37.1 |
| ST-5103A | 8 | 98% Nitric Acid (Conc. Nitric Acid) | 20000 | 1.50 | CS GL (Glass lined) | 0.9 Dead volume |
| ST-5103B | 9 | 98% Nitric Acid (Conc. Nitric Acid) | 20000 | 1.50 | CS GL (Glass lined) | 0.9 Dead volume +18.8 =19.7 |
| ST-5104A | 10 | Ortho Dichloro Benzene (ODCB) | 30000 | 1.3 | CS | 24.8 |
| ST-5104B | 11 | Ortho Dichloro Benzene (ODCB) | 30000 | 1.3 | CS | 10.6 |
| ST-5105A | 12 | Caustic Potash Lye (KOH Lye) | 60000 | 1.48 | CS | 43.4 |
| ST-5105B | 13 | Caustic Potash Lye (KOH Lye) | 60000 | 1.48 | CS | 28.9 |
| ST-5106A | 14 | Caustic Soda Lye (NaOH Lye) | 50000 | 1.48 | CS | 12.8 |
| ST-5106B | 15 | Caustic Soda Lye (NaOH Lye) | 50000 | 1.48 | CS | 11.8 |
| ST-5107A | 4 | Dimethyl Sulphate (DMS) | 60000 | 1.32 | CS | *Dead volume* |
| ST-5107B | 5 | Dimethyl Sulphate (DMS) | 60000 | 1.32 | CS | *7.5 +22.9 =30.4* |

As the information provided by the company, the tank-9 (Nitric Acid) had 0.9 MT Dead volume & tank No 5 had 7.5 MT volume of DMS (Dimethyl Sulphate). Accidently, 18.8 MT $HNO_3$ unloaded from tanker in to tank No.5 of DMS and then shifted to tank No. 9 along with 7.5 MT DMS (Mixture of DMS & $HNO_3$) = 0.9+7.5+18.8=27.2 MT mixed chemicals. Similarly, accidently 22.9 MT of DMS filled in $HNO_3$ tank (Tank No. 8). As to resolve this complex chemistry for linear calculation we have segregated & considered combustion of an individual chemical storage from mixtures.

## 2.2 Methodology

**Table 1** shows the quantity of chemicals available in the industry premises. Emission is estimated by stoichiometric balancing of different chemicals. **Table 2** shows the emitted major pollutants along with authentic reference.

**Table 2: Pollutants emitted after explosion & fire.**

| Chemical Name | Formula | Density | Most Emitted Gases After An Independent Combustion | Reference |
|---|---|---|---|---|
| 2,5-Dichloro Aniline (2,5-DCA) | $C_6H_5Cl_2N$ | 1.31 | Nitrogen oxides (NOx), Carbon dioxide (CO2), Hydrogen chloride gas | https://www.fishersci.com/store/msds?partNumber=AC113091000&productDescription=2%2C3-DICHLOROANILINE%2C+99%25+100GR&vendorId=VN00032119&countryCode=US&language=en-Structure |

| Chemical Name | Formula | Density | Most Emitted Gases After An Independent Combustion | Reference |
|---|---|---|---|---|
| 2,5-Dichloro Nitrobenzene (2,5-DCNB) | $C_6H_3Cl_2NO$ | 1.423 | Nitrogen Oxides (NOx), Carbon dioxide ($CO_2$), Hydrogen chloride (HCL) | https://www.fishersci.com/store/msds?partNumber=AC209212500&productDescription=2%2C5-DICHLORONITROBENZENE+250GR&vendorId=VN00032119&countryCode=US&language=en |
| 98% Sulphuric Acid | $H_2SO_4$ | 1.83 | Mainly $SO_2$ | https://www.sciencedirect.com/topics/earth-and-planetary-sciences/nitric-acid |
| 98% Sulphuric Acid | $H_2SO_4$ | 1.83 | | |
| 98% Nitric Acid (Conc. Nitric Acid) | $HNO_3$ | 1.50 | Mainly $NO_2$ | https://www.ch.ic.ac.uk/rzepa/mim/environmental/html/nitric.htm |
| 98% Nitric Acid (Conc. Nitric Acid) | $HNO_3$ | 1.50 | | |
| Ortho Di-chloro Benzene (ODCB) | $C_6H_4Cl_2$ | 1.3 | Carbon dioxide (CO2), Hydrogen chloride(HCL) | https://www.sciencedirect.com/science/article/abs/pii/S2468823119301452 |
| Ortho Di-chloro Benzene (ODCB) | $C_6H_4Cl_2$ | 1.3 | | |
| Caustic Potash Lye (KOH Lye) | KOH | 1.48 | Emissions to air are also not a concern because the substance is rapidly neutralized in air due the presence of carbon dioxide in air Like NaOH, KOH exhibits high thermal stability. | https://www.helpe.gr/userfiles/8a53b155-76e9-4d45-9773-a27000e44a36/Caustic-Soda-Summary-GPS.pdf |
| Caustic Potash Lye (KOH Lye) | KOH | 1.48 | | |
| Caustic Soda Lye (NaOH Lye) | NaOH | 1.48 | | |
| Caustic Soda Lye (NaOH Lye) | NaOH | 1.48 | | |
| Dimethyl Sulphate (DMS) | $C_2H_6SO_4$ | 1.32 | Carbon dioxide ($CO_2$), Sulphur di oxide($SO_2$) | https://pubchem.ncbi.nlm.nih.gov/compound/Dimethyl-sulfate |
| Dimethyl Sulphate (DMS) | $C_2H_6SO_4$ | 1.32 | | |

- **2, 5-Dichloro Aniline (2, 5- DCA)**

  After decomposition of 2,5 DCA in an instant explosion in storage produces mainly, Nitrogen oxides (NOx), Carbon monoxide (CO), Carbon dioxide ($CO_2$), Hydrogen chloride gas according to Thermo Fisher Scientific Safety Data Sheet.

  According to the calculation and reaction balancing, 77.9 MT of stored 2,5 DCA produces approximately 184.2 MT of pollutants (Nitrogen oxides (NOx) = 22.1 MT, Carbon dioxide ($CO_2$) = 127 MT, Hydrogen chloride gas = 35.1 MT ). Formation of CO is neglected because in the atmosphere, it is spatially variable and short-lived, $CO_2$ is considered in place after balancing the reactions.

  $$2C_6H_5CL_2N + 31/2O_2 \rightarrow 4HCL + 2NO_2 + 12CO_2 + 3H_20$$
  $$4C_6H_5CL_2N + 31O_2 \rightarrow 8HCL + 4NO_2 + 24CO_2 + 6H_20$$

- **2, 5 – Di-chloro-nitrobenzene (2, 5 DCNB)**

  Combustion of 2, 5-Dichloronitrobenzene leads to Nitrogen oxides (NOx), Carbon monoxide (CO), Carbon dioxide ($CO_2$), Hydrogen chloride gas (Thermo Fisher Scientific Safety Data Sheet)

  According to calculation and reaction balancing 99.6 MT of stored 2, 5 DNB produces approximately 198.7 MT of pollutants (Nitrogen oxides (NOx) = 23.9 MT, Carbon dioxide ($CO_2$) = 137 MT, Hydrogen chloride gas = 37.8)

  $$2C_6H_3Cl_2NO_2 + 25/2O_2 \rightarrow 4HCL + 2NO_2 + 12CO_2 + H_20$$
  $$4C_6H_3Cl_2NO_2 + 25O_2 \rightarrow 8HCL + 4NO_2 + 24CO_2 + 2H_20$$

- **Sulphuric Acid**

  At higher temperatures, $SO_2$ is the major component generated from decomposition of $H_2SO_4$ in the tank.

  According to stoichiometric calculation S1-30.4 MT, S2-37.1 MT of stored Sulphuric acid produces approximately S1-sulphur di oxide (SOx))= (19.856 MT), S2-sulphur di oxide (SOx)) = 24.232 MT of pollutants.

$$H_2SO_4 \rightarrow SO_{3+} H_20$$

$$SO_3 \rightarrow SO_{2+} O_2$$

- **Nitric acid**

  Nitric acid decomposes slowly to nitrogen dioxide. The nitric oxide produced may react with atmospheric oxygen to give nitrogen dioxide. With more concentrated nitric acid, nitrogen dioxide is produced directly in a reaction with 1:4 stoichiometry.

  One mole of Nitric acid break down into 4 moles Nitrogen di oxide and 2 moles of water & a oxygen through molecular weight ratio calculation we found that 1 part of Nitric acid emits around 0.7 parts of pollutants that include mainly Nitrogen di oxide (NOx)

  According to above calculation N1-0.9 MT Dead volume, N2-19.7 MT of stored Nitric acid produces approximately N1- Nitrogen di oxide (NOX)= 0.63 MT, N2- Nitrogen di oxide (NOx) = 13.79 MT, of pollutants.

$$4\ HNO_3 \rightarrow 4\ NO_2 + 2\ H_2O + O_2$$

- **Ortho Di-chloro Benzene (ODCB)**

  Combustion by-products include hydrogen chloride, and chloro-carbons. It is combustible above 66 °C. It forms the explosive vapour /air mixtures.

According to reaction calculation ODCB1-24.8 MT, ODCB 2-10.6 MT of stored Ortho Di-chloro Benzene (ODCB) produces approximately from storage1- HCL= 12.3 MT, $CO_2$ = 44.5 MT, storage2- HCL= 5.3 MT, $CO_2$ = 19.03 MT of pollutants

$$2C_6H_4Cl_2 + 13O_2 \rightarrow 4HCL + 12CO_2 + 2H_20$$

- **Caustic Potash Lye (KOH Lye) & Caustic Soda Lye (NaOH Lye)**

  According to global product strategy and safety summary, emissions to air are also not a concern because the substance is rapidly neutralized in air due the presence of carbon dioxide in air and have high thermal stability as well.

- **Di methyl Sulphate (DMS**)

  Above 83 °C explosive vapour is formed if released to air, a vapour pressure of 0.677 mm Hg at 25 °C indicates dimethyl sulphate will exist solely as a vapour in the atmosphere. Vapour-phase dimethyl sulphate will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 82 days. Vapour-phase dimethyl sulphate will be degraded in the atmosphere by reaction with water (estimated atmospheric lifetime of >2 days).

  Decomposes on heating and on burning. This produces toxic fumes including sulphur oxides. One mole of DMS break down into 2 moles CO2 and 1 moles of SO2 & water through molecular weight ratio calculation we found that 1 part of Di methyl Sulphate DMS emits around 1.2 parts of pollutants, i.e. 0.507 parts of SOx & 0.697 parts of $CO_2$.

  According to above calculation DMS of dead volume 7.5 MT+ New batch of 22.9MT of DMS i.e. in total 7.5+22.9=30.4MT would produce SOx=15.41 MT, CO2=21.18 MT of pollution

$$2C_2H_6SO_4 + 5O_2 \rightarrow 2SO_2 + 4CO_2 + 6H_20$$

The consolidated results are given in the following table:

**Table 3: Quantity (MT) of pollutants formed due to explosion & fire**

| Stored Material | Storage (MT) | $SO_2$ (MT) (a) | NOx (MT) (b) | HCl (MT) (c) | $CO_2$ (MT) (d) | CO (MT) (e) | Total Pollutant in air (MT) (a+b+c+d+e) |
|---|---|---|---|---|---|---|---|
| 2,5-Dichloro Aniline (2,5- | 77.9 | - | 22.1 | 35.1 | 127 | - | 184.2 |
| 2,5-Dichloro Nitrobenzene (2,5-DCNB) | 99.6 | - | 23.9 | 37.8 | 137 | - | 198.7 |
| 98% Sulphuric Acid | 30.4 | 19.856 | - | - | - | - | 19.856 |
| 98% Sulphuric Acid | 37.1 | 24.232 | - | - | - | - | 24.232 |
| 98% Nitric Acid (Conc. Nitric Acid) | 0.9 | - | 0.63 | - | - | - | 0.63 |
| 98% Nitric Acid (Conc. Nitric Acid) | 19.7 | - | 13.79 | - | - | - | 13.79 |
| Ortho Dichloro Benzene (ODCB) | 24.8 | - | - | 12.3 | 44.5 | - | 56.8 |
| Ortho Dichloro Benzene (ODCB) | 10.6 | - | - | 5.3 | 19 | - | 24.38 |
| Caustic Potash Lye (KOH Lye) | 43.4 | - | - | - | - | - | 0 |
| Caustic Potash Lye (KOH Lye) | 28.9 | - | - | - | - | - | 0 |
| Caustic Soda Lye (NaOH Lye) | 12.8 | - | - | - | - | - | 0 |
| Caustic Soda Lye (NaOH Lye) | 11.8 | - | - | - | - | - | 0 |
| Dimethyl Sulphate (DMS) | *Dead volume* | - | - | - | - | - | - |
| Dimethyl Sulphate (DMS) | *30.4* | 15.41 | - | - | 21.18 | - | 36.59 |
| Total in MT (Rounded off to 1 decimal) | | 59.4 | 60.4 | 90.5 | 348.6 | 0.0 | 559.17 |

## 2.3 Valuation of Environmental Damages

Business activities in most of the sectors result in harmful emission of particulates and gases pollutants into air leading to air pollution. Pollutants are either emitted directly (primary pollutants) or are formed in atmosphere due to reaction of two or more pollutants. Due to uncertainty, secondary gaseous pollutants are not considered here. Most of the primary and secondary air pollutants create negative impact on human health, visibility, agriculture, tourism etc. There is a need to understand the level of impact the pollutants generate and monetizing these impacts /damages is one of the ways by which the scale of impact can be communicated.

In order to quantify the impacts in monetary terms, it is essential to understand the mechanism by which the impact happens. The impact pathway reveals, how emitted pollutants lead to different adverse outcomes on human wellbeing and other natural environment.

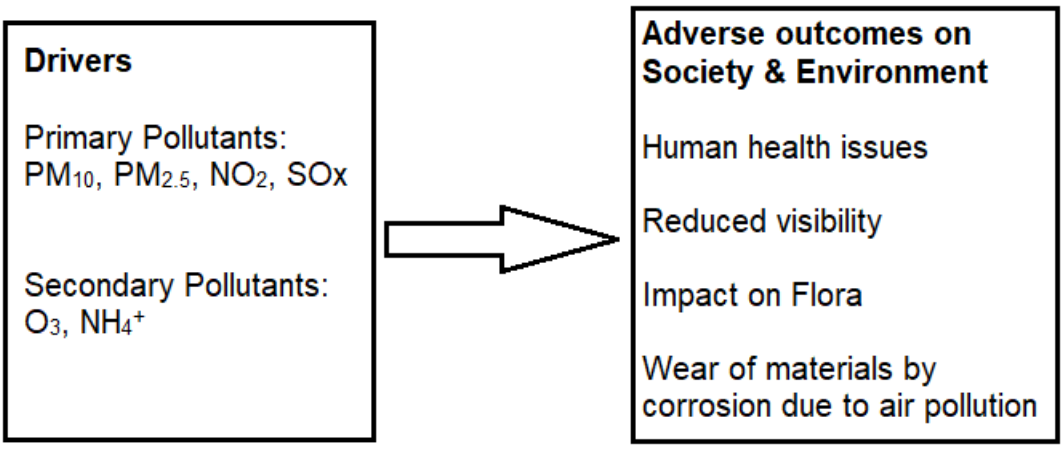


**Figure:** Impact Pathway.

Emission of primary pollutants and formation of secondary pollutants results in poor air quality ultimately leading to some adverse impacts on human and environment as follows

1. **Health effects on human**: Emission of pollutants lead to respiratory diseases such as bronchitis, asthma, allergy, lung disorder, pulmonary diseases, Lung cancer etc.

2. **Visibility**: Navigation during the time of transportation is largely affected due to the formation of smog. PM and $O_3$ are the major contributors to reduced visibility.

3. **Impacts on flora**: Reduced air quality within the atmosphere can retard the growth of trees affecting metabolism at the cellular level. Acid rain can also damage trees and acidifies soil reducing the yield.

4. **Wear and tear of materials**: Acidic components formed due to the reaction of pollutants in the atmosphere result in acid rain that has a tendency to corrode the building materials. PM has discoloring properties reducing aesthetic beauty and quality.

Given the above impacts, it is necessary to properly quantify the concentration of pollutants released into the atmosphere, track their dispersion, study the impacts and use various econometric tools to conduct valuation. While the ideal scenario in the current case would be monitor the emissions on site from the instance of the accident to understand the pollutant load released into the atmosphere. In the event of non-availability of monitored data, the stoichiometric results are used for valuation purposes.

For economic valuation, Value Transfer Method (VTM) has been used. In VTM, the valuation of extent of damages produced by same pollutants at one geographic place, can be transferred to another place using economic checks and balances. The base methodology, using the VTM, used for the current valuation has been taken from CSIR-NEERI's framework and publications[1,2]. The framework defines the use of VTM and the approach in detail. The base formula used in the analysis includes

$$Damage\ Cost\ in\ India\ (I)(₹) = Damage\ Cost\ at\ Location\ x * PPP\ Adustment\ Factor\ (I\ vs\ x) * IR$$

For valuation of SOx and NOx, UK-Defra values have been taken for calculating the monetary value of damages. Suitable econometric conversions including purchasing power parity (PPP) and inflation rate (IR) have been used to convert UK defra values to Indian values. The Indian values per tonne of emission hence arrived are used for valuation of damages

For Carbon dioxide, since it is GHG and can have a long term impact on environment, the social cost of carbon median values have been used as estimated by USEPA. Similar econometric factors including PPP and IR have been used to get the Indian values. For HCl, externalities estimates done for utility sector calculated by Fraunhofer Institute, Germany and Pace University, USA is referred due to limited availability of literature with suitable econometric adjustments as stated above. Using the above equation and given literature, the damage value per tonne for all the pollutants have been calculated in Indian Rupees for the base year of

[1] https://www.neeri.res.in/file_homes/41441989_EDCA_Final_Soft.pdf
[2] https://link.springer.com/article/10.1007/s11869-020-00845-3

2019 and is given in **Table 4.** The consolidated table for environmental damages is given below:

**Table 4: Calculated damage cost (₹ Lakhs) for air pollution due to explosion & fire**

| **Pollutant** | **$SO_2$** | **$NO_X$** | **HCl** | **$CO_2$** | **Total** |
|---|---|---|---|---|---|
| Pollutant Load (MT) (a) | 59.4 | 60.4 | 90.5 | 348.6 | 558.9 |
| Damage Value per tonne in ₹ Lakhs (b) | 2.1989 | 2.1729 | 0.2189 | 0.0225 | - |
| Damage Value in ₹ Lakhs (c=a*b) | 130.6 | 131.2 | 19.8 | 7.8 | **289.5** |

From above table, the estimates, suggest a **total environmental damage of ₹ 2.895 Crores due to air pollution** caused by explosion and fire at M/s. Yashashvi Rasyan Pvt Ltd, Dahej.

## References


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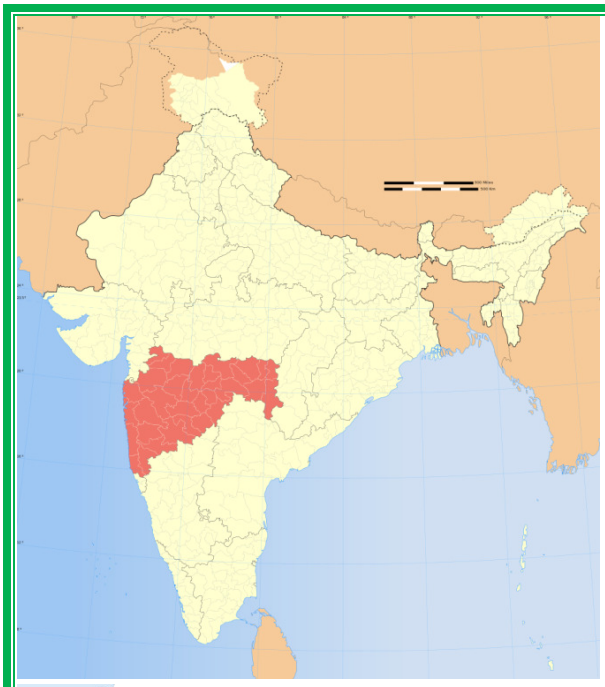
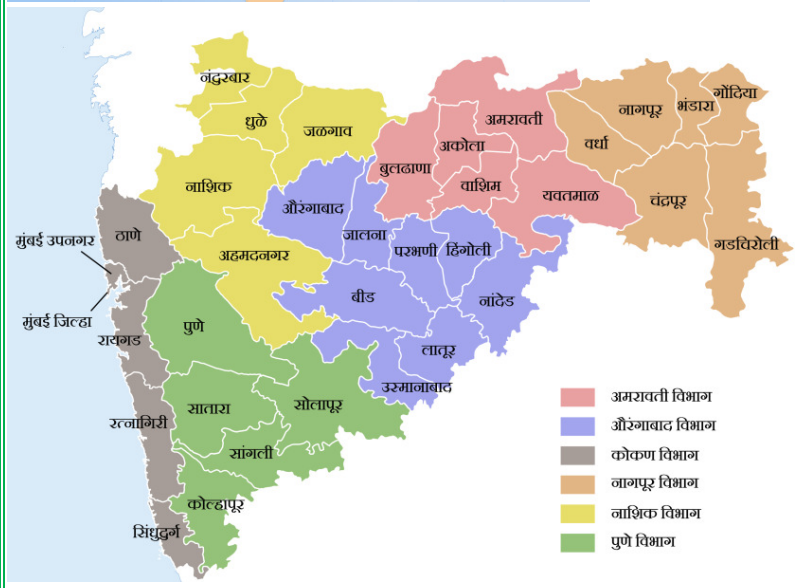


# Action Plan for Industrial Cluster in Severely Polluted Areas

**Monitoring, sampling, analysis of Stack, Ambient Air Quality, Surface Water, Ground Water, Waste Water**

# तारापुर Tarapur





MAHARASHTRA

## Maharashtra Pollution Control Board

## महाराष्ट्र प्रदूषण नियंत्रण मंडळ

**February, 2019**

# INDEX

## Acknowledgement

We gratefully acknowledge **E. Ravendiran**, Member Secretary, Maharashtra Pollution Control Board, for entrusting this very important and prestigious project to us.

Our special thanks are to Regional and Sub Regional Officer of the concerned areas, for guidance during the sampling. The contribution of **Shri V. M Motghare** (Joint director APC) and Mr. Sameer Hundlekar (Field officer) is appreciated.

We would also like to extend our thanks to the concerned staff of Regional Hospitals, who has provided us the health data, which is the most important component of this revised concept of CEPI.

By undertaking this project and completing in schedule time, we consider ourselves very lucky since we have helped the mankind by giving the data on pollution load and further action by the Board, to bring down the pollution level.

We also thank our associates for working on this project for making the write up, making graphs and feeding the data on computer.

This acknowledgement will be incomplete if we do not thank our laboratory analysts and others who made this project a success by timely analysing the samples.

We also thank our sampling team members for conducting the sampling in this vast area.

## Abbreviations:

| | |
|---|---|
| **APHA** | American Public Health Association |
| **BDL** | Below Detection Limit |
| **BOD** | Biochemical Oxygen Demand |
| **CEPI** | Comprehensive Environmental Pollution Index |
| **CETP** | Common Effluent Treatment Plant |
| **COD** | Chemical Oxygen Demand |
| **CPA** | Critically Polluted Areas |
| **SPA** | Severely Polluted Areas |
| **DO** | Dissolved Oxygen |
| **ETP** | Effluent Treatment Plant |
| **MIBK** | Methyl Isobutyl Ketone |
| **MPCB** | Maharashtra Pollution Control Board |
| **NAAQS** | National Ambient Air Quality Standards |
| **$NO_x$** | Oxides of Nitrogen |
| **ND** | Not Detected |
| **PAH** | Poly Aromatic Hydrocarbons |
| **PCB** | Poly Chlorinated Biphenyls |
| **PCT** | Poly Chlorinated Terphenyls |
| **$PM_{10}$** | Particulate Matter (size less than 10 µm) |
| **$PM_{2.5}$** | Particulate Matter (size less than 2.5 µm) |
| **$SO_2$** | Sulphur Dioxide |
| **STAP** | Short Term Action Plan |
| **WHO** | World Health Organization |

# 1. Introduction:

Although industries contribute significantly to India's economic growth and development, the increase in pollution of land, water, air, noise and resulting degradation of environment that they have caused, cannot be overlooked. Industries are responsible for four types of pollution: a) Air b) water c) land d) noise. Rapid industrialization carries with it the seeds of environmental damage. Pollution of natural environment not only affects people but also have adverse impact on economic growth in the long run. Analysis of pollution load shows that there are few industries in the country which contribute to more than 90percent of the pollution. Hence, scientists are exploring the quantum of pollution load as well as to device certain strategies and technologies so that our sustainable development would not be jeopardized otherwise our long cherished dream of establishing eco-socialism on this watery planet could not come true.

Industrial pollution takes on many faces. It contaminates many sources of drinking water, releases unwanted toxins into the air and reduces the quality of soil all over the world. Every litre of waste water discharged by our industries pollute eight times the quantity of fresh water. The extent of pollution varies with the size of the industry, the nature of the industry, the type of products used and produced etc. In view of this, Central Pollution Control Board (CPCB) has evolved the concept of Comprehensive Environmental Pollution Index (CEPI) during 2009-10 as a tool for comprehensive environmental assessment of prominent industrial clusters and formulation of remedial Action Plans for the identified critically polluted areas. Later-on proposals were received from the SPCBs, State Governments, and Industrial Associations and concerned Stake-holders for revisiting the criteria of assessment under CEPI concept. After careful examination and consideration of the suggestions of concerned stake-holders, it was decided to prepare the revised concept of CEPI by eliminating the subjective factors but retaining the factors which can be measured precisely. Hence, revised concept came into existence, which is termed as Revised CEPI Version 2016.

The present report is also based on the revised CEPI version 2016. The results of the application of the Comprehensive Environmental Pollution Index (CEPI) to selected industrial clusters or areas are presented in this report. The main objective of the study is to identify polluted industrial clusters or areas in order to take concerted action and to centrally monitor them at the national level to improve the current status of their environmental components such as air and water quality data, ecological damage, and visual environmental conditions. A total of 88 industrial areas or clusters have been selected by the Central Pollution Control Board (CPCB) in consultation with the Ministry of Environment & Forests Government of India for the study. The index captures the various dimensions of environment including air, water and land. Comprehensive Environmental Pollution Index (CEPI), which is a rational number to characterize the environmental quality at a given location following the algorithm of source, pathway and receptor have been developed.

In this report, CEPI study includes Tarapur industrial area of Maharashtra state. It is one of the best industrial area situated near Mumbai, Thane and adjacent to Gujarat state on Mumbai - Ahmedabad Express Highway. The industrial part of this place has a number of factories manufacturing dyes, paints and industrial / agricultural chemicals. Heavy metal factories manufacturing a wide variety of equipment are also based in this region. A few nationally prominent industrial establishments have their manufacturing plants in Tarapur. This city accommodates bulk drug manufacturing units, speciality chemical manufacturing units, steel plants and some textile plants. Government of Maharashtra has established Industrial Estate at Boisar, Tarapur in the year 1972. This estate is known as MIDC Tarapur. This is one of the largest chemical industrial estates in the State of Maharashtra.

# 2. Scope of Work

The Scope of Work consisted of the following:

Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water, and Ground Water Quality for identified five Critically Polluted areas (CPAs) in Maharashtra i.e. **Chandrapur, Dombivli, Aurangabad, Navi Mumbai** and **Tarapur** and 3 Severely Polluted areas (SPAs) in Maharashtra i.e. **Chembur, Pimpri-Chinchwad and Nashik** as per standard methods.

- At each of the 5 CPAs and 3 SPAs, 24 hourly ambient air quality monitoring to be carried out.
- Representative samples for surface water quality, waste water quality and Ground Water quality to be collected from prominent surface and Ground Water bodies located in and around the clusters/areas.
- Submission of complete monitoring, sampling and analysis reports including the summary of the parameters exceeding the prescribed standards/norms for all the 5 CPAs and 3 SPAs.
- Submission of 3 copies of final report with photographs at prominent locations and the CD (soft copy) on completion of the project for every critically polluted and severely polluted area separately.

**Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water and Ground Water Quality for Tarapur:**

- The sampling was carried out in 6 days at various locations i.e. from 30$^{th}$ January, to 04$^{th}$ February, 2019.
- In Tarapur, a total of 7 Stack Monitoring Samples, 6 Ambient Air Quality Monitoring Samples, 2 Volatile Organic Carbon samples 7 Waste Water Samples and 5 Ground Water Samples were collected and analyzed.

## 2.1 Stack Emission Parameters

The Stack Emissions were analyzed with the following parameters:

1. Acid Mist
2. Ammonia
3. Carbon Monoxide
4. Chlorine
5. Fluoride(gaseous)
6. Fluoride (particulate)
7. Hydrogen Chloride
8. Hydrogen Sulphide
9. Oxides of Nitrogen
10. Oxygen
11. Polyaromatic Hydrocarbons (Particulate)

12. Suspended Particulate Matter
13. Sulphur Dioxide
14. Benzene
15. Toluene
16. Xylene
17. Volatile Organic Compounds (VOCs)

## 2.2 Ambient Air Quality Parameters

The Ambient Air Quality was analyzed with the following parameters:

1. Sulphur Dioxide ($SO_2$)
2. Nitrogen Dioxide ($NO_2$)
3. Particulate Matter ($PM_{10}$)
4. Particulate Matter ($PM_{2.5}$)
5. Ozone ($O_3$)
6. Lead (Pb)
7. Carbon Monoxide (CO)
8. Ammonia ($NH_3$)
9. Benzene ($C_6H_6$)
10. Benzo (a) Pyrene (BaP) (Particulate Phase Only)
11. Arsenic (As)
12. Nickel (Ni)

## 2.3 Water/Waste Water Parameters

The Water/Waste Water was analyzed with the following parameters:

a. Prominent Surface Water bodies such as outfalls of CETPs, ETPs, treated effluent drainage, river, canal, ponds, lakes and other such water supply resources flowing through the area or flowing adjoining the CPA.

b. Ground Water Quality data of prominent ground water resources such as observation wells of Central Ground Water Board, drinking water wells, hand pumps, bore wells, hand pumps, bore wells and other such water supply resources located in the industrial cluster/area under consideration or in the peripheral areas.

**Basic water quality parameters for surface water and ground water both are as follows:**

**i. Simple Parameters:**

1. Sanitary Survey
2. General Appearance
3. Colour
4. Smell
5. Transparency
6. Ecological(Presence of animals like fish, insects) (Applicable to only surface water)

**ii. Regular Monitoring Parameters:**

7. pH
8. Oil & Grease
9. Suspended Solids
10. Dissolved Oxygen (% saturation) (Not applicable for ground waters)
11. Chemical Oxygen Demand
12. Biochemical Oxygen Demand
13. Electrical Conductivity
14. Nitrite-Nitrogen
15. Nitrate-Nitrogen
16. ($NO_2$ + $NO_3$)-Nitrogen
17. Free Ammonia
18. Total Residual Chlorine
19. Cyanide
20. Fluoride
21. Sulphide

22. Dissolved Phosphate
23. Sodium Absorption Ratio (SAR)
24. Total Coliforms (MPN/100 ml)
25. Faecal Coliforms (MPN/100 ml)

**iii. Special Parameters:**

26. Total Phosphorous
27. Total Kjeldahl Nitrogen(TKN)
28. Total Ammonia ($NH_4$ +$NH_3$)-Nitrogen
29. Phenols
30. Surface Active Agents
31. Organo Chlorine Pesticides
32. Polynuclear aromatic hydrocarbons (PAH)
33. Polychlorinated Biphenyls (PCB)and Polychlorinated Terphenyls (PCT)
34. Zinc
35. Nickel
36. Copper
37. Hexavalent Chromium
38. Chromium (Total)
39. Arsenic (Total)
40. Lead
41. Cadmium
42. Mercury
43. Manganese

44. Iron
45. Vanadium
46. Selenium
47. Boron

**iv. Bioassay (Zebra Fish) Test:** For specified samples only.

### 2.4 Methodology followed in Sampling and Analysis

Industries, places and locations that have been chosen for the sampling are representative of the city/area. Sampling has been done at the potential polluted areas so as to arrive at the CEPI. This will further help the authorities to monitor the areas in order to improve the current status of their environmental components such as air and water quality data, ecological damage and visual environmental conditions. Methodology for sampling, preservation and analysis have been done according to the references incorporated. Methodology of various types of parameters is presented under following annexure:

1. Stack Emission Sampling and Analysis Methodology – **Annexure II**
2. Ambient Air Sampling and Analysis Methodology **- Annexure III**
3. Water/Wastewater Sampling and Analysis Methodology - **Annexure IV**

## 3. Results of Analysis

Results of Analysis are tabulated below for Stack Emission Monitoring, Ambient Air Quality Monitoring, Waste Water Analysis and Water Analysis. These are followed by their respective graphical representation.

**Kindly note:**

- NA specifies the sample is not analysed for the specific parameter.
- ND specifies that even though the sample was analysed for the parameter, it was not detected.
- BDL specifies that the result obtained is below detection limit.

***Please Note: Industrial clusters observed with below detection limit parameters are NOT included into the graphs***

### 3.1 Stack Emission Monitoring:

Stack Emission Monitoring Results are compared against The Environment (Protection) Rules, 1986 General Emission Standard - Part D. The limits are represented on the graphical representation. Graph of Volatile Organic Carbon (VOCs) could not be prepared as their concentration was found either very less or not detected.

| Sr. | Name of Industry | Included in |
|---|---|---|
| 1. | Mandhana Industrial Ltd. (Dyeing Unit- II) | Table No. I |
| 2. | Siyaram Silk Mills Ltd. | Table No. I |
| 3. | IVP Ltd. | Table No. I |
| 4. | Sarex Overseas | Table No. II |
| 5. | Lupin Ltd. | Table No. II |
| 6. | Dicitex Furnishing | Table No. II |

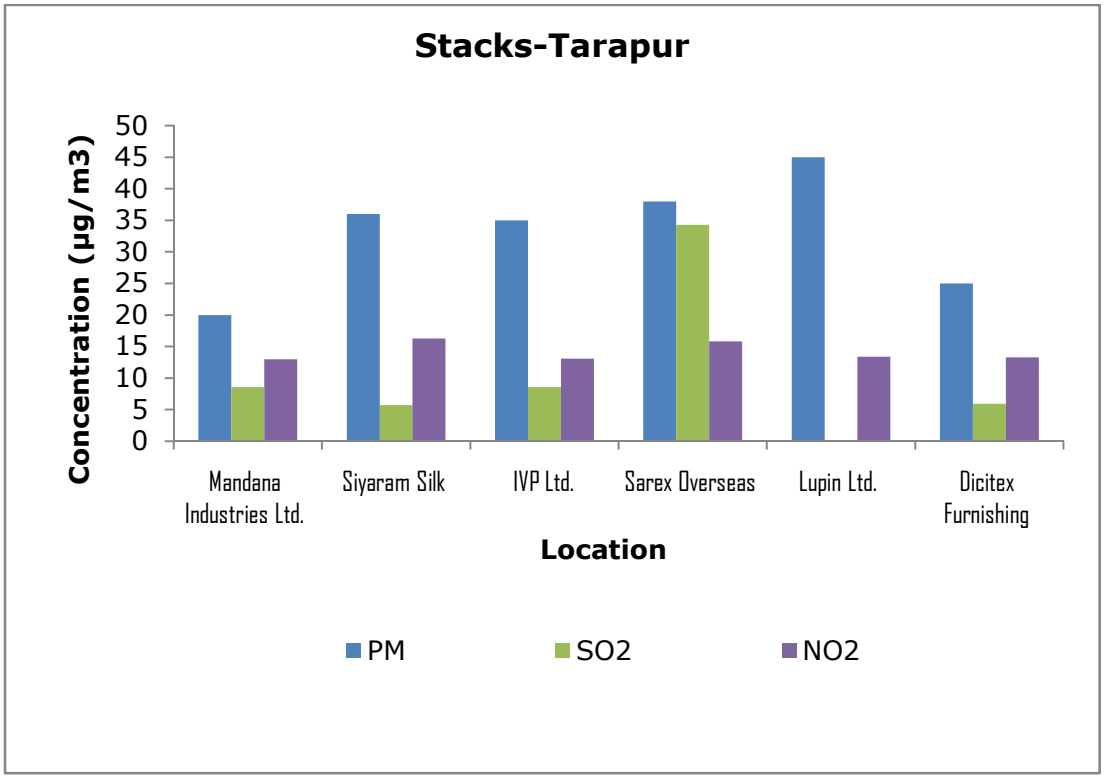
**Table No. I:**

| **Name of Industry** | | | **Mandhana Industrial Ltd. (Dyeing Unit- II)** | **Siyaram Silk Mills Ltd.** | **IVP Ltd.** |
|---|---|---|---|---|---|
| **Date of Sampling** | | | **30.01.19** | **30.01.19** | **31.01.19** |
| **Stack ID** | | | Boiler | Boiler | Boiler |
| **Sr.** | **Parameters** | **Unit** | **Result** | | |
| 1 | Particulate Matter | $mg/Nm^3$ | 20 | 36 | 35 |
| | **Std. Limit** | **$mg/Nm^3$** | **150** | **150** | **150** |
| 2 | Sulphur Dioxide ($SO_2$) | $mg/Nm^3$ | 8.57 | 5.71 | 8.57 |
| | | kg/d | 6.35 | 1.38 | 3.02 |
| | **Std. Limit** | **$mg/Nm^3$** | **-** | **-** | **-** |
| 3 | Nitrogen Dioxide ($NO_2$) | $mg/Nm^3$ | 13 | 16.3 | 13.1 |

**Table No. II:**

| **Name of Industry** | | | **Sarex Overseas** | **Lupin Ltd.** | **Dicitex Furnishing** |
|---|---|---|---|---|---|
| **Date of Sampling** | | | 31.01.19 | 02.02.19 | 02.02.19 |
| **Stack ID** | | | Boiler | Boiler | Boiler |
| **Sr.** | **Parameters** | **Unit** | **Result** | | |
| 1 | Particulate Matter | $mg/Nm^3$ | 38 | 45 | 25 |
| | **Std. Limit** | **$mg/Nm^3$** | **150** | **150** | **150** |
| 2 | Sulphur Dioxide ($SO_2$) | $mg/Nm^3$ | 34.3 | <5 | 5.93 |
| | | kg/d | 5.45 | <0.02 | 6.13 |
| | **Std. Limit** | **$mg/Nm^3$** | **-** | **-** | **-** |
| 3 | Nitrogen Dioxide ($NO_2$) | $mg/Nm^3$ | 15.8 | 13.4 | 13.3 |

**Graphs: Stack Monitoring Results:**



### 3.2 Ambient Air Quality:

In order to arrive at conclusions, the Ambient Air Quality Monitoring Results are compared against National Ambient Air Quality Standards, 2009 (**Annexure V**).

***Please Note: In Tarapur, all the parameters observed below detection limit in their concentrations are not shown in the graphs.***

| Sr. | Locations | Location details | Table No. |
|---|---|---|---|
| 1. | Mandhana Industrial Ltd. (Dyeing Unit- II) | Near ETP | Table No. I |
| 2. | Siyaram Silk Mills Ltd. | Near ETP | Table No. I |
| 3. | IVP Ltd. | Near Plant Area | Table No. I |
| 4. | Sarex Overseas | Near Main Gate | Table No. I |
| 5. | CETP | Near Plant Area | Table No. II |
| 6. | Lupin Ltd. | Near Main Gate | Table No. II |

**Table No. I:**

| **Location** | | | | **Mandhana Industrial Ltd. (Dyeing Unit- II)** | **Siyaram Silk Mills Ltd.** | **IVP Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **30.01.19** | **30.01.19** | **31.01.19** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit (NAAQS, 2009)** | **Results** | | |
| 1. | Sulphur Dioxide ($SO_2$) | $\mu g/m^3$ | **80** | 5.64 | 5.8 | 5.36 |
| 2. | Nitrogen Dioxide ($NO_2$) | $\mu g/m^3$ | **80** | 9.35 | 8.21 | 8.45 |
| 3. | Particulate Matter (size <10 µm)or $PM_{10}$ | $\mu g/m^3$ | **100** | 401 | 104 | 90 |
| 4. | Particulate Matter (size <2.5µm)or $PM_{2.5}$ | $\mu g/m^3$ | **60** | 99 | 24 | 20 |

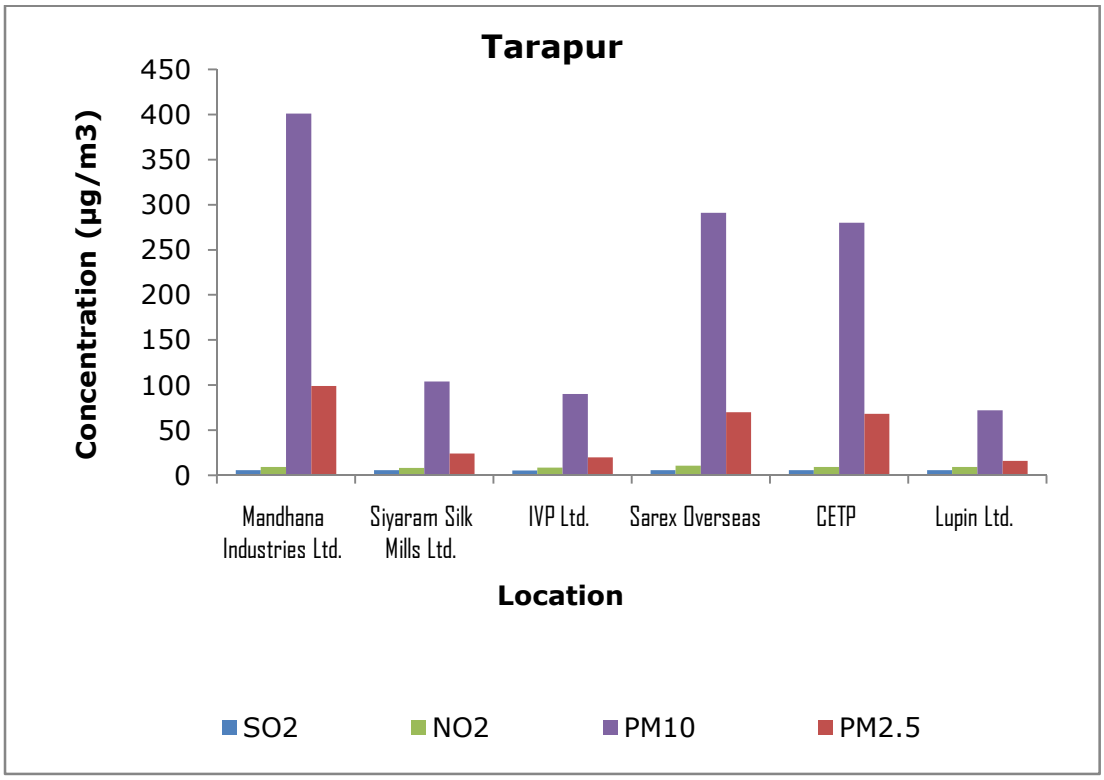
| **Location** | | | | **Mandhana Industrial Ltd. (Dyeing Unit- II)** | **Siyaram Silk Mills Ltd.** | **IVP Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **30.01.19** | **30.01.19** | **31.01.19** |
| 5. | Ozone ($O_3$) | $\mu g/m^3$ | **180** | BDL | BDL | BDL |
| 6. | Lead (Pb) | $\mu g/m^3$ | **1** | BDL | BDL | BDL |
| 7. | Carbon Monoxide (CO) | $mg/m^3$ | **04** | 1.71 | 5.04 | 1.74 |
| 8. | Ammonia ($NH_3$) | $\mu g/m^3$ | **400** | BDL | BDL | BDL |
| 9. | Benzene ($C_6H_6$) | $\mu g/m^3$ | **5** | BDL | BDL | BDL |
| 10. | Benzo (a) Pyrene (BaP) – particulate phase only | $ng/m^3$ | **1** | BDL | BDL | BDL |
| 11. | Arsenic (as As) | $ng/m^3$ | **6** | BDL | BDL | BDL |
| 12. | Nickel (as Ni) | $ng/m^3$ | **20** | BDL | BDL | BDL |

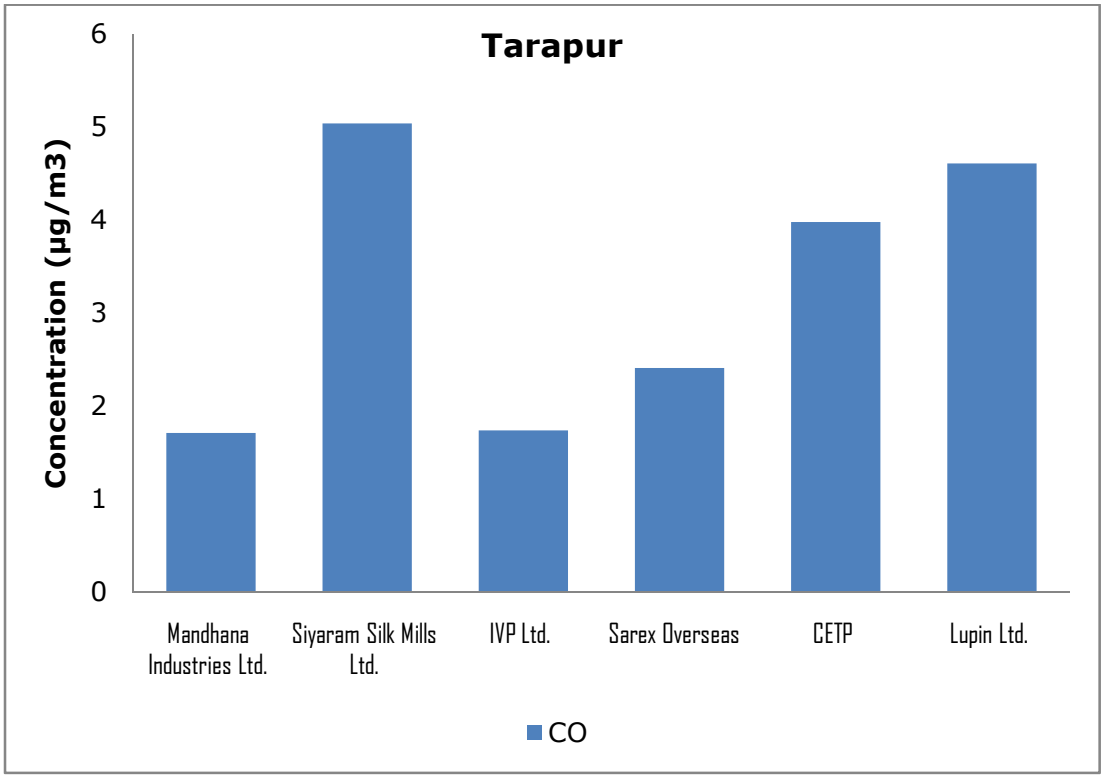
**Table No. II:**

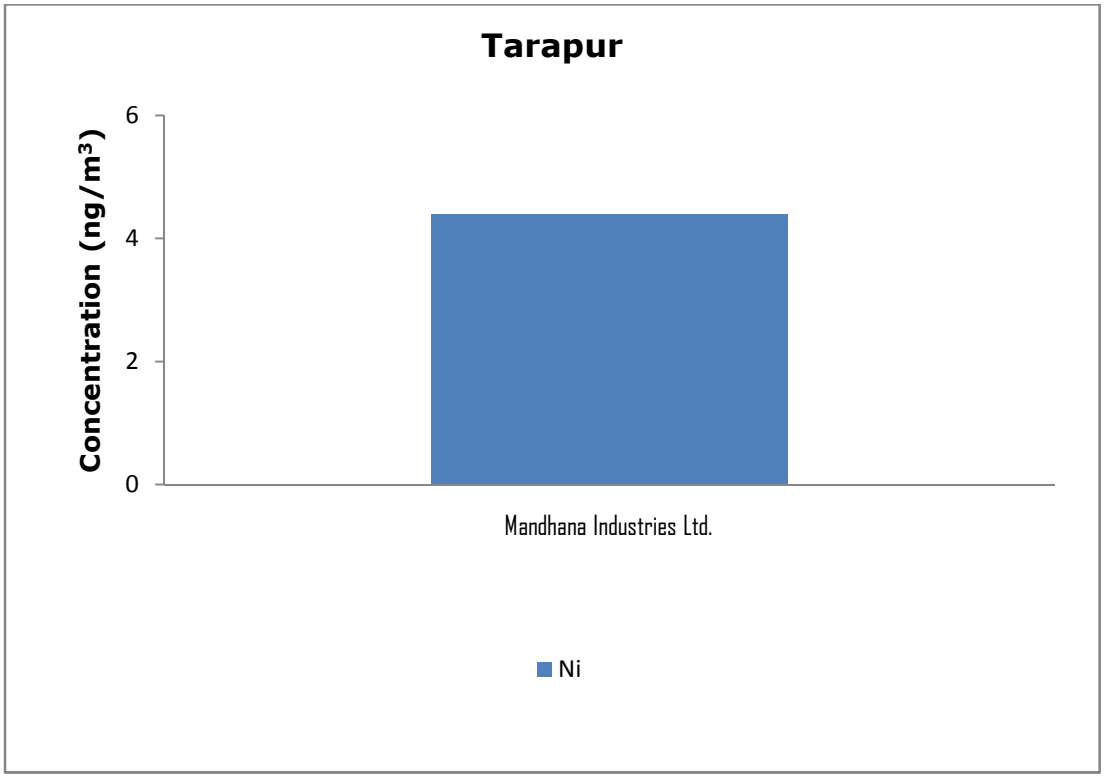
| **Location** | | | | **Sarex Overseas** | **CETP** | **Lupin Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **31.01.19** | **01.02.19** | **01.02.19** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit (NAAQS, 2009)** | **Results** | | |
| 1. | Sulphur Dioxide ($SO_2$) | $\mu g/m^3$ | **80** | 5.70 | 5.52 | 5.52 |
| 2. | Nitrogen Dioxide ($NO_2$) | $\mu g/m^3$ | **80** | 10.6 | 9.20 | 9.24 |
| 3. | Particulate Matter (size <10 µm)or $PM_{10}$ | $\mu g/m^3$ | **100** | 291 | 280 | 72 |

| **Location** | | | | **Sarex Overseas** | **CETP** | **Lupin Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **31.01.19** | **01.02.19** | **01.02.19** |
| 4. | Particulate Matter (size <2.5µm)or $PM_{2.5}$ | µg/$m^3$ | **60** | 70 | 68 | 16 |
| 5. | Ozone ($O_3$) | µg/$m^3$ | **180** | BDL | BDL | BDL |
| 6. | Lead (Pb) | µg/$m^3$ | **1** | BDL | BDL | BDL |
| 7. | Carbon Monoxide (CO) | mg/$m^3$ | **04** | 2.41 | 3.98 | 4.61 |
| 8. | Ammonia ($NH_3$) | µg/$m^3$ | **400** | BDL | BDL | BDL |
| 9. | Benzene ($C_6H_6$) | µg/$m^3$ | **5** | BDL | BDL | BDL |
| 10. | Benzo (a) Pyrene (BaP) – particulate phase only | ng/$m^3$ | **1** | BDL | BDL | BDL |
| 11. | Arsenic (as As) | ng/$m^3$ | **6** | BDL | BDL | BDL |
| 12. | Nickel (as Ni) | ng/$m^3$ | **20** | BDL | BDL | BDL |

**Graphs: Ambient Air Monitoring Results:**






### 3.3 Water/Waste Water:

Water Analysis Results are compared against CPCB document on criteria for Comprehensive Environmental Assessment of Industrial Clusters-Water Quality Parameters Requirement and Classification (Annexure IX), CPCB Water Quality Criteria (Annexure VIII) and Drinking Water Specification, IS 10500:2012 (Annexure VII), Wastewater Analysis Results are compared with General Standards for Discharge of Environmental Pollutants Part A: Effluents, The Environment (Protection) Rules, 1986, Schedule VI.

| Sr. | Locations | Location detail | Included in |
|---|---|---|---|
| 1. | CETP inlet | ETP Outlet | Table I |
| 2. | CETP outlet | ETP Outlet | Table I |
| 3. | Siyaram Silk | ETP Inlet | Table I |
| 4. | Resonance Specialities | ETP Outlet | Table II |
| 5. | Aarti Drugs | ETP Outlet | Table II |
| 6. | Aarti Industries | ETP Outlet | Table II |
| 7. | Calex Chemicals Ltd. | ETP Outlet | Table II |

**Table I:**

| **Location** | | | | **CETP Inlet** | **CETP Outlet** | **Siyaram Silk Mill** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 1. | Colour | Hazen | | 400 | 350 | 1 |
| 2. | Smell | - | | Disagreeable | Disagreeable | Disagreeable |
| 3. | pH | - | **5.5 -9.0** | 6.29 | 7.01 | 8.22 |
| 4. | Oil & Grease | mg/L | **10.0** | BDL | BDL | BDL |
| 5. | Suspended Solids | mg/L | **100.0** | 73 | 91 | 63 |
| 6. | Dissolved Oxygen (% Saturation) | % | | 130 | 120 | 120 |
| 7. | Chemical Oxygen Demand | mg/L | **250.0** | 4400 | 2400 | 80 |
| 8. | Biochemical Oxygen Demand (3 days,27$^{o}$ C) | mg/L | **30.0** | 1470 | 799 | 26 |
| 9. | Electrical Conductivity (at 25$^{o}$ C) | µmhos/cm | | 12570 | 6400 | 2450 |
| 10. | Nitrite Nitrogen (as N) | mg/L | | 1.12 | 0.82 | 0.08 |
| 11. | Nitrate Nitrogen (as N) | mg/L | **100** | 11 | 4.93 | 14.3 |
| 12. | ($NO_2$ + $NO_3$)-Nitrogen | mg/L | **5.0** | 12.1 | 5.75 | 14.4 |
| 13. | Free Ammonia (as $NH_3$-N) | mg/L | **5.0** | 0.11 | 0.50 | BDL |
| 14. | Total Residual Chlorine | mg/L | **1.0** | BDL | BDL | BDL |

| **Location** | | | | **CETP Inlet** | **CETP Outlet** | **Siyaram Silk Mill** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 15. | Cyanide (as CN) | mg/L | **0.2** | BDL | BDL | BDL |
| 16. | Fluoride (as F) | mg/L | **2.0** | 47.5 | 70 | 0.46 |
| 17. | Sulphide (as $S^{2-}$) | mg/L | **2.0** | BDL | 4.32 | BDL |
| 18. | Dissolved Phosphate (as P) | mg/L | **5.0** | 3.42 | 0.59 | 1.10 |
| 19. | Sodium Absorption Ratio | - | | 47.8 | 29.4 | 30 |
| 20. | Total Coliforms | MPN index/100 mL | **100.0** | BDL | 23 | BDL |
| 21. | Faecal Coliforms | MPN index/100 mL | **1000.0** | BDL | 7.8 | BDL |
| 22. | Total Phosphorous (as P) | mg/L | **1.0** | 7.27 | 0.88 | 1.30 |
| 23. | Total Kjeldahl Nitrogen | mg/L | **100.0** | 1140 | 627 | 5.26 |
| 24. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **5.0** | 68 | 60.8 | 1.6 |
| 25. | Phenols (as $C_6H_5OH$) | mg/L | **3.0** | BDL | BDL | BDL |
| 26. | Surface Active Agents (as MBAS) | mg/L | **3.0** | BDL | BDL | BDL |
| 27. | Organo Chlorine Pesticides | µg/L | **0.1** | | | |
| i. | Alachlor | µg/L | **2.0** | BDL | BDL | BDL |

| **Location** | | | | **CETP Inlet** | **CETP Outlet** | **Siyaram Silk Mill** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| ii. | Atrazine | µg/L | **0.2** | BDL | BDL | BDL |
| iii. | Aldrin | µg/L | **0.1** | BDL | BDL | BDL |
| iv. | Dieldrin | µg/L | **2.0** | BDL | BDL | BDL |
| v. | Alpha HCH | µg/L | **0.01** | BDL | BDL | BDL |
| vi. | Beta HCH | µg/L | **2.0** | BDL | BDL | BDL |
| vii. | Butachlor | µg/L | **3.0** | BDL | BDL | BDL |
| viii. | Chlorpyrifos | | | BDL | BDL | BDL |
| ix. | Delta HCH | µg/L | **0.2** | BDL | BDL | BDL |
| x. | p,p DDT | µg/L | **0.05** | BDL | BDL | BDL |
| xi. | o,p DDT | µg/L | **100.0** | BDL | BDL | BDL |
| xii. | p,p DDE | µg/L | **250.0** | BDL | BDL | BDL |
| xiii. | o,p DDE | µg/L | **30.0** | BDL | BDL | BDL |
| xiv. | p,p DDD | µg/L | | BDL | BDL | BDL |
| xv. | o,p DDD | µg/L | | BDL | BDL | BDL |
| xvi. | Alpha Endosulfan | µg/L | **10.0** | BDL | BDL | BDL |
| xvii. | Beta Endosulfan | µg/L | | BDL | BDL | BDL |
| xviii. | Endosulfan Sulphate | µg/L | **5.0** | BDL | BDL | BDL |
| xix. | Y HCH (Lindane) | µg/L | **1.0** | BDL | BDL | BDL |
| 28. | Poly Aromatic hydrocarbons (as PAH) | µg/L | **0.2** | 0.01 | 0.045 | BDL |

| **Location** | | | | **CETP Inlet** | **CETP Outlet** | **Siyaram Silk Mill** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 29. | Polychlorinated Biphenyls (PCB) | µg/L | **2.0** | BDL | BDL | BDL |
| 30. | Zinc (as Zn) | mg/L | **5.0** | 3.38 | 2.04 | BDL |
| 31. | Nickel (as Ni) | mg/L | **3.0** | 0.123 | 0.107 | BDL |
| 32. | Copper (as Cu) | mg/L | | 11 | 0.859 | BDL |
| 33. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **0.1** | BDL | BDL | BDL |
| 34. | Total Chromium (as Cr) | mg/L | **2.0** | 0.643 | 0.632 | 0.027 |
| 35. | Total Arsenic (as As) | mg/L | **0.2** | BDL | BDL | BDL |
| 36. | Lead (as Pb) | mg/L | **0.1** | 0.035 | 0.080 | BDL |
| 37. | Cadmium (as Cd) | mg/L | **2.0** | 0.006 | 0.007 | BDL |
| 38. | Mercury (as Hg) | mg/L | **0.01** | BDL | BDL | BDL |
| 39. | Manganese (as Mn) | mg/L | **2.0** | 0.548 | 0.715 | 0.041 |
| 40. | Iron (as Fe) | mg/L | **3.0** | 26.4 | 23.5 | 0.733 |
| 41. | Vanadium (as V) | mg/L | **0.2** | 0.055 | 0.033 | BDL |
| 42. | Selenium (as Se) | mg/L | **0.05** | 0.579 | BDL | BDL |
| 43. | Boron (as B) | mg/L | | 0.588 | 0.905 | 0.112 |

| Location | | | | CETP Inlet | CETP Outlet | Siyaram Silk Mill |
|---|---|---|---|---|---|---|
| Date of Sampling | | | | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 44. | Bioassay Test on fish | % survival | **90% survival after 96h in 100% effluent** | 0 | 0 | 0 |

**Table II:**

| Location | | | | Resonance Specialities Ltd. | Aarti Drugs | Aarti Industries | Calex Chemicals Ltd. |
|---|---|---|---|---|---|---|---|
| Date of Sampling | | | | 04.02.19 | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | | |
| 1. | Colour | Hazen | | 1 | 1 | 1 | 1 |
| 2. | Smell | - | | Agreeable | Disagreeable | Disagreeable | Disagreeable |
| 3. | Transparency | m | | | | | |
| 4. | pH | - | **5.5 - 9.0** | 8.04 | 5.73 | 7 | 7.15 |
| 5. | Oil & Grease | mg/L | **10.0** | BDL | BDL | BDL | BDL |
| 6. | Suspended Solids | mg/L | **100.0** | 9 | 70 | 23 | 10 |
| 7. | Dissolved Oxygen (% Saturation) | % | | 142 | 98 | 122 | 125 |

| **Location** | | | | **Resonance Specialities Ltd.** | **Aarti Drugs** | **Aarti Industries** | **Calex Chemicals Ltd.** |
|---|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | | |
| 8. | Chemical Oxygen Demand | mg/L | **250.0** | 30 | 50 | 10 | 20 |
| 9. | Biochemical Oxygen Demand (3 days,27$^{o}$ C) | mg/L | **30.0** | 11 | 16 | 3.3 | 7 |
| 10. | Electrical Conductivity (at 25 $^{o}$ C) | µmhos/cm | | 186.5 | 11600 | 79.4 | 557 |
| 11. | Nitrite Nitrogen (as N) | mg/L | | BDL | 1.12 | BDL | BDL |
| 12. | Nitrate Nitrogen (as N) | mg/L | **100** | 0.61 | 55.8 | 0.27 | 1.42 |
| 13. | ($NO_2$ + $NO_3$)-Nitrogen | mg/L | **5.0** | 0.61 | 56.9 | 0.27 | 1.42 |
| 14. | Free Ammonia (as $NH_3$-N) | mg/L | **5.0** | BDL | BDL | BDL | BDL |
| 15. | Total Residual Chlorine | mg/L | **1.0** | BDL | BDL | BDL | BDL |
| 16. | Cyanide (as CN) | mg/L | **0.2** | BDL | BDL | BDL | BDL |
| 17. | Fluoride (as F) | mg/L | **2.0** | 0.73 | 0.64 | 0.90 | 0.38 |
| 18. | Sulphide (as $S^{2-}$) | mg/L | **2.0** | BDL | BDL | BDL | BDL |
| 19. | Dissolved Phosphate (as P) | mg/L | **5.0** | BDL | 3.31 | BDL | BDL |

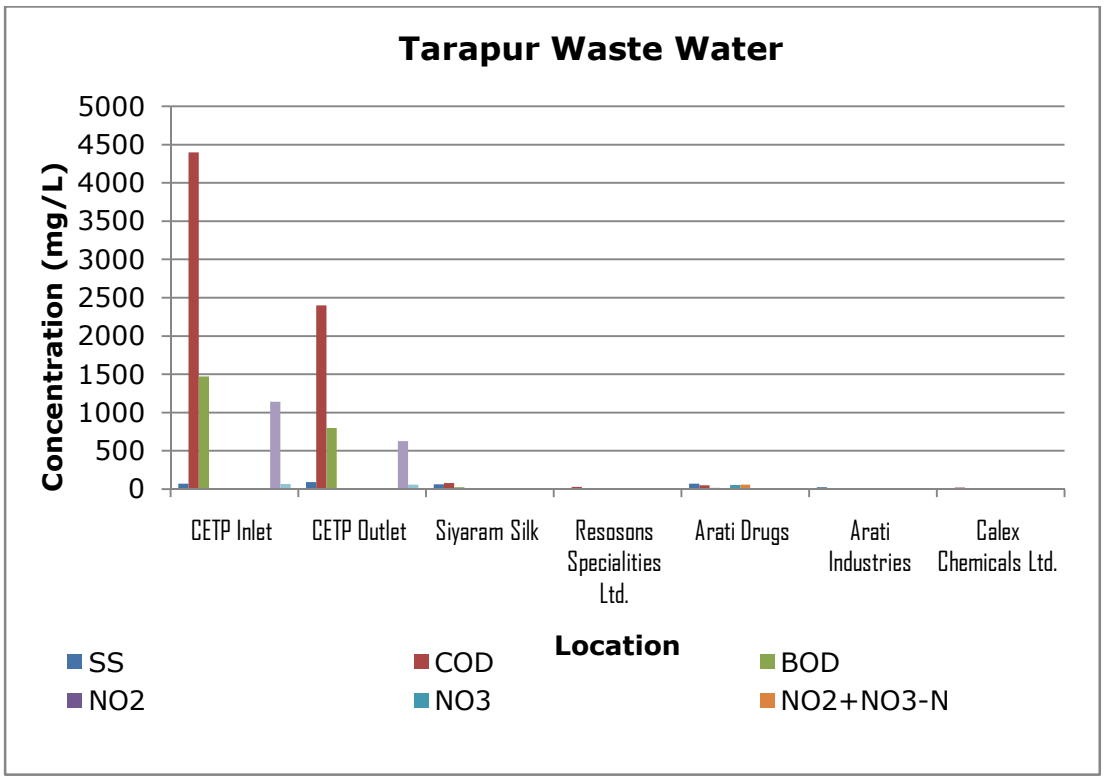
| **Location** | | | | **Resonance Specialities Ltd.** | **Aarti Drugs** | **Aarti Industries** | **Calex Chemicals Ltd.** |
|---|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | | |
| 20. | Sodium Absorption Ratio | - | | 0.48 | 83.7 | 0.39 | 4.43 |
| 21. | Total Coliforms | MPN index/100 mL | **100.0** | 7.8 | 7.8 | 23 | 23 |
| 22. | Faecal Coliforms | MPN index/100 mL | **1000.0** | BDL | BDL | 23 | 13 |
| 23. | Total Phosphorous (as P) | mg/L | **1.0** | BDL | 5.69 | BDL | 0.29 |
| 24. | Total Kjeldahl Nitrogen | mg/L | **100.0** | 3.36 | 1.8 | 0.56 | 5.61 |
| 25. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **5.0** | BDL | 0.42 | BDL | BDL |
| 26. | Phenols (as $C_6H_5OH$) | mg/L | **3.0** | BDL | BDL | BDL | BDL |
| 27. | Surface Active Agents (as MBAS) | mg/L | **3.0** | BDL | BDL | BDL | BDL |
| 28. | Organo Chlorine Pesticides | µg/L | **0.1** | | | | |
| i. | Alachlor | µg/L | **2.0** | BDL | BDL | BDL | BDL |
| ii. | Atrazine | µg/L | **0.2** | BDL | BDL | BDL | BDL |
| iii. | Aldrin | µg/L | **0.1** | BDL | BDL | BDL | BDL |

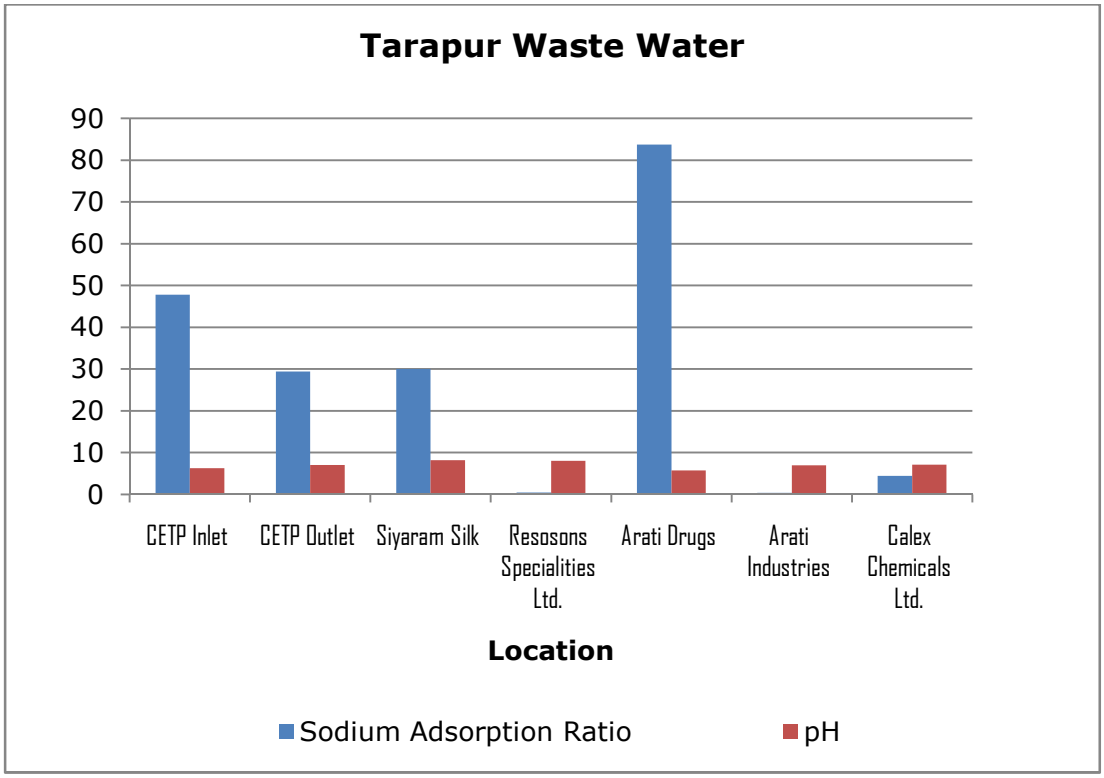
| **Location** | | | | **Resonance Specialities Ltd.** | **Aarti Drugs** | **Aarti Industries** | **Calex Chemicals Ltd.** |
|---|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | | |
| iv. | Dieldrin | µg/L | **2.0** | BDL | BDL | BDL | BDL |
| v. | Alpha HCH | µg/L | **0.01** | BDL | BDL | BDL | BDL |
| vi. | Beta HCH | µg/L | **2.0** | BDL | BDL | BDL | BDL |
| vii. | Butachlor | µg/L | **3.0** | BDL | BDL | BDL | BDL |
| viii. | Chlorpyrifos | | | BDL | BDL | BDL | BDL |
| ix. | Delta HCH | µg/L | **0.2** | BDL | BDL | BDL | BDL |
| x. | p,p DDT | µg/L | **0.05** | BDL | BDL | BDL | BDL |
| xi. | o,p DDT | µg/L | **100.0** | BDL | BDL | BDL | BDL |
| xii. | p,p DDE | µg/L | **250.0** | BDL | BDL | BDL | BDL |
| xiii. | o,p DDE | µg/L | **30.0** | BDL | BDL | BDL | BDL |
| xiv. | p,p DDD | µg/L | | BDL | BDL | BDL | BDL |
| xv. | o,p DDD | µg/L | | BDL | BDL | BDL | BDL |
| xvi. | Alpha Endosulfan | µg/L | **10.0** | BDL | BDL | BDL | BDL |
| xvii. | Beta Endosulfan | µg/L | | BDL | BDL | BDL | BDL |
| xviii. | Endosulfan Sulphate | µg/L | **5.0** | BDL | BDL | BDL | BDL |
| xix. | Y HCH (Lindane) | µg/L | **1.0** | BDL | BDL | BDL | BDL |
| 29. | Poly Aromatic hydrocarbons (as PAH) | µg/L | **0.2** | 0.012 | 0.011 | BDL | 0.003 |

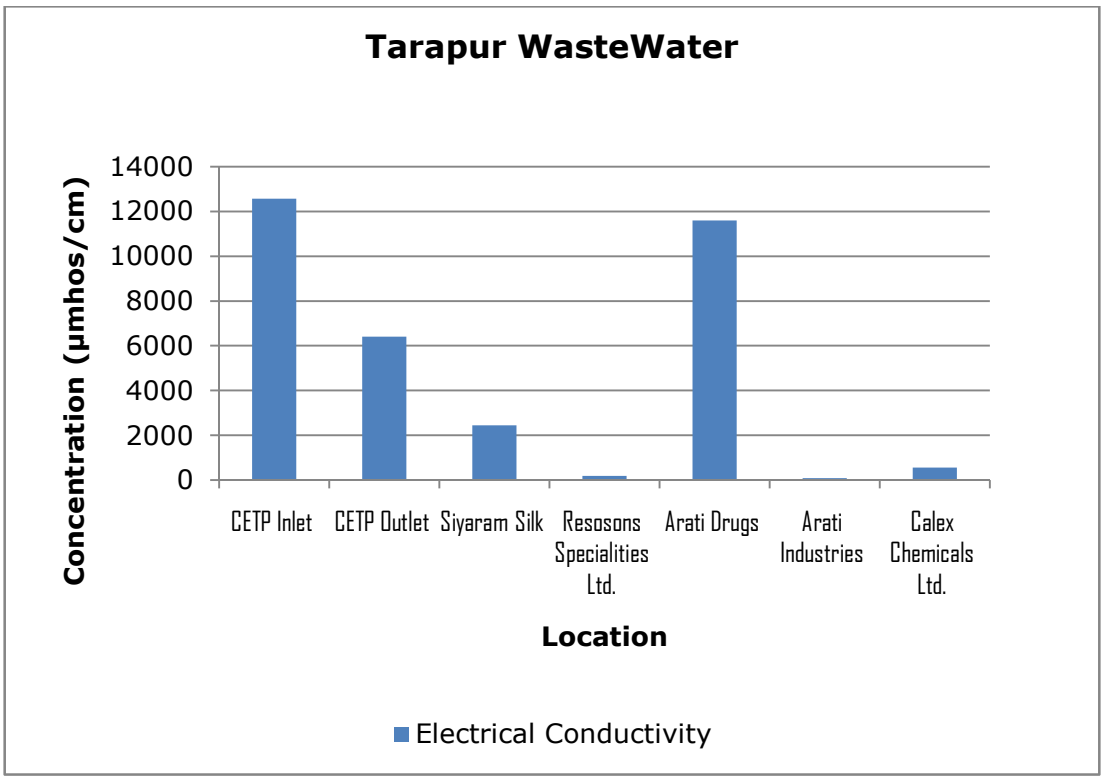
| **Location** | | | | **Resonance Specialities Ltd.** | **Aarti Drugs** | **Aarti Industries** | **Calex Chemicals Ltd.** |
|---|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | 04.02.19 | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | | |
| 30. | Polychlorinated Biphenyls (PCB) | µg/L | **2.0** | BDL | BDL | BDL | BDL |
| 31. | Zinc (as Zn) | mg/L | **5.0** | BDL | 0.741 | BDL | BDL |
| 32. | Nickel (as Ni) | mg/L | **3.0** | BDL | 0.042 | BDL | BDL |
| 33. | Copper (as Cu) | mg/L | | BDL | BDL | BDL | BDL |
| 34. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **0.1** | BDL | BDL | BDL | BDL |
| 35. | Total Chromium (as Cr) | mg/L | **2.0** | BDL | BDL | BDL | BDL |
| 36. | Total Arsenic (as As) | mg/L | **0.2** | BDL | BDL | BDL | BDL |
| 37. | Lead (as Pb) | mg/L | **0.1** | BDL | BDL | BDL | BDL |
| 38. | Cadmium (as Cd) | mg/L | **2.0** | BDL | BDL | BDL | 0.016 |
| 39. | Mercury (as Hg) | mg/L | **0.01** | BDL | BDL | BDL | BDL |
| 40. | Manganese (as Mn) | mg/L | **2.0** | BDL | 0.269 | BDL | BDL |
| 41. | Iron (as Fe) | mg/L | **3.0** | 0.193 | 5.28 | 0.366 | 0.234 |
| 42. | Vanadium (as V) | mg/L | **0.2** | BDL | BDL | BDL | BDL |
| 43. | Selenium (as Se) | mg/L | **0.05** | BDL | BDL | BDL | BDL |

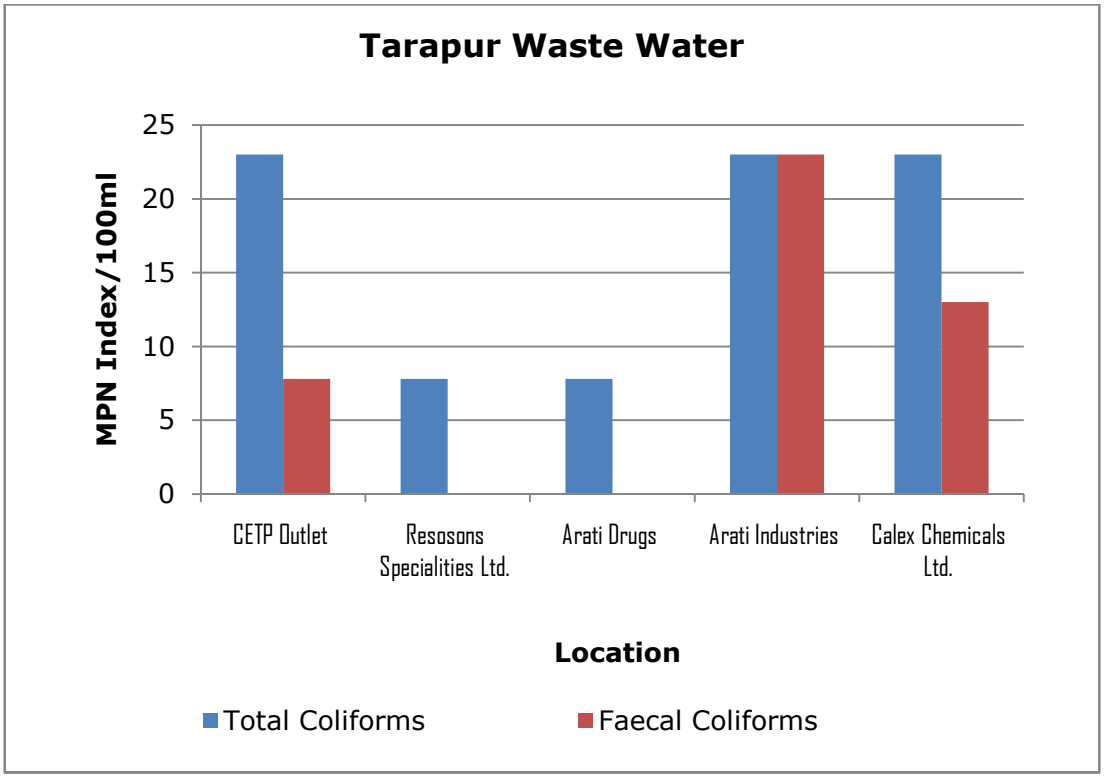
| Location | | | | Resonance Specialities Ltd. | Aarti Drugs | Aarti Industries | Calex Chemicals Ltd. |
|---|---|---|---|---|---|---|---|
| Date of Sampling | | | | 04.02.19 | 04.02.19 | 04.02.19 | 04.02.19 |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | | |
| 44. | Boron (as B) | mg/L | | BDL | BDL | BDL | BDL |
| 45. | Bioassay Test on fish | % survival | **90% survival after 96h in 100% effluent** | 100 | 0 | 100 | 100 |

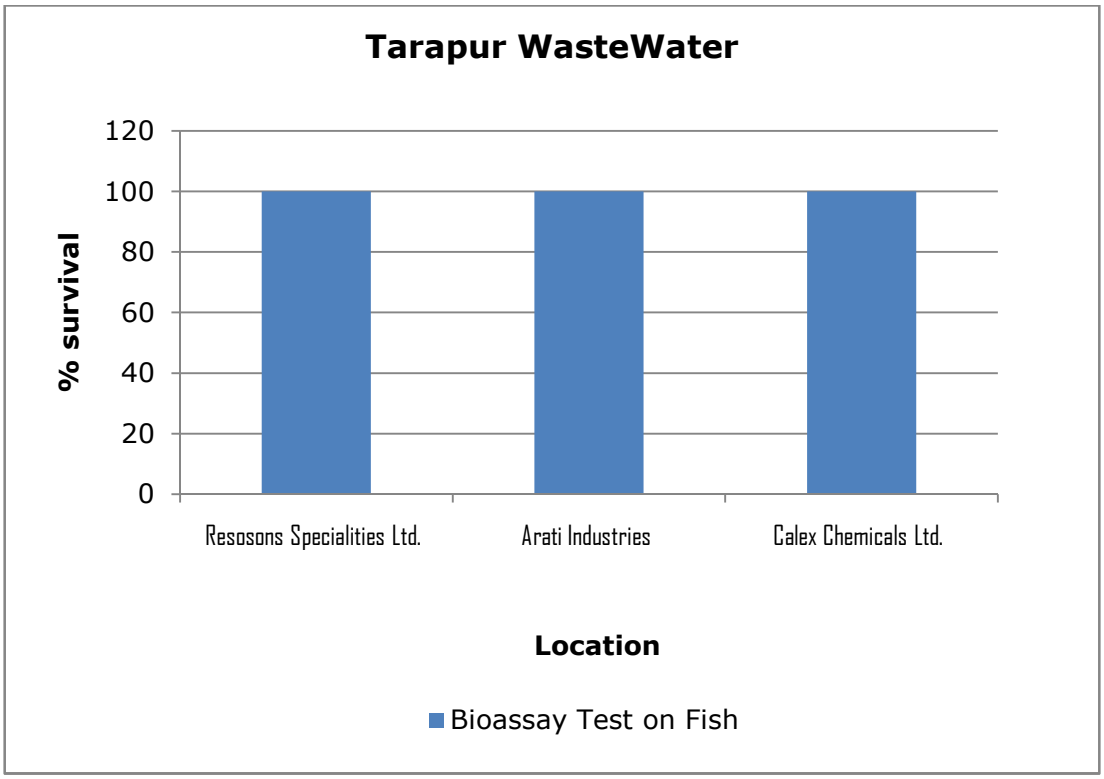
**Graphs: Waste Water Monitoring**




Tarapur Waste Water
90
80
70
60
50
40
30
20
10
0
CETP Inlet
CETP Outlet
Siyaram Silk
Resosons Specialities Ltd.
Arati Drugs
Arati Industries
Calex Chemicals Ltd.
Location
Sodium Adsorption Ratio
pH


Tarapur WasteWater
Concentration (µmhos/cm)
14000
12000
10000
8000
6000
4000
2000
0
CETP Inlet
CETP Outlet
Siyaram Silk
Resosons Specialities Ltd.
Arati Drugs
Arati Industries
Calex Chemicals Ltd.
Location
Electrical Conductivity


Tarapur Waste Water
MPN Index/100ml
25
20
15
10
5
0
CETP Outlet
Resosons Specialities Ltd.
Arati Drugs
Arati Industries
Calex Chemicals Ltd.
Location
Total Coliforms
Faecal Coliforms


Tarapur WasteWater
% survival
120
100
80
60
40
20
0
Resosons Specialities Ltd.
Arati Industries
Calex Chemicals Ltd.
Location
Bioassay Test on Fish

### 3.4 Ground Water Analysis Results:

| Sr. No. | Locations | Included in |
|---|---|---|
| 1. | Ankush Gharatwadi | Table I |
| 2. | Dhodi Pooja Area | Table I |
| 3. | Lala Vajpayee Area | Table I |
| 4. | Chiku Wadi | Table II |
| 5. | Kumbhavali Village | Table II |
| 6. | Salvad Village | Table II |

**Table I**

| **Location** | | | | **Dhodi Pooja Area** | **Lala Vajpayee Area** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** | **04.02.19** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit** | **Results** | | |
| 1. | Colour | Hazen | **5** | 1 | 1 | 1 |
| 2. | Odour | | **Agreeable** | Agreeable | Agreeable | Agreeable |
| 3. | pH | - | **6.5-8.5** | 7.54 | 7.75 | 7.75 |
| 4. | Oil & Grease | mg/L | **100** | BDL | BDL | BDL |
| 5. | Suspended Solids | mg/L | **500** | 14 | 14 | 10 |
| 6. | Chemical Oxygen Demand | mg/L | **10 (WHO, 1993)** | 37 | 32 | 13 |
| 7. | Biochemical Oxygen Demand (3 days, 27$^{o}$ C) | mg/L | **6 (WHO, 1993)** | 12 | 11 | BDL |

| **Location** | | | | **Dhodi Pooja Area** | **Lala Vajpayee Area** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** | **04.02.19** |
| 8. | Electrical Conductivity (at 25° C ) | µmhos/cm | **750** | 523 | 1298 | 2330 |
| 9. | Nitrite Nitrogen (as N) | mg/L | | BDL | BDL | BDL |
| 10. | Nitrate Nitrogen (as N) | mg/L | **45** | 6.49 | 4.90 | 9.29 |
| 11. | $(NO_2 + NO_3)$-Nitrogen | mg/L | **1.0** | 6.49 | 4.90 | 9.29 |
| 12. | Free Ammonia (as $NH_3$-N) | mg/L | **0.5** | BDL | BDL | BDL |
| 13. | Total Residual Chlorine | mg/L | **0.2** | BDL | BDL | BDL |
| 14. | Cyanide (as CN) | mg/L | | BDL | BDL | BDL |
| 15. | Fluoride (as F) | mg/L | **1** | 1.25 | 1.27 | 1.18 |
| 16. | Sulphide (as $S^{2-}$) | mg/L | **0.05** | BDL | BDL | BDL |
| 17. | Dissolved Phosphate (as P) | mg/L | | BDL | BDL | BDL |
| 18. | Sodium Absorption Ratio | | | 1.33 | BDL | 4.18 |
| 19. | Total Coliforms | MPN index/100 mL | **ND** | 79 | 63 | 11 |
| 20. | Faecal Coliforms | MPN index/100 mL | **ND** | 23 | 26 | BDL |
| 21. | Total Phosphorous (as P) | mg/L | **0.5** | BDL | BDL | BDL |

| **Location** | | | | **Dhodi Pooja Area** | **Lala Vajpayee Area** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** | **04.02.19** |
| 22. | Total Kjeldahl Nitrogen | mg/L | **0.001** | 0.39 | 0.90 | 1.34 |
| 23. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **0.5** | BDL | BDL | BDL |
| 24. | Phenols (as $C_6H_5OH$) | mg/L | **0.001** | BDL | BDL | BDL |
| 25. | Surface Active Agents (as MBAS) | mg/L | **0.05** | BDL | BDL | BDL |
| 26. | Organo Chlorine Pesticides | µg/L | | | | |
| i. | Alachlor | µg/L | | BDL | BDL | BDL |
| ii. | Atrazine | µg/L | **2** | BDL | BDL | BDL |
| iii. | Aldrin | µg/L | **0.03** | BDL | BDL | BDL |
| iv. | Dieldrin | µg/L | **0.03** | BDL | BDL | BDL |
| v. | Alpha HCH | µg/L | **0.01** | BDL | BDL | BDL |
| vi. | Beta HCH | µg/L | **0.04** | BDL | BDL | BDL |
| vii. | Chlorpryriphos | µg/L | | BDL | BDL | BDL |
| viii. | Butachlor | µg/L | **125** | BDL | BDL | BDL |
| ix. | Delta HCH | µg/L | **0.04** | BDL | BDL | BDL |
| x. | p,p DDT | µg/L | **1** | BDL | BDL | BDL |
| xi. | o,p DDT | µg/L | **1** | BDL | BDL | BDL |
| xii. | p,p DDE | µg/L | **1** | BDL | BDL | BDL |

| **Location** | | | | **Dhodi Pooja Area** | **Lala Vajpayee Area** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** | **04.02.19** |
| xiii. | o,p DDE | µg/L | **1** | BDL | BDL | BDL |
| xiv. | p,p DDD | µg/L | **1** | BDL | BDL | BDL |
| xv. | o,p DDD | µg/L | **1** | BDL | BDL | BDL |
| xvi. | Alpha Endosulfan | µg/L | **0.4** | BDL | BDL | BDL |
| xvii. | Beta Endosulfan | µg/L | **0.4** | BDL | BDL | BDL |
| xviii. | Endosulfan Sulphate | µg/L | **0.4** | BDL | BDL | BDL |
| xix. | Y HCH (Lindane) | µg/L | **2.0** | BDL | BDL | BDL |
| 27. | Polynuclear aromatic hydrocarbons (as PAH) | µg/L | **0.0001** | BDL | BDL | BDL |
| 28. | Polychlorinated Biphenyls (PCB) | µg/L | **0.0005** | BDL | BDL | BDL |
| 29. | Zinc (as Zn) | mg/L | **5.0** | BDL | BDL | BDL |
| 30. | Nickel (as Ni) | mg/L | **0.02** | BDL | BDL | BDL |
| 31. | Copper (as Cu) | mg/L | **0.05** | BDL | BDL | 0.152 |
| 32. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **1** | BDL | BDL | BDL |
| 33. | Total Chromium (as Cr) | mg/L | **0.05** | BDL | BDL | BDL |
| 34. | Total Arsenic (as As) | mg/L | **0.01** | BDL | BDL | BDL |
| 35. | Lead (as Pb) | mg/L | **0.01** | BDL | BDL | BDL |

| **Location** | | | | **Dhodi Pooja Area** | **Lala Vajpayee Area** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** | **04.02.19** |
| 36. | Cadmium (as Cd) | mg/L | **0.003** | BDL | BDL | BDL |
| 37. | Mercury (as Hg) | mg/L | **0.001** | BDL | BDL | BDL |
| 38. | Manganese (as Mn) | mg/L | **0.1** | BDL | BDL | 0.129 |
| 39. | Iron (as Fe) | mg/L | **0.3** | 0.138 | 0.137 | 0.082 |
| 40. | Vanadium (as V) | mg/L | | BDL | BDL | BDL |
| 41. | Selenium (as Se) | mg/L | **0.01** | BDL | BDL | BDL |
| 42. | Boron (as B) | mg/L | | BDL | BDL | BDL |
| 43. | Bioassay Test on fish | % survival | | 0 | 0 | 100 |

**Table II**

| **Location** | | | | **Ankush Gharat wali** | **Chiku Wadi** |
|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** |
| **Sr.** | **Parameter** | **Std. Limit** | **Results** | | |
| 1. | Colour | Hazen | **5** | 1 | 1 |
| 2. | Odour | | **Agreeable** | Agreeable | Agreeable |
| 3. | pH | - | **6.5-8.5** | 8.03 | 6.91 |
| 4. | Oil & Grease | mg/L | **100** | BDL | BDL |
| 5. | Suspended Solids | mg/L | **500** | 12 | 18 |

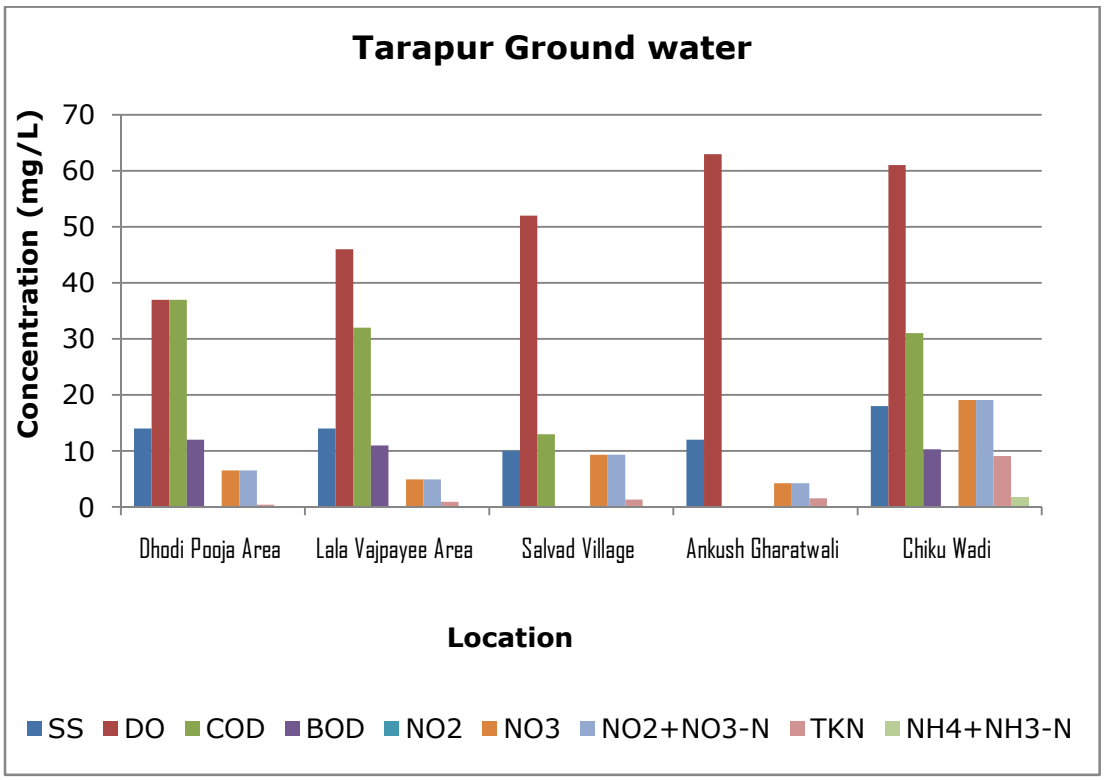
| **Location** | | | | **Ankush Gharatwali** | **Chiku Wadi** |
|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** |
| 6. | Chemical Oxygen Demand | mg/L | **10 (WHO, 1993)** | BDL | 31 |
| 7. | Biochemical Oxygen Demand (3 days, 27$^{o}$ C) | mg/L | **6 (WHO, 1993)** | BDL | 10.3 |
| 8. | Electrical Conductivity (at 25$^{o}$ C ) | µmhos/cm | **1000** | 745 | 5570 |
| 9. | Nitrite Nitrogen (as N) | mg/L | | BDL | BDL |
| 10. | Nitrate Nitrogen (as N) | mg/L | **45** | 4.22 | 19.1 |
| 11. | ($NO_2$ + $NO_3$)-Nitrogen | mg/L | **1.0** | 4.22 | 19.1 |
| 12. | Free Ammonia (as $NH_3$-N) | mg/L | **0.5** | BDL | BDL |
| 13. | Total Residual Chlorine | mg/L | **0.2** | BDL | BDL |
| 14. | Cyanide (as CN) | mg/L | | BDL | BDL |
| 15. | Fluoride (as F) | mg/L | **1** | 0.63 | 0.75 |
| 16. | Sulphide (as $S^{2-}$) | mg/L | **0.05** | BDL | BDL |
| 17. | Dissolved Phosphate (as P) | mg/L | | BDL | BDL |
| 18. | Sodium Absorption Ratio | | | 0.58 | 1.34 |
| 19. | Total Coliforms | MPN index/100 mL | **ND** | 43 | 70 |
| 20. | Faecal Coliforms | MPN index/100 mL | **ND** | BDL | 17 |

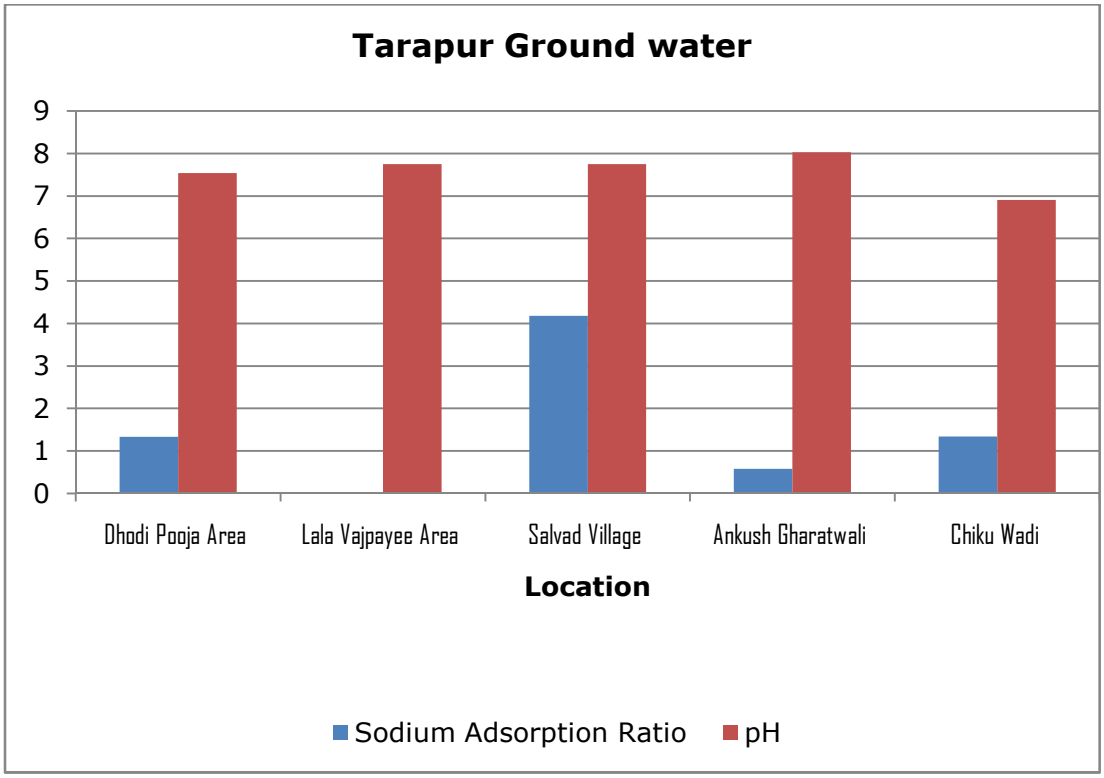
| **Location** | | | | **Ankush Gharatwali** | **Chiku Wadi** |
|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** |
| 21. | Total Phosphorous (as P) | mg/L | **0.5** | BDL | BDL |
| 22. | Total Kjeldahl Nitrogen | mg/L | **0.001** | 1.57 | 9.1 |
| 23. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **0.5** | BDL | 1.7 |
| 24. | Phenols (as $C_6H_5OH$) | mg/L | **0.001** | BDL | BDL |
| 25. | Surface Active Agents (as MBAS) | mg/L | **0.05** | BDL | BDL |
| 26. | Organo Chlorine Pesticides | µg/L | | | |
| i. | Alachlor | µg/L | | BDL | BDL |
| ii. | Atrazine | µg/L | **2** | BDL | BDL |
| iii. | Aldrin | µg/L | **0.03** | BDL | BDL |
| iv. | Dieldrin | µg/L | **0.03** | BDL | BDL |
| v | Alpha HCH | µg/L | **0.01** | BDL | BDL |
| vi. | Beta HCH | µg/L | **0.04** | BDL | BDL |
| vii. | Chlorpryriphos | µg/L | **0.04** | BDL | BDL |
| viii | Butachlor | µg/L | | BDL | BDL |
| viii. | Delta HCH | µg/L | **125** | BDL | BDL |
| ix. | p,p DDT | µg/L | **1** | BDL | BDL |
| x. | o,p DDT | µg/L | **1** | BDL | BDL |
| xi. | p,p DDE | µg/L | **1** | BDL | BDL |

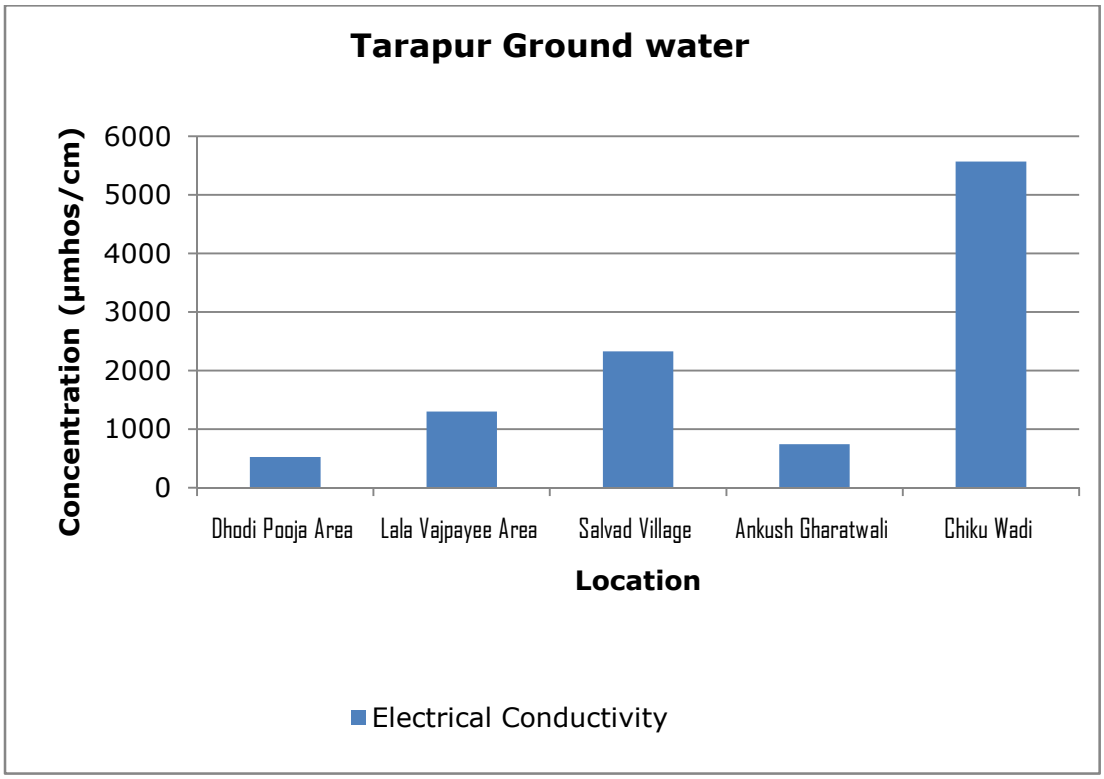
| **Location** | | | | **Ankush Gharatwali** | **Chiku Wadi** |
|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** |
| xii. | o,p DDE | µg/L | **1** | BDL | BDL |
| xiii. | p,p DDD | µg/L | **1** | BDL | BDL |
| xiv. | o,p DDD | µg/L | **1** | BDL | BDL |
| xv. | Alpha Endosulfan | µg/L | **0.4** | BDL | BDL |
| xvi. | Beta Endosulfan | µg/L | **0.4** | BDL | BDL |
| xvii. | Endosulfan Sulphate | µg/L | **0.4** | BDL | BDL |
| xviii. | Y HCH (Lindane) | µg/L | **2.0** | BDL | BDL |
| 31. | Polynuclear aromatic hydrocarbons (as PAH) | µg/L | **0.0001** | BDL | BDL |
| 32. | Polychlorinated Biphenyls (PCB) | µg/L | **0.0005** | BDL | BDL |
| 33. | Zinc (as Zn) | mg/L | **5.0** | BDL | BDL |
| 34. | Nickel (as Ni) | mg/L | **0.02** | BDL | 0.022 |
| 35. | Copper (as Cu) | mg/L | **0.05** | BDL | 7.39 |
| 36. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **1** | BDL | BDL |
| 37. | Total Chromium (as Cr) | mg/L | **0.05** | 0.022 | 0.022 |
| 38. | Total Arsenic (as As) | mg/L | **0.01** | BDL | BDL |
| 39. | Lead (as Pb) | mg/L | **0.01** | BDL | BDL |
| 40. | Cadmium (as Cd) | mg/L | **0.003** | BDL | BDL |

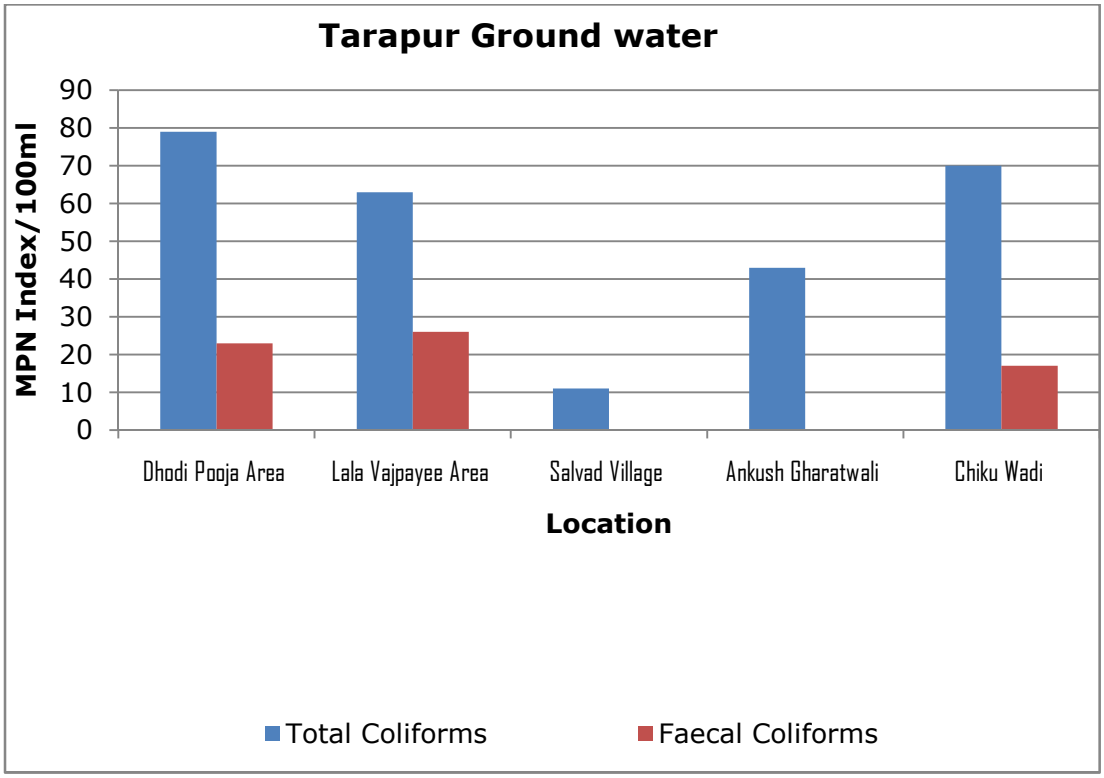
| **Location** | | | | **Ankush Gharat wali** | **Chiku Wadi** |
|---|---|---|---|---|---|
| **Type** | | | | Borewell | Borewell |
| **Date of Sampling** | | | | **04.02.19** | **04.02.19** |
| 41. | Mercury (as Hg) | mg/L | **0.001** | BDL | BDL |
| 42. | Manganese (as Mn) | mg/L | **0.1** | 3.69 | 3.75 |
| 43. | Iron (as Fe) | mg/L | **0.3** | 0.091 | 0.091 |
| 44. | Vanadium (as V) | mg/L | | BDL | BDL |
| 45. | Selenium (as Se) | mg/L | **0.01** | BDL | BDL |
| 46. | Boron (as B) | mg/L | **1.0-5.0** | BDL | BDL |
| 47. | Bioassay Test on fish | % survival | | 100 | 0 |

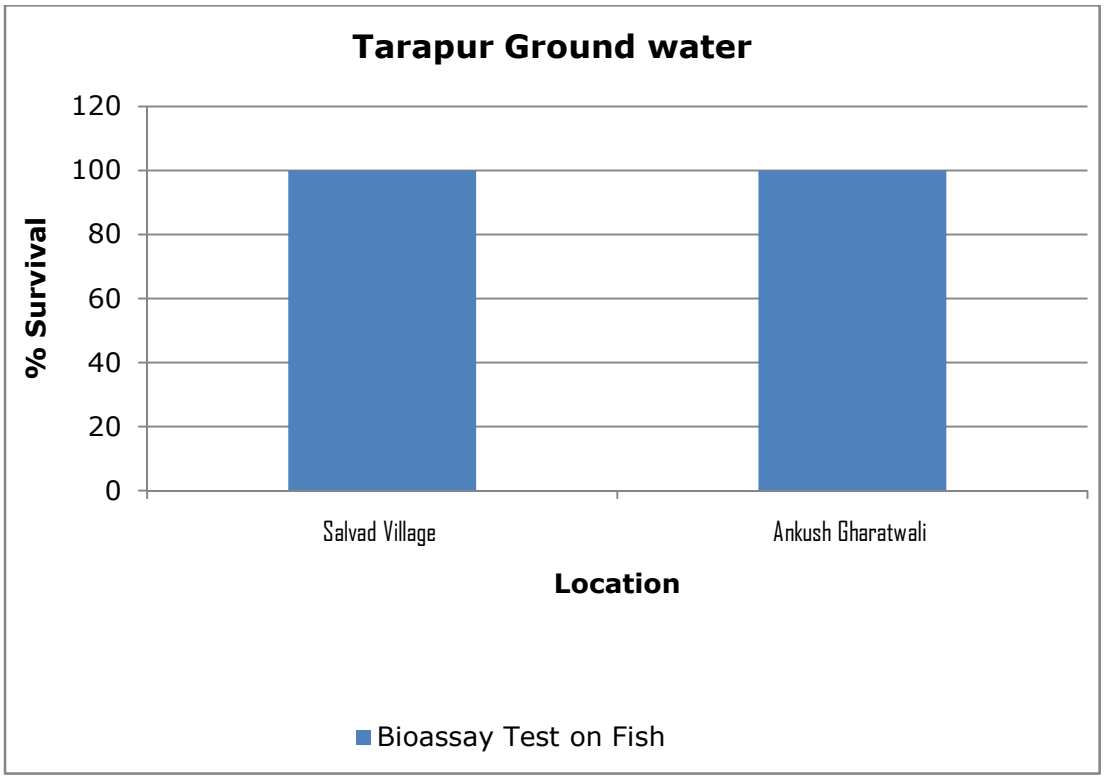
**Graphs: Ground Water Monitoring Results:**




Tarapur Ground water
9
8
7
6
5
4
3
2
1
0
Dhodi Pooja Area
Lala Vajpayee Area
Salvad Village
Ankush Gharatwali
Chiku Wadi
Location
Sodium Adsorption Ratio
pH


Tarapur Ground water
Concentration (µmhos/cm)
6000
5000
4000
3000
2000
1000
0
Dhodi Pooja Area
Lala Vajpayee Area
Salvad Village
Ankush Gharatwali
Chiku Wadi
Location
Electrical Conductivity


Tarapur Ground water
MPN Index/100ml
90
80
70
60
50
40
30
20
10
0
Dhodi Pooja Area
Lala Vajpayee Area
Salvad Village
Ankush Gharatwali
Chiku Wadi
Location
Total Coliforms
Faecal Coliforms


Tarapur Ground water
% Survival
120
100
80
60
40
20
0
Salvad Village
Ankush Gharatwali
Location
Bioassay Test on Fish

# 4 Summary of the Results

Based on the study done, the results are summarised and concluded as follows:

## 4.1 Stack Emission Monitoring:

In Tarapur, six different stacks were monitored at Mandana Industries Ltd., Siyaram Silk, IVP Ltd., Sarex Overseas, Lupin Ltd. and Dicitex Furnishing. Results show that concentration of all the parameters, particulate matter, nitrogen dioxide and sulphur dioxide, are below the standard limits. Particulate matter is observed in the range of 25 to 45 mg/Nm$^3$ and sulphur dioxide in the range of Below Detection Limit (BDL i.e.<5) to 34.3 mg/Nm$^3$. However, the nitrogen dioxide is observed is observed with the range of 13.1 mg/Nm$^3$ – 16.3mg/Nm$^3$.

## 4.2 Ambient Air Monitoring:

At Tarapur, ambient air quality was monitored at six locations namely: Mandana Industries Ltd., Siyaram Silk, IVP Ltd., Sarex Overseas, CETP and Lupin Ltd. At all these places 12 parameters of ambient air quality standards were monitored.

1. **Suphur dioxide ($SO_2$):** All the results for $SO_2$ are observed lower than the standard limit of 80 µg/m$^3$. It is observed in the range of 5.36 to 5.80 µg/m$^3$.
2. **Nitrogen Dioxide ($NO_x$):** All the results for $SO_2$ are observed lower than the standard limit of 80 µg/m$^3$. It is observed in the range of 8.21 to 10.6 µg/m$^3$.
3. **Particulate Matter ($PM_{10}$):** It is the most critical parameter as its higher concentration in the air affects ecosystem health a lot. However, 50% of all the locations are observed with above the standard limit of 100 µg/m$^3$ of PM10. Minimum of 72µg/m$^3$ is observed at Lupin Ltd. and maximum of 401 µg/m$^3$ at Mandhana Industries Ltd.
4. **Particulate Matter ($PM_{2.5}$):** Concentration of $PM_{2.5}$ also followed the similar trend as $PM_{10}$ is observed. It is observed in the range of 16 to 99 µg/m$^3$.
5. **Ozone ($O_3$):** All values of $O_3$ recorded below the detection limit i.e.19.8µg/m$^3$.
6. **Lead (Pb):** Lead is categorised as known human carcinogen by CPCB. In our results, concentration of Lead is found below the standard limit.
7. **Carbon Monoxide (CO):** Values of Carbon Monoxide are also observed below standard limit at all the studied locations. It is observed minimum of 1.71 mg/m$^3$ at Mandhana Industries Ltd. and maximum (5.04mg/m$^3$) at Siyaram Silks.
8. **Ammonia ($NH_3$):** All values of $O_3$ recorded below the detection limit.
9. **Benzene:** Benzene falls under group C category, which includes known carcinogens. All values are recorded below the standard limit of 5µg/m$^3$.
10. **Benzo (a) Pyrene (BaP):** All values recorded below the detection limit i.e. <0.2ng/m$^3$.
11. **Arsenic:** Arsenic values are also observed well below the detection limit i.e. BDL.
12. **Nickel:** All the values are observed below the standard limit of 20 ng/m$^3$.

## 4.3 Waste Water Quality:

Seven samples of ETP outlet and inlet were collected from different industries in Tarapur region. The quality of waste water was determined by determining various parameters as per standards and corresponding results are discussed below:

1. **pH:** At all the locations, pH of water samples is found well within the range prescribed by CPCB. It is ranged from 5.73 to 8.22.
2. **Oil and Grease:** All values within the acceptable range.

3. **Suspended Solids:** All the samples of different locations are found within the acceptable limits.
4. **Chemical Oxygen Demand:** Chemical Oxygen Demand is found above the standards of 250 mg/L in two water samples namely CETP inlet (4400 mg/L) and CETP Outlet (2400 mg/L).
5. **Biochemical Oxygen Demand:** Biochemical Oxygen demand also exhibits the same picture as COD. This is recorded highest (1470 mg/L) at CETP inlet and minimum at CETP Outlet (799 mg/L).
6. **Total Kjeldahl Nitrogen:** It is also observed beyond permissible limit at two locations namely CETP inlet (1140 mg/L) and CETP Outlet (627 mg/L).
7. **Total Ammonia:** Out of all values of minimum is observed as BDL at three locations and maximum is observed as 68 mg/L at CETP Inlet.
8. **Metals:** All metals like Arsenic, Nickel, Copper, Hexavalent Chromium ($Cr^{6+}$) are observed either below detection limit or below their standard limits. However water sample of CETP Inlet is observed with above permissible limits of metals also.
9. **Fish Bioassay:** Fish bioassay exhibits 0-100% survival.
10. Parameters like Total Residual Chlorine, Cyanide, Fluoride, Sulphide, Dissolved Phosphate, Total Ammonical Nitrogen and Phenolic compounds, also meet the criteria as prescribed by CPCB.

### 4.4 Ground Water Quality:

Five Borewell samples were collected from different locations namely: (i) Dhodi Pooja Area (ii) Lala Vajpayee (iii) Salvad Village (iv) Ankush Gharatwadi (v) Chiku Wadi

1. **Colour** (Hazen Units): Colour units are below the acceptable standard.
2. **Odour** of the sample is agreeable.
3. **pH:** At all the locations, pH of water samples is found well within the range prescribed by CPCB. It is ranged from 6.91 to 8.03.
4. **Chemical Oxygen Demand:** Except Ankush Ghratwadi water sample (<5mg/L), all other samples were detected above the standard limit of 10 mg/L set by WHO. It is ranged from <5 to 37 mg/L.
5. **Biological Oxygen Demand:** Except Ankush Ghratwadi and Salvad village water samples, all other samples were detected above the standard limit of 6 mg/L set by WHO. It is ranged from <1 to 12 mg/L.

Following are the parameters which are compared with 10500:2012 Drinking water specifications.

1. **Nitrite**: Values of Nitrite are at below detection level.
2. **Nitrate:** Nitrate value ranged between 4.22mg/L and 19.1mg/L. Nitrate concentrations are below the acceptable standards of IS 10500:2012.
3. **Residual Free Chlorine**: Values are below the acceptable standards.
4. **Total Ammonia**: observed within the acceptable range.
5. **Cyanide:** Concentration of cyanide in all the bore well water is very much below the standard.
6. **Fluoride:** out of five, three samples are observed above standard limit. It is observed in the range of 0.63 to 1.27 mg/L.
7. **Sulphide:** Analytical values are below the detection limits and below the standards.

8. **Sodium Absorption Ratio:** These values fit within range of water quality criteria of CPCB.
9. **Electrical Conductivity:** As per the water quality criteria of CPCB, water samples exceed the limit of electrical conductivity.
10. **Metals:** Metals like Copper, Total Chromium, Lead, Arsenic, Cadmium and Mercury are well within the acceptable limits of drinking water standards.
11. **PAH & PCB** are also below the acceptable limits.
12. **Fish Bioassay:** Fish bioassay exhibits 0-100% survival

# 5 CEPI Score:

Comprehensive Environmental Pollution Index (CEPI) is intended to act as early warning tool which helps in categorization of industrial clusters/areas in terms of priority of needing attention.

CPCB had evolved certain methodology to calculate CEPI, in which a score has been fixed for different environmental components based on the level of pollution. The scoring system involves an algorithm that takes into account the basic selection criteria. This approach is based on the basic hazard assessment logic that can be summarized as below.

**Hazard = pollutant source, pathways, and receptor**

CPCB has calculated CEPI for the identified critically polluted industrial clusters. It is calculated separately for air, water, and land. The basic framework and scoring system of the CEPI – based on three factors namely pollutant, pathway, and receptor – has been described further under this section.

To overcome the subjectivity, revised concept is proposed by eliminating the subjective factors as described in the previous section but retaining the factors which can be measured precisely.

I. Revised concept is prepared by eliminating the debatable factors but retaining the factors which can be measured precisely.

II. It is decided to develop the Comprehensive Environmental Pollution Index (CEPI) retaining the existing algorithm of Source, Pathway and Receptor.

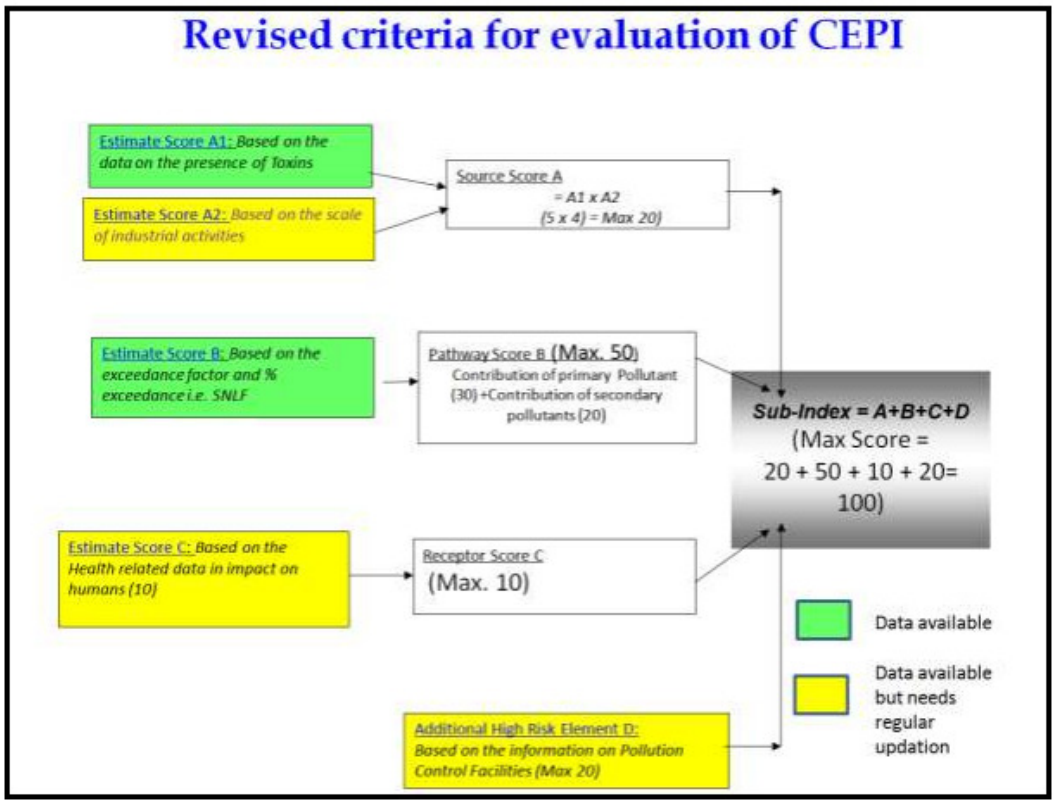
III. Health component was also retained in the revised concept in line with the suggestions of Secretary, MoEFCC during the meeting held in MoEF.

## Outlines of revised CEPI 2016 criteria

The outlines of the revised CEPI criteria are as follows:

1. It is proposed to develop the Comprehensive Environmental Pollution Index (CEPI) based on Sources of pollution, real time observed values of the pollutants in the ambient air, surface water and ground water in & around the industrial cluster and health related statistics.
2. For assessment of the environmental quality of the area i.e. CEPI score, the concept of SNLF i.e. a surrogate number which represents the level of exposure (a function of percentage sample Exceedance & Exceedance Factor) shall be used.
3. Health component to be evaluated based on the health data available from major hospitals in the area was also retained in the revised concept.

The evaluation criterion of the revised CEPI version 2016 is described in the flowchart given below:




Here, health data collected for Receptor Score C is included in Annexure I

Based on Sub-Index Score (score of individual environmental component like air, water etc.):

**Score more than 63:** A Critical Level of Pollution in the respective level of environmental component

**Score between 51-63:** Severe to critical level of pollution with reference to respective environmental component

**Cut-off Score**

**Score 50:** Severely Polluted Industrial Clusters/areas

**Score 60:** Critically Polluted Industrial Clusters/areas

Based on Aggregated CEPI Score (score includes sub-index score of all individual environmental components together):

**Aggregated CEPI score >70:** Critically polluted areas

**Aggregated CEPI score between 60-70:** Severely polluted areas

Since the inception of the programme, MPCB has also formulated Action Plans to mitigate the environmental pollution problems for each of the 8 Critically Polluted Areas (CPAs) in Maharashtra. Based on available information, parameters selected and monitored in continuation with this, CEPI has been calculated and Short-Term Action Plan (STAP) as well as Long Term Action Plan (LTAP) was prepared in 2010.

Subsequently NAAQS 2009 came in force. List of parameters to be considered increased and expanded including more critical and hazardous pollutants like benzene, BaP, Metals,

etc. existing in the environment. There was revision of standards (limiting values) as well. In this present report of 2016 prepared by MPCB, CEPI is calculated considering all these revised standards' limiting values, list of parameters and complete scope of monitoring.

## 5.1 Comparison of CEPI scores:

The result shows that CEPI score of present report is 53.60. The present study is the compilation of post monsoon season, which also regulates the score value. This time locations under study were different from past studies. Hence, comparative results cannot be illustrated and discussed. But the overall CEPI is observed as 53.60 in Tarapur city, which falls below the category of severely polluted areas, according to the revised CEPI guidelines. Hence, it can be concluded that the industries are following environmental rules and regulations laid by MoEF and MPCB to control the pollution and to keep the environment clean and green.

Detailed and Aggregated CEPI score of present report is being compared with the previous years studies in the tables given below:

**Air:**

| | **A1** | **A2** | **A** | **B1** | **B2** | **B3** | **B** | **C1** | **C2** | **C3** | **C** | **D** | **CEPI** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CEPI score Feb 2019** | 2 | 4 | 8 | | | | 16.75 | | | | 0 | 10 | **34.75** |
| **CEPI score June 2018** | 2 | 4 | 8 | | | | 8 | | | | 0 | 10 | **26** |
| **CEPI score February 2018** | 2.75 | 4 | 11 | | | | 11.5 | | | | 0 | 10 | **32.5** |
| **CEPI score June 2017** | 2.5 | 4 | 10 | - | - | - | 0 | - | - | - | 0 | 10 | **20** |
| **CEPI score February 2017** | 2 | 5 | 10 | 6 | 3 | 3 | 12 | 3 | 3 | 5 | 14 | 10 | **46** |
| **CEPI score 2016** | 4 | 5 | 20 | 6 | 3 | 3 | 12 | 3 | 3 | 5 | 14 | 10 | **56** |
| **CEPI score 2013** | 6 | 5 | 30 | 8 | 3 | 3 | 14 | 3 | 5 | 5 | 20 | 10 | **74** |
| **CPCB Report 2009** | 5.75 | 5.0 | 28.75 | 2.0 | 3 | 3 | 8 | 3 | 3 | 5 | 14 | 10 | **60.75** |

**Water:**

| | A1 | A2 | A | B1 | B2 | B3 | B | C1 | C2 | C3 | C | D | CEPI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CEPI score Feb 2019** | 2.5 | 4 | 10 | | | | 20 | | | | 0 | 15 | 45 |
| **CEPI score June 2018** | 2.5 | 4. | 10 | | | | 14.25 | | | | 0 | 15 | **39.25** |
| **CEPI score February 2018** | 2.5 | 4 | 14 | | | | 13.5 | | | | 0 | 15 | **38.5** |
| **CEPI score June 2017** | 3.5 | 4 | 14 | - | - | - | 20 | - | - | - | 0 | 15 | **49** |
| **CEPI score February 2017** | 1 | 5 | 5 | 8 | 3 | 3 | 14 | 5 | 5 | 0 | 25 | 15 | **59** |
| **CEPI score 2016** | 1 | 5 | 5 | 8 | 0 | 3 | 11 | 3 | 5 | 0 | 15 | 15 | **46** |
| **CEPI score 2013** | 4 | 5 | 20 | 8 | 0 | 3 | 11 | 3 | 3.75 | 0 | 11.25 | 15 | **57.25** |
| **CPCB Report 2009** | 3 | 5 | 15 | 8 | 0 | 3 | 11 | 3 | 5 | 0 | 15 | 15 | **56** |

**Land:**

| | A1 | A2 | A | B1 | B2 | B3 | B | C1 | C2 | C3 | C | D | CEPI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CEPI score Feb 2019** | 2.5 | 4 | 10 | | | | 20 | | | | 0 | 15 | **45** |
| **CEPI score June 2018** | 2.5 | 4 | 10 | | | | 20 | | | | 0 | 15 | **45** |
| **CEPI score February 2018** | 2.5 | 4 | 10 | | | | 20 | | | | 0 | 15 | **45** |
| **CEPI score June 2017** | 3.5 | 4 | 14 | - | - | - | 17.25 | - | - | - | 0 | 15 | **46.25** |

| | A1 | A2 | A | B1 | B2 | B3 | B | C1 | C2 | C3 | C | D | CEPI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CEPI score February 2017** | 1 | 5 | 5 | 8 | 0 | 3 | 11 | 3 | 5 | 0 | 15 | 15 | **46** |
| **CEPI score 2016** | 1 | 5 | 5 | 6 | 3 | 3 | 12 | 5 | 3 | 0 | 15 | 15 | **47** |
| **CEPI score 2013** | 4 | 5 | 20 | 8 | 3 | 3 | 14 | 5 | 5 | 0 | 25 | 15 | **74** |
| **CPCB Report 2009** | 3 | 5 | 15 | 7.75 | 3 | 3 | 13.75 | 5 | 1.5 | 0 | 7.5 | 15 | **51.25** |

**Aggregated CEPI:**

| | Air Index | Water Index | Land Index | CEPI |
|---|---|---|---|---|
| **CEPI score February 2019** | 34.75 | 45 | 45 | **53.60** |
| **CEPI score June 2018** | 26 | 39.25 | 45 | **50.61** |
| **CEPI score February 2018** | 32.5 | 38.5 | 45 | **51.88** |
| **CEPI score June 2017** | 20 | 49 | 46.25 | **53.72** |
| **CEPI score February 2017** | 46 | 59 | 46 | **67.67** |
| **CEPI Score 2016** | 56 | 46 | 47 | **65.51** |
| **CEPI score 2013** | 74 | 57.25 | 74 | **85.01** |
| **CPCB Report 2009** | 60.75 | 51.25 | 56 | **72.01** |

# 6 Conclusions

This is an attempt to check the characteristics and status of environment among the different industrial clusters of Tarapur city. Revised CEPI version 2016 includes 2 major modifications in terms of evaluation of data: (1) It includes Contribution of primary as well as secondary pollutants under Factor B (Max Value 50) and (2) Exhaustive collection of health data of people residing in the vicinity of industrial clusters under study, Factor C (Max Value 10). This has changed the entire criteria of calculating CEPI as compared to the previous CEPI version and hence affected the overall CEPI score also. It shows that the concentration of pollutants in air, ground water and surface water is lowered down as compared to past studies, as most of the results are observed below their standards with an exception of one or two parameters.

Parameters of air sampling are observed within the standard limit all the sampling locations. Among waste water samples, BOD and COD of CETP Inlet, CETP outlet samples are found beyond standard limit. All the ground water samples are found within the limits except BOD and COD of few the water samples, which are observed above standard limits at one location.

Moreover, the lower value (53.60) of Comprehensive Environmental Pollution Index (CEPI) in the present study as compared to past few years study also reveals the fact that the environmental pollution in this city is substantially decreased over the period of times. To achieve this target, improvement in conventional practice and procedures adopted by the industries coupled with initiatives taken by Maharashtra Pollution Control Board played a major role. Although, a decrease in environmental pollution is observed, but still there is lot of scope to improve the environmental quality of the city, for which continuous efforts, strategies, planning and actions are required. Overall CEPI figures are comprised in the table below:

| | A1 | A2 | A | B | C | D | CEPI |
|---|---|---|---|---|---|---|---|
| **Air Index** | 2 | 4 | 8 | 16.75 | 0 | 10 | **34.75** |
| **Water Index** | 2.5 | 4 | 10 | 20 | 0 | 15 | **45** |
| **Land Index** | 2.5 | 4 | 10 | 20 | 0 | 15 | **45** |
| | | | | | | **Aggregated CEPI** | **53.60** |

# 7 Efforts Taken For the Abatement and Control of Pollution

The regional office of Maharashtra pollution control board has taken various initiatives in reducing the CEPI Score of 67.67 of June to 53.60. Below mentioned are some of the efforts:

a) Expansion of TEPS-CETP from existing 25 MLD to 37 MLD

b) Due to various measures taken by the industries solvent recovery improved. And following industries has taken measures

- M/s. Arti Drugs Ltd, Plot No. N-198, MIDC Tarapur, Tal. Palghar. This industry has developed new technology for the recovery of ammonium sulphate 2000 Mt/month by unit operation like evaporation, crystallization. Earlier the same was treated in their ETP.
- M/s Camlin Fine Chemicals. Ltd., Plot No. D, MIDC Tarapur has segregated of high COD stream.
- M/s. Aarti Industries Ltd., Plot No E-50, has installed zero discharge plant such as incineration high COD.
- M/s Lupin Limited Plt No. T-142 MIDC, Tarapur has provided Anaerobic Digestor for segregated effluents.

c) Board has informed CHWTSDF to increase the frequency of collecting of HW and its transportation.

d) MIDC is carrying out massive tree plantation program on empty/ reserved plots, and on boundary of MIDC. 4500 nos of trees have been distributed by MIDC to TIMA.

e) Replacement of RCC drainage by HDPE within MIDC area.

f) Five nos of industries has started and recycling 50 % of their treated effluent i.e 1604.5 CMD

g) 7 No. of Textile industries has provided zero discharge system and recycling about 2434 CMD

# 8 Photographs

**Mandhana Industries**

**Lupin Ltd.**

**Sarex Overseas**

**Siyaram Silk Mills**

**IVP Ltd.**

**CETP**

**CETP Inlet**

**CETP Outlet**

**Resonance Specialities**

**Siyaram Silk Mills**

**Chikuwadi borewell**

**Dhodi Pooja borewell**

**Salvad Village borewell**

**Lalla vajpayee Well water**

# 9 References

1. Criteria for Comprehensive Environmental Assessment of Industrial Clusters, December 2009, CPCB, EIAS/4/2009-10
2. Comprehensive Environmental Assessment of Industrial Clusters, December 2009,CPCB, EIAS/5/2009-10
3. Action Plan for Industrial Cluster: Chandrapur, November 2010, MPCB
4. Action Plan for Industrial Cluster: Dombivli, November 2010, MPCB
5. Action Plan for Industrial Cluster: Aurangabad, November 2010, MPCB
6. Action Plan for Industrial Cluster: Navi Mumbai, November 2010, MPCB
7. Action Plan for Industrial Cluster: Navi Mumbai, November 2010, MPCB
8. Standard Methods for the Examination of Water and Waste Water, American Public Health Association, 22nd Edition, 2012.
9. IS 3025 (various parts)
10. www.mpcb.gov.in
11. www.cpcb.gov.in

# 10 Annexures

**Annexure I Health related data in impact on humans**

**C: Receptor**

| Component C<br>(Impact on Human Health)<br>10 | |
|---|---|
| **Main - 10** | |
| **% increase in cases** | **Marks** |
| **<5%** | **0** |
| **5-10%** | **5** |
| **>10%** | **10** |

- % increase is evaluated based on the total no. of cases recorded during two consecutive years.
- For Air Environment, total no. of cases related to Asthma, Bronchitis, Cancer, Acute respiratory infections etc. are to be considered.
- For surface water/ ground water Environment, cases related to Gastroenteritis, Diarrhoea, renal (kidney) malfunction, cancer etc are to be considered.
- For the above evaluation, the previous 5 years records of 3-5 major hospitals of the area shall be considered.

**Attached below health data collected for the region**

**ANNEXURE B**

## INFORMATION ON HEALTH STATISTICS IN PIA

1. **Name of the Polluted Industrial Area (PIA):** Tarapur
2. **Name of the major health centre/ organization:** Thunga Hospital
3. **Name and designation of the contact person:**
4. **Address:** AM-32,Tarapur M.I.D.C., Boisar, Maharashtra 401506
5. **Year of Establishment:**

| Sl No. | Diseases | No. of patients reported for the years | | | | |
|---|---|---|---|---|---|---|
| | | 2018-2017 | 2017-2016 | 2016-2015 | 2015-2014 | 2014-2013 |
| | **Air Borne Diseases** | | | | | |
| **1.** | **Asthma** | 21 | 53 | | | |
| **2.** | **Acute Respiratory Infection** | 58 | 184 | | | |
| **3.** | **Bronchitis** | 26 | 43 | | | |
| **4.** | **Cancer** | 2 | 6 | | | |
| | **Water Borne Diseases** | | | | | |
| **5.** | **Gastroenteritis** | 50 | 101 | | | |
| **6.** | **Diarrhea** | 154 | 133 | | | |
| **7.** | **Renal diseases** | 0 | 0 | | | |
| **8.** | **Cancer** | 0 | 0 | | | |


**Signature of the Hospital Head/ Superintend**

**ANNEXURE B**

## INFORMATION ON HEALTH STATISTICS IN PIA

6. **Name of the Polluted Industrial Area (PIA):**
7. **Name of the major health centre/ organization:** TAPS Hospital
8. **Name and designation of the contact person:**
9. **Address:** Tarapur Rd, Boisar, Maharashtra 401504
10. **Year of Establishment:**

| Sl No. | Diseases | No. of patients reported for the years | | | | |
|---|---|---|---|---|---|---|
| | | 2018-2017 | 2017-2016 | 2016-2015 | 2015-2014 | 2014-2013 |
| | **Air Borne Diseases** | | | | | |
| **1.** | **Asthma** | 27 | 59 | | | |
| **2.** | **Acute Respiratory Infection** | 95 | 75 | | | |
| **3.** | **Bronchitis** | 5 | | | | |
| **4.** | **Cancer** | | | | | |
| | **Water Borne Diseases** | | | | | |
| **5.** | **Gastroenteritis** | 39 | 73 | | | |
| **6.** | **Diarrhea** | 41 | 37 | | | |
| **7.** | **Renal diseases** | | | | | |
| **8.** | **Cancer** | | | | | |

**Signature of the Hospital Head/ Superintend**

**Annexure II: Stack Emission Sampling and Analysis Methodology**

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| 1. | Acid Mist (as Sulphuric Acid) | US EPA Method no.m-8 | Barium thorine titration Method | 0.6 mg/Nm$^3$ |
| 2. | Ammonia | IS 11255 (Part 6):1999, Reaffirmed 2003 | Titration/ Nessler Reagent/ Spectrophotometric Method | 1 mg/Nm$^3$ |
| 3. | Carbon Monoxide | USEPA Method 10B | GC-FID Method | 0.2 mg/Nm$^3$ |
| 4. | Chlorine | US EPA Method 26 for sampling | Titrimetric | 0.001 mg/Nm$^3$ |
| 5. | Fluoride (Gaseous) | US EPA Method 13 A | SPADNS Zirconium Lake Spectrophotometric Method | 0.025 mg/Nm$^3$ |
| 6. | Fluoride (Particulate) | US EPA Method 13 A | SPADNS Zirconium Lake Spectrophotometric Method | 0.005 mg/Nm$^3$ |
| 7. | Hydrogen Chloride | US EPA Method 26 for sampling | Titrimetric | 0.25 mg/Nm$^3$ |
| 8. | Hydrogen Sulphide | IS 11255 (Part 4):1985 | Titrimetric | 1 mg/Nm$^3$ |
| 9. | Oxides of Nitrogen | IS 11255 (Part 7): 2005 | PDSA Colorimetric Method | 10 mg/Nm$^3$ |
| 10. | Oxygen | IS 13270 : 1992 | ORSAT Apparatus | 1 % |
| 11. | Poly Aromatic Hydrocarbons (Particulate) | IS 5182 (Part 12) : 2004, Reaffirmed 2009<br>CPCB Guidelines, May 2011, Page No.39 | GC-FID Method | 0.25 mg/Nm$^3$ |
| 12. | Suspended Particulate Matter | IS 11255 (Part 1):1985, Reaffirmed 2003 | Gravimetric Method | 10 mg/Nm$^3$ |
| 13. | Sulphur Dioxide | IS 11255 (Part 2): 1985, Reaffirmed 2003 | Titrimetric IPA thorine Method | 5.0 mg/Nm$^3$<br>0.02 kg/day |

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| 14. | BTX (Benzene, Toluene, Xylene) | NIOSH (NMAM) 1501 | Adsorption and Desorption followed by GC-FID analysis | 0.001 mg/$Nm^3$ |
| 15. | VOC (Volatile Organic Compounds) | NIOSH (NMAM) 1501 for sampling | Adsorption and Desorption followed by GC-FID or GC/ MS analysis | - |
| i | Methyl Isobutyl Ketone | - | - | 0.001 mg/$Nm^3$ |
| ii | Benzene | - | - | 0.001 mg/$Nm^3$ |
| iii | Toluene | - | - | 0.001 mg/$Nm^3$ |
| iv | Xylene | - | - | 0.001 mg/$Nm^3$ |
| v | Ethyl Benzene | - | - | 0.001 mg/$Nm^3$ |
| vi | Ethyl Acetate | - | - | 0.001 mg/$Nm^3$ |

**Annexure III: Ambient Air Sampling and Analysis Methodology**

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| 1. | Sulphur Dioxide ($SO_2$) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.1 | Improved West & Gaeke Method | 4 µg/$m^3$ |
| 2. | Nitrogen Dioxide ($NO_2$) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.7 | Modified Jacob & Hochheiser Method | 3 µg/$m^3$ |
| 3. | Particulate Matter (size less than 10 µm) or $PM_{10}$ | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.11 | Gravimetric Method | 2 µg/$m^3$ |
| 4. | Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 15 | Gravimetric Method | 0.4 µg/$m^3$ |
| 5. | Ozone ($O_3$) | APHA, Method No. 820, Page no. 836 | Chemical Method | 19.6 µg/$m^3$ |
| 6. | Lead (Pb) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47 | AAS Method | 0.02 µg/$m^3$ |
| 7. | Carbon Monoxide (CO) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume II, May 2011, Page No. 16 | Non Dispersive Infra Red (NDIR) spectroscopy | 0.05 mg/$m^3$ |
| 8. | Ammonia ($NH_3$) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 35 | Indophenol Blue Method | 4.0 µg/$m^3$ |
| 9. | Benzene ($C_6H_6$) | IS 5182 (Part 11):2006 | Adsorption and Desorption followed by GC-FID analysis | 1.0 µg/$m^3$ |
| 10. | Benzo (a) Pyrene (BaP) – particulate phase only, | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 39 | Solvent extraction followed by GC-FID analysis | 0.2 ng/$m^3$ |

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| 11. | Arsenic (As) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47 | AAS Method | 0.3 ng/$m^3$ |
| 12. | Nickel (Ni) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47 | AAS Method | 3.0 ng/$m^3$ |

**Annexure IV: Water/Wastewater Sampling and Analysis Methodology**

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| 1. | Sampling Procedure for Chemical Parameters | IS 3025 (Part 1): 1987, Reaffirmed 1998, Amds.1& APHA, 22nd Ed., 2012, 1060 B, 1-39 | - | - |
| 2. | Sampling Procedure for Microbiological Parameters | APHA, 22nd Ed., 2012, 1060 B, 1-39, 9040, 9-17, and 9060B, 9-35 | - | - |
| 3. | Temperature | APHA, 22nd Ed., 2012, 2550-B, 2-69 | By Thermometer | - |
| 4. | Colour | APHA, 22nd Ed., 2012, 2120-B, 2-26 | Visible Comparison Method | 1 Hazen Unit |
| 5. | Odour | IS 3025 (Part 5): 1983, Reaffirmed 2006 | Qualitative Method | - |
| 6. | pH | APHA, 22nd Ed., 2012, 4500-$H^+$- B, 4-92 | By pH Meter | 1 |
| 7. | Oil & Grease | APHA, 22nd Ed., 2012, 5520-B, 5-40 | Liquid -liquid Partition-Gravimetric Method | 1.0 mg/L |
| 8. | Suspended Solids | IS 3025 (Part 17): 1984, Reaffirmed 2006, Amds.1 | Filtration /Gravimetric Method | 5.0 mg/L |
| 9. | Dissolved Oxygen | IS 3025 (Part 38): 1989, Reaffirmed 2009 | Iodometric Method-Azide modification | 0.05 mg/L |
| 10. | Chemical Oxygen Demand | APHA, 22nd Ed., 2012, 5220-B, 5-17 | Open Reflux Method | 5.0 mg/L |
| 11. | Biochemical Oxygen Demand | IS 3025 ( Part 44): 1993, Reaffirmed 2009, Amds.1 | Iodometric Method | 5.0 mg/L |
| 12. | Electrical Conductivity | APHA, 22nd Ed., 2012, 2510- B, 2-54 | By Conductivity Meter | 0.1 µmho/cm |
| 13. | Nitrite-Nitrogen | APHA, 22nd Ed., 2012, 4500-$NO_2$-B, 4-120 | Colorimetric Method | 0.006 mg/L |

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| 14. | Nitrate-Nitrogen | APHA,22nd Ed., 2012, 4500-$NO_3$, B-4-122 | UV Spectrophotometer Screening Method | 0.2 mg/L |
| 15. | ($NO_2$ + $NO_3$)-Nitrogen | APHA, 22nd Ed., 2012, 4500-$NO_2$-B, 4-120<br>APHA, 22nd Ed., 2012, 4500-$NO_3$, B-4-122 | Colorimetric Method<br>V Spectrophotometer Screening Method | 0.2 mg/L |
| 16. | Free Ammonia | APHA, 22nd Ed., 2012, 4500 $NH_3$, F, 4 -115 | Colorimetric Method | 0.006 mg/L |
| 17. | Total Residual Chlorine | IS 3025 (Part 26): 1986, Reaffirmed 2009, Ed. 2.1 (2004-02) | Iodometric Method | 0.1 mg/L |
| 18. | Cyanide (CN) | APHA, 22nd Ed., 2012,4500-CN, C & E, 4-41 & 4-43 | Colorimetric Method | 0.001 mg/L |
| 19. | Fluoride (F) | APHA, 22nd Ed., 2012, 4500-F, D, 4-87 | SPADNS Method | 0.05 mg/L |
| 20. | Sulphide ($S^{2-}$) | APHA, 22nd Ed., 2012, 4500 –$S^2$, C-4-175, F-4-178 | Iodometric Method | 0.08 mg/L |
| 21. | Dissolved Phosphate (P) | APHA,22nd Ed., 2012, 4500 P,E, 4-155 | Ascorbic Acid Method | 0.03 mg/L |
| 22. | Sodium Absorption Ratio | IS11624: 1986, Reaffirmed 2006 | By Calculation | 0.3 |
| 23. | Total Phosphorous (P) | APHA,22nd Ed., 2012, 4500 P,E, 4-155 | Ascorbic Acid Method | 0.03 mg/L |
| 24. | Total Kjeldahl Nitrogen | APHA, 22nd Ed., 2012, 4500 $NH_3$, B & C, 4 -110, 4-112 | Titrimetric Method | 0.1 mg/L |
| 25. | Total Ammonia ($NH_4$ +$NH_3$)-Nitrogen | APHA, 22nd Ed., 2012, 4500 $NH_3$, F, 4 - 115 | Colorimetric Method | 0.001 mg/L |
| 26. | Phenols ($C_6H_5OH$) | APHA,22nd Ed., 2012, 5530- B & C, 5-44 & 5-47 | Chloroform Extraction Method | 0.001 mg/L |

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| 27. | Surface Active Agents | APHA, 22nd Ed., 2012, 5540-B & C, 5-50 | Methylene Blue Extraction Method | 0.1 mg/L |
| 28. | Organo Chlorine Pesticides | APHA, 22nd Ed., 2012, 6410B, 6-74 | GC MS-MS Method | 0.01 µg/L |
| 29. | Polynuclear aromatic hydrocarbons (PAH) | APHA, 22nd Ed., 2012, 6410B, 6-74 | GC MS-MS Method | 0.01 µg/L |
| 30. | Polychlorinated Biphenyls (PCB) | APHA, 22nd Ed., 2012, 6410B, 6-74 | GC MS-MS Method | 0.01 µg/L |
| 31. | Zinc (Zn) | IS 3025 (Part 2): 2004 | ICP Method | 0.1 mg/L |
| 32. | Nickel (Ni) | IS 3025 (Part 2): 2004 | ICP Method | 0.05 mg/L |
| 33. | Copper (Cu) | IS 3025 (Part 2): 2004 | ICP Method | 0.03 mg/L |
| 34. | Hexavalent Chromium ($Cr^{6+}$) | APHA, 22ndEd., 2012, 3500-Cr, B, 3-69 | Colorimetric Method | 0.02 mg/L |
| 35. | Total Chromium (Cr) | IS 3025 (Part 2): 2004 | ICP Method | 0.02 mg/L |
| 36. | Total Arsenic (As) | IS 3025 (Part 2): 2004 | ICP Method | 0.005 mg/L |
| 37. | Lead (Pb) | IS 3025 (Part 2): 2004 | ICP Method | 0.008 mg/L |
| 38. | Cadmium (Cd) | IS 3025 (Part 2): 2004 | ICP Method | 0.002 mg/L |
| 39. | Mercury (Hg) | IS 3025 (Part 2): 2004 | ICP Method | 0.0008 mg/L |
| 40. | Manganese (Mn) | IS 3025 (Part 2): 2004 | ICP Method | 0.02 mg/L |
| 41. | Iron (Fe) | IS 3025 (Part 2): 2004 | ICP Method | 0.06 mg/L |
| 42. | Vanadium (V) | IS 3025 (Part 2): 2004 | ICP Method | 0.05 mg/L |

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| 43. | Selenium (Se) | IS 3025 (Part 2): 2004 | ICP Method | 0.005 mg/L |
| 44. | Boron (B) | IS 3025 (Part 2): 2004 | ICP Method | 0.1 mg/L |
| 45. | Total Coliforms | APHA, 22nd Ed., 2012, 9221-B, 9-66 | Multiple tube fermentation technique (MPN/100ml) | 1.1 MPN/100ml |
| 46. | Faecal Coliforms | APHA, 22nd Ed., 2012, 9221-E, 9-74 | Multiple tube fermentation technique (MPN/100ml) | 1.1 MPN/100ml |
| 47. | Bioassay (Zebra Fish) Test | IS 6582, 1971, Reaffirmed 1987 | Static Technique | - |

## Annexure V: National Ambient Air Quality Standards, 2009

The Gazette of India

EXTRAORDINARY PART III-Section 4 PUBLISHED BY AUTHORITY
NEW DELHI, WEDNESDAY, NOBEMBER 18, 2009 No. B-29016/20/90/PCI-I

### National Ambient Air Quality Standards: Central Pollution Control Board

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevntion and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in suppression of the Notification No(s). S.O.384(E), dated 11th April, 1994 and S.O.935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards **with immediate effect**, namely:

| Sr. No. | Pollutant | Time Weighted Average | Concentration in Ambient Air | | |
|---|---|---|---|---|---|
| | | | Industrial, Residential, Rural and Other Areas | Ecologically Sensitive Areas (Notified by Central Government) | Methods of Measurement |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1 | Sulphur Dioxide ($SO_2$) µg/m³ | Annual * | 50 | 20 | – Improved West and Gaeke<br>– Ultraviolet fluorescence |
| | | 24 hours ** | 80 | 80 | |
| 2 | Nitrogen Dioxide ($NO_2$) µg/m³ | Annual * | 40 | 30 | – Modified Jacob & Hochheiser (Na-Arsenite)<br>– Chemilminescence |
| | | 24 hours ** | 80 | 80 | |
| 3 | Particulate Matter (size less than 10 µm) or $PM_{10}$ µg/m³ | Annual * | 60 | 60 | – Gravimetric<br>– TOEM<br>– Beta attenuation |
| | | 24 hours ** | 100 | 100 | |
| 4 | Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ µg/m³ | Annual * | 40 | 40 | – Gravimetric<br>– TOEM<br>– Beta attenuation |
| | | 24 hours ** | 60 | 60 | |
| 5 | Ozone ($O_3$) µg/m³ | 8 hours ** | 100 | 100 | – UV photometric<br>– Chemiluminescence<br>– Chemical Method |
| | | 1 hour ** | 180 | 180 | |
| 6 | Lead (Pb) µg/m³ | Annual * | 0.50 | 0.50 | – AAS/ICP method after sampling on EPM 2000 or equivalent filter paper<br>– EDXRF using Teflon filter |
| | | 24 hours ** | 1.0 | 1.0 | |
| 7 | Carbon Monoxide (CO) mg/m³ | 8 hours ** | 02 | 02 | – Non Dispersive Infra Red (NDIR) spectroscopy |
| | | 1 hour ** | 04 | 04 | |
| 8 | Ammonia ($NH_3$) µg/m³ | Annual * | 100 | 100 | – Chemiluminescence<br>– Indophenol blue method |
| | | 24 hours ** | 400 | 400 | |
| 9 | Benzene ($C_6H_6$) µg/m³ | Annual * | 05 | 05 | – Gas Chromatography based continuous analyzer<br>– Adsorption and Desorption followed by GC analysis |
| 10 | Benzo (a) Pyrene (BaP) – particulate phase only, ng/m³ | Annual * | 01 | 01 | – Solvent extraction followed by HPLC/GC analysis |
| 11 | Arsenic (As) ng/m³ | Annual * | 06 | 06 | – AAS/ICP method after sampling on EPM 2000 or equivalent filter paper. |
| 12 | Nickel (Ni) ng/m³ | Annual * | 20 | 20 | – AAS/ICP method after sampling on EPM 2000 or equivalent filter paper. |

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2 % of the time, they may exceed the limits but not on two consecutive days of monitoring.

**Note:** Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

**SANT PRASAD GAUTAM, Chairman, Central Pollution Control Board [ADVT-III/4/184/09/Exty.]**

**Note:** The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India. Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October,1998.

**µg/m³**: micro-gram/m³ i.e. $10^{-6}$gm/m³ ng/m³ : nano-gram/m³ i.e. $10^{-9}$gm/m³

**Annexure VI: General Standards for Discharge of Environmental Pollutants, Part A: Effluents (The Environment (Protection) Rules, 1986, Schedule VI)**

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 1. | Colour and Odour | See Note 1 | -- | See Note I | See Note 1 |
| 2. | Suspended solids, mg/L, Max. | 100 | 600 | 200 | a) For process waste water - 100<br>b) For cooling water effluent- 10 percent above total suspended mailer of influent cooling water. |
| 3. | Particle size of suspended solids | Shall pass 850 micron IS Sieve | | | a. Floatable solids, Max 3 mm<br>b. Settleable solids Max 850 microns |
| 4. | Dissolved solids (Inorganic), mg/L, Max. | 2100 | 2100 | 2100 | -- |
| 5. | pH value | 5.5 -9.0 | 5.5 -9.0 | 5.5 -9.0 | 5.5-9.0 |
| 6. | Temperature °C, Max | Shall not exceed 40 in any section of the stream within 15 mts. Downstream from the effluent outlet | 45 at the point of discharge | -- | 45 at the point of discharge |

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 7. | Oil and Grease mg/L, Max | 10 | 20 | 10 | 20 |
| 8., | Total Residual chlorine, mg/L, Max | 1.0 | -- | -- | 1.0 |
| 9. | Ammonical Nitrogen (as N), mg/L, Max | 50 | 50 | -- | 50 |
| 10. | Total Kjeldahl Nitrogen (as N), mg/L, Max. | 100 | -- | -- | 100 |
| 11. | Free Ammonia (as $NH_3$), mg/L, Max | 5.0 | -- | -- | 5.0 |
| 12. | Biochemical oxygen demand (5 days, at 20° 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 | - | 1.0 |
| 17. | Cadmium (as Cd), mg/L, | 2.0 | 1.0 | -- | 2.0 |
| 18. | Hexavalent Chromium (as $Cr^{+6}$) mg/L, Max | 1 | 2.0 | -- | 1.0 |
| 19. | Total Chromium (as Cr), mg/L, Max | 2.0 | 2.0 | -- | 2.0 |

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 20. | Copper (as Cu), mg/L, Max. | 3.0 | 3.0 | -- | 3.0 |
| 21. | Zinc (as Zn), mg/L, Max. | 5.0 | 15 | 0-- | 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 |
| 24 | Boron (as B), mg/L, Max. | 2.0 | 2.0 | 2.0 | -- |
| 25. | Percent Sodium, Max. | -- | 60 | 60 | -- |
| 26. | Residual Sodium carbonate, mg/L, Max. | -- | -- | 5.0 | -- |
| 27. | Cyanide (as Cn), mg/L, Max. | 0.2 | 2.0 | 0.2 | 0.2 |
| 28. | Chloride (as Cl), mg/L, Max. | 1000 | 1000 | 600 | -- |
| 29. | Fluoride (as F), mg/L, Max. | 2.0 | 15 | -- | 15 |
| 30. | Dissolved Phosphate (as P), mg/L, Max. | 5.0 | -- | -- | -- |
| 31. | Sulphate (as $SO_4$), mg/L, Max. | 1000 | 1000 | 1000 | -- |
| 32. | Sulphide (as S), mg/L, Max. | 2.0 | -- | -- | 5.0 |
| 33. | Pesticides | Absent | Absent | Absent | Absent |
| 34. | Phenolic compounds (as $C_6H_5OH$), mg/L, Max. | 1.0 | 5.0 | -- | 5.0 |

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 35. | Radioactive materials: | | | | |
| | a. Alpha emitters MC/ml., Max. | $10^{-7}$ | $10^{-7}$ | $10^{-8}$ | $10^{-7}$ |
| | b. Beta emitters µc/ml., Max | $10^{-6}$ | $10^{-6}$ | $10^{-7}$ | $10^{-6}$ |

**Annexure VII: Drinking Water Specification-IS 10500:2012**

| Sr. | Characteristic | Unit | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|---|---|---|---|---|
| **Table 1** | **Organoleptic and Physical Parameters** | | | |
| 1. | Colour | Hazen units | Max 5 | Max 15 |
| 2. | Odour | - | Agreeable | Agreeable |
| 3. | pH value | - | 6.5-8.5 | No relaxation |
| 4. | Taste | - | Agreeable | Agreeable |
| 5. | Turbidity | NTU | Max 1 | Max 5 |
| 6. | Total dissolved solids | mg/L | Max 500 | Max 2000 |
| **Table 2** | **General parameters concerning substances undesirable in excessive amounts** | | | |
| 7. | Aluminium (as Al) | mg/L | Max 0.03 | Max 0.2 |
| 8. | Ammonia (as total ammonia- N) | mg/L | Max 0.5 | No relaxation |
| 9. | Anionic detergents (as MBAS) | mg/L | Max 0.2 | Max 1.0 |
| 10. | Barium (as Ba) | mg/L | Max 0.7 | No relaxation |
| 11. | Boron (as B) | mg/L | Max 0.5 | Max 1.0 |
| 12. | Calcium (as Ca) | mg/L | Max 75 | Max 200 |
| 13. | Chloramines (as $C1_2$) | mg/L | Max 4.0 | No relaxation |
| 14. | Chlorides (as Cl) | mg/L | Max 250 | Max 1000 |
| 15. | Copper (as Cu) | mg/L | Max 0.05 | Max 1.5 |
| 16. | Fluoride (as F) | mg/L | Max 1.0 | Max 1.5 |
| 17. | Free residual chlorine | mg/L | Min 0.2 | Min 1 |
| 18. | Iron (as Fe) | mg/L | Max 0.3 | No relaxation |
| 19. | Magnesium (as Mg) | mg/L | Max 30 | Max100 |

| Sr. | Characteristic | Unit | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|---|---|---|---|---|
| 20. | Manganese (as Mn) | mg/L | Max 0.1 | Max 0.3 |
| 21. | Mineral Oil | mg/L | Max 0.5 | No relaxation |
| 22. | Nitrate (as $NO_3$) | mg/L | Max 45 | No relaxation |
| 23. | Phenolic compounds (as $C_6H_5OH$) | mg/L | Max 0.001 | Max 0.002 |
| 24. | Selenium (as Se) | mg/L | Max 0.01 | No relaxation |
| 25. | Silver (as Ag) | mg/L | Max 0.1 | No relaxation |
| 26. | Sulphate (as $SO_4$) | mg/L | Max 200 | Max 400 |
| 27. | Sulphide (as $H_2S$) | mg/L | Max 0.05 | No relaxation |
| 28. | Total Alkalinity as calcium carbonate | mg/L | Max 200 | Max600 |
| 29. | Total hardness (as $CaCO_3$) | mg/L | Max 200 | Max 600 |
| 30. | Zinc (as Zn) | mg/L | Max 5 | Max15 |
| **Table 3** | **Parameters Concerning Toxic Substances** | | | |
| 31. | Cadmium (as Cd) | mg/L | Max 0.003 | No relaxation |
| 32. | Cyanide (as CN) | mg/L | Max 0.05 | No relaxation |
| 33. | Lead (as Pb) | mg/L | Max 0.01 | No relaxation |
| 34. | Mercury (as Hg) | mg/L | Max 0.001 | No relaxation |
| 35. | Molybdenum (as Mo) | mg/L | Max 0.07 | No relaxation |
| 36. | Nickel (as Ni) | mg/L | Max 0.02 | No relaxation |
| 37. | Pesticides | mg/L | See Table 5 | No relaxation |
| 38. | Polychlorinatedbiphenyls | mg/L | Max 0.0005 | No relaxation |
| 39. | Poly nuclear aromatic Hydrocarbons (as PAH) | mg/L | Max 0.0001 | No relaxation |
| 40. | Total Arsenic(as As) | mg/L | Max 0.01 | Max0.05 |
| 41. | Total Chromium (as Cr) | mg/L | Max 0.05 | No relaxation |

| Sr. | Characteristic | Unit | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|---|---|---|---|---|
| 42. | Trihalomethanes | | | |
| a) | Bromoform | mg/L | Max 0.1 | No relaxation |
| b) | DibromochloroMethane | mg/L | Max 0.1 | No relaxation |
| c) | Bromodichloromethane | mg/L | Max 0.06 | No relaxation |
| d) | Chloroform | mg/L | Max 0.2 | No relaxation |
| **Table 4** | **Parameters Concerning Radioactive Substances** | | | |
| 43. | Radioactive Materials | | | |
| a) | Alpha emitters | Bq/L | Max 0.1 | No relaxation |
| b) | Beta emitters | Bq/L | Max 1.0 | No relaxation |
| **Table 5** | **Pesticide Residues Limits and Test Method** | | | |
| i) | Alachor | µg/L | 20 | No relaxation |
| ii) | Atrazine | µg/L | 2 | No relaxation |
| iii) | Aldrin/ Dieldrin | µg/L | 0.03 | No relaxation |
| iv) | Alpha HCH | µg/L | 0.01 | No relaxation |
| v) | Beta HCH | µg/L | 0.04 | No relaxation |
| vi) | Butachlor | µg/L | 125 | No relaxation |
| vii) | Chlorpyriphos | µg/L | 30 | No relaxation |
| viii) | Delta HCH | µg/L | 0.04 | No relaxation |
| ix) | 2,4- Dichlorophenoxyacetic acid | µg/L | 30 | No relaxation |
| x) | DDT (o,p&p,p — Isomers of DDT, DDE and DDD) | µg/L | 1 | No relaxation |
| xi) | Endosulfan (α,β & sulphate) | µg/L | 0.4 | No relaxation |
| xii) | Ethion | µg/L | 3 | No relaxation |
| xiii) | Gamma - HCH (Lindane) | µg/L | 2 | No relaxation |

| **Sr.** | **Characteristic** | **Unit** | **Requirement (Acceptable Limit)** | **Permissible Limit in the Absence of Alternate Source** |
|---|---|---|---|---|
| xiv) | Isoproturon | µg/L | 9 | No relaxation |
| xv) | Malathion | µg/L | 190 | No relaxation |
| xvi) | Methyl parathion | µg/L | 0.3 | No relaxation |
| xvii) | Monocrotophos | µg/L | 1 | No relaxation |
| xviii) | Phorate | µg/L | 2 | No relaxation |
| **Table 6** | **Bacteriological Quality of Drinking Water** | | | |
| 44. | E.coli or thermotolerant coliform bacteria | /100 | Not detectable | - |
| 45. | Total coliform bacteria | /100 mL | Not detectable | - |
| | **Virological Requirements** | | | |
| 46. | MS2 phage | /1 L | Absent | - |
| | **Biological Requirements** | | | |
| 47. | Cryptosporidium | /10 L | Absent | - |
| 48. | Giardia | /10 L | Absent | - |
| 49. | Microscopic organisms such as algae, zooplanktons, flagellates, parasites and toxin producing organisms | | Free from microscopic organisms | - |

**Annexure VIII: CPCB Water Quality Criteria:**

| **Designated best use** | **Quality Class** | **Primary Water Quality Criteria** |
|---|---|---|
| Drinking water source without conventional treatment but with chlorination | A | ➢ Total coliform organisms (MPN*/100 ml) shall be 50 or less<br>➢ pH between 6.5 and 8.5<br>➢ Dissolved Oxygen 6 mg/L or more, and<br>➢ Biochemical Oxygen Demand 2 mg/L or less |
| Outdoor bathing (organized) | B | ➢ Total coliform organisms (MPN/100 ml) shall be 500 or less<br>➢ pH between 6.5 and 8.5<br>➢ Dissolved Oxygen 5 mg/L or more, and<br>➢ Biochemical Oxygen Demand 3 mg/L or less |
| Drinking water source with conventional treatment | C | ➢ Total coliform organisms (MPN/100ml) shall be 5000 or less<br>➢ pH between 6 and 9<br>➢ Dissolved Oxygen 4 mg/L or more, and<br>➢ Biochemical Oxygen Demand 3 mg/L or less |
| Propagation of wildlife and fisheries | D | ➢ pH between 6.5 and 8.5<br>➢ Dissolved Oxygen 4 mg/L or more, and<br>➢ Free ammonia (as N) 1.2 mg/L or less |
| Irrigation, industrial cooling, and controlled disposal | E | ➢ pH between 6.0 and 8.5<br>➢ Electrical conductivity less than 2250 micro mhos/cm,<br>➢ Sodium Absorption Ratio less than 26,<br>➢ and Boron less than 2 mg/l. |
| | Below E | ➢ Not Meeting A, B, C, D & E Criteria |

**Annexure IX: Water Quality Parameters Requirements and Classification**

Water quality parameters are classified into three categories, given in Table (i), (ii) and (iii) (Source: CPCB, 2002, "Water Quality Criteria and Goals", Monitoring of Indian National aquatic Resources Series: MINARS/17/2001-2002).

Table: Basic Water Quality Requirement and Classification (Surface Water + Ground Water)

**i) Simple Parameters:**

| Sr. | Parameters | Requirement for Waters of Class | | |
|---|---|---|---|---|
| | | **A-Excellent** | **B-Desirable** | **C-Acceptable** |
| (i) | Sanitary Survey | Very Clean neighborhood and catchment | Reasonably clean neighborhood | Generally clean neighborhood |
| (ii) | General Appearance | No floating matter | No floating matter | No floating matter |
| (iii) | Colour | Absolutely Colourless | Almost colourless, very light shade if any | No colour of anthropogenic origin |
| (iv) | Smell | Odourless | Almost odourless | No unpleasant odour |
| (v) | Transparency | >1.0 depth | >0.5 to 0.1m depth | >0.2 to 0.5 m depth |
| (vi) | Ecological* (Presence of Animals) | Fish & Insects | Fish & Insects | Fish & Insects |

* Applicable to only surface water

**ii) Regular Monitoring Parameters:**

| Sr. | Parameters | Requirement for Waters of Class | | |
|---|---|---|---|---|
| | | **A Excellent** | **B-Desirable** | **C-Acceptable** |
| (i) | pH | 7.0 to 8.5 | 6.5 to 9.0 | 6.5 to 9.0 |
| (ii) | DO (% Saturation) | 90-110 | 80-120 | 60-140 |
| (iii) | BOD, mg/l | Below 2 | Below 5 | Below 8 |
| (iv) | EC, µmhos/cm | <1000 | <2250 | <4000 |
| (v) | $(NO_2+NO_3)$-Nitrogen, mg/l | <5 | <10 | <15 |
| (vi) | Suspended solid, mg/l | <25 | <50 | <100 |

| Sr. | Parameters | Requirement for Waters of Class | | |
|---|---|---|---|---|
| | | A Excellent | B-Desirable | C-Acceptable |
| (vii) | Fecal Coliform, MPN/ 100 ml | <20 per 100 ml | <200 per 100 ml | <2000 per 100 ml |
| (viii) | Bio-assay (Zebra Fish) | No death in 5 days | No death in 3 days | No death in 2 days |

**Note:**

1. Dissolved Oxygen (DO) not applicable for ground waters.
2. Dissolved Oxygen in eutrophicated waters should include measurement for diurnal variation.
3. Suspended solid limit is applicable only during non-monsoon period.
4. Faecal Coliform values should meet for 90% times.
5. Static Bio-Assay method may be adopted.

**iii) Specific Parameters: (Only in case of need/apprehensions)**

| Sr. | Parameters | Requirement for Waters of Class | | |
|---|---|---|---|---|
| | | A- Excellent | B-Desirable | C-Acceptable |
| (i) | Total Phosphorous | <0.1 mg/l | <0.2 mg/l | <0.3 mg/l |
| (ii) | T.K.N | <1.0 mg/l | <2.0 mg/l | <3.0 mg/l |
| (iii) | Total Ammonia (NH4 + NH3)-Nitrogen | <0.5 mg/l | <1.0 mg/l | <1.5 mg/l |
| (iv) | Phenols | <2 µg/l | <5 µg/l | <10 µg/l |
| (v) | Surface Active Agents | <20 µg/l | <100 µg/l | <200 µg/l |
| (vi) | Organo Chlorine Pesticides | <0.05 µg/l | <0.1 µg/l | <0.2 µg/l |
| (vii) | PAH | <0.05 µg/l | <0.1 µg/l | <0.2 µg/l |
| (viii) | PCB and PCT | <0.01 µg/l | <0.01 µg/l | <0.02 µg/l |
| (ix) | Zinc | <100 µg/l | <200 µg/l | <300 µg/l |
| (x) | Nickel | <50 µg/l | <100 µg/l | <200 µg/l |
| (xi) | Copper | <20 µg/l | <50 µg/l | <100 µg/l |

| Sr. | Parameters | Requirement for Waters of Class | | |
|---|---|---|---|---|
| | | A- Excellent | B-Desirable | C-Acceptable |
| (xii) | Chromium (Total) | <20 µg/l | <50 µg/l | <100 µg/l |
| (xiii) | Arsenic (Total) | <20 µg/l | <50 µg/l | <100 µg/l |
| (xiv) | Lead | <20 µg/l | <50 µg/l | <100 µg/l |
| (xv) | Cadmium | <1.0 µg/l | <2.5 µg/l | <5.0 µg/l |
| (xvi) | Mercury | <0.2 µg/l | <0.5 µg/l | <1.0 µg/l |