

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

Principal Bench, New Delhi

Original Application No. 1016/2019

In the matter of: -

Utkarsh Panwar

Applicant(s)

Vs.

Central Pollution Control Board & Ors.

Respondent(s)

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(S.K. Gupta)

Scientist-E

Central Pollution Control Board,
Parivesh Bhawan, East Arjun Nagar,
Delhi- 110032.

Date: 08.02.2021

Place: Delhi

Report of the Expert Committee constituted in compliance of Hon'ble NGT order dated 15/10/2020, in the matter of O.A. No. 1016 of 2019; Utkarsh Panwar Vs. Central Pollution Control Board & Ors.

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1. Introduction

The matter is related to O.A. No. 1016/2019; Utkarsh Panwar Vs. CPCB and Ors., wherein directions were sought by the applicant to close down all the brick kilns in the NCR till end of February, 2020 or till level of pollution reaches normal levels.

CPCB was directed by Hon'ble NGT vide order dated 15/11/2019, to submit a scientific study/report about the impact of brick kilns including those run on zig zag technology. Accordingly, a scientific report was submitted by CPCB, stating that the stack emissions are less in case of kilns operating on Zig-Zag technology, when compared to the kilns operating on FCBTK technology on the same fuel. However, the quantum of fugitive dust emissions from all type of kilns are more or less same. CPCB was directed by Hon'ble NGT vide order dated 15/12/2019, to conduct further study for assessment of different types of brick kilns with reference to source emissions.

The report submitted by CPCB in compliance of the above order of Hon'ble NGT concluded that stack emissions are less in case of kilns operating on Zig-zag technology and also that such brick kilns comply with the standards prescribed for stack emissions. CPCB was further directed by Hon'ble NGT vide order dated 30/01/2020, to furnish a report about carrying capacity of the NCR region, since brick kilns can be permitted only after ascertaining the carrying capacity.

CPCB, in its report dated 04/03/2020, to Hon'ble NGT, submitted that in NCR regions, out of 2187, 2216 and 251 brick kilns in Haryana, Uttar Pradesh and Rajasthan respectively, 1504, 1032 and 127 brick kilns have been converted to Zig-Zag technology. As per GRAP, Brick kilns in NCR are required to be shut under severe conditions i.e. when $PM_{2.5}$ and/or PM_{10} concentration goes beyond $250 \mu\text{g}/\text{m}^3$ and/or $430 \mu\text{g}/\text{m}^3$ respectively and now looking into the forecast of favorable meteorological conditions and expected improvement in the air quality, Environmental Pollution Control Authority (EPCA) has directed that operation of those brick kilns in NCR districts, which have converted to Zig-zag technology, be allowed, vide letter No. EPCA-R/2020/L-09 dated February 14, 2020. It was also submitted by CPCB that PM_{10} and $PM_{2.5}$ concentrations in summer months are lower in comparison to winter months.

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CPCB was directed by Hon'ble NGT vide order dated 05/03/2020, to collect and furnish the particulate emission data for corresponding months of March, April, May and June in the year 2019, pending further assessment of the carrying capacity. In compliance, a report was submitted by CPCB on 16/3/2020, giving District-wise breakup of locations of Zig-Zag type brick kilns in NCR Region and Ambient Air Quality data of NCR Districts with regard to PM₁₀ and PM_{2.5}.

CPCB was further directed by Hon'ble NGT vide order dated 17/3/2020, to submit a report with an expert opinion in consideration of Siting & carrying Capacity and use of cleaner fuels or any other alternative measures, on following issues: (a) How brick kilns can be allowed in NCR without damage to the air quality; (b) Conditions subject to which it may be done; (c) Number of brick kilns to be allowed and criteria for fixing such numbers. The key information provided by CPCB in the report submitted to Hon'ble NGT on 06/07/2020, in compliance of orders of Hon'ble NGT, was as follows:

- i) The district-wise and month wise carrying capacity of ambient air environment, in NCR districts of Haryana, Uttar Pradesh and Rajasthan were determined.
- ii) The number of district-wise and month-wise brick kilns, which can be operated based on the available carrying capacity, were estimated, along with conditions and criteria for fixing such numbers.
- iii) It was submitted by CPCB that brick kiln industry contributes about 5 & 7% w.r.t. PM₁₀ emissions in Winter and summer respectively, in ambient air of Delhi and NCR. Further reduction of 4% in total PM₁₀ was expected after conversion to Zig-Zag technology, which has now been implemented by brick Kilns in Delhi-NCR. In view of this, the reduction in PM₁₀ emissions by all the contributing sources of PM₁₀ emissions in Delhi-NCR becomes more significant.

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- iv) Staggered permission for operation may be given to the existing brick kilns in such a way that only estimated number of brick kilns in area operate during any given time.
- v) All Zig-Zag brick kilns may be considered to perform upstream activities such as green brick manufacturing, stacking of green bricks, etc. during non-firing period.

The above report was considered by Hon'ble NGT during hearing on 15/10/2020 and it was observed and directed by Hon'ble NGT vide order dated 15/10/2020, as under **(Annexure-1)**:

".....at this stage it is not possible to vacate direction not to permit operation of brick kilns in NCR beyond the carrying capacity found by the CPCB. All applications of the brick kiln owners seeking rejection of CPCB report and vacation of interim order against operation of brick kilns, without air quality assimilative capacity permitting such activity will stand rejected subject to further exploring viable options, including change to clean fuel like natural gas. We are conscious that brick kilns may be necessary. Object of this order is not to stop any legitimate business activity but to enforce the right to breathe fresh air which is right to life. The source apportionment studies, placed on record, show that brick kilns contribute 5-7% PM. Air pollution Control devices to be installed by the polluting sources including the brick kilns need to comply not only the consent standards but are also the Ambient Air Quality norms and available assimilative capacity of the region. If the right to fresh air is not enforced, the consequences of brick kilns beyond carrying capacity of the air quality in the area are disastrous in terms of deaths and air borne diseases. This will be contrary to the mandate of the Constitution and the environmental law, particularly the principle of 'Sustainable Development'. It is well established that deteriorated ambient air quality in terms of PM10 and PM2.5 affects respiratory system particularly, the lungs which may make individuals more vulnerable to get other related fatal diseases.

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Accordingly, we direct CPCB to constitute a Committee of five experts to suggest ways and means, if any, by which sustenance of brick kilns activities may be viable. It will be open to CPCB to nominate in house or other Experts. The CPCB may also explore viability of PNG as replacement of coal and other best practices in terms of fuel used, at other places or in other Countries. It will be open to the brick kilns owners/associations to give any other suggestions or alternatives for consideration by CPCB in spirit of collaboration with a view to find a solution within two weeks from today. Subject to the report of the expert Committee finding it viable, possibility of permitting operation of brick kilns, having regard to the extent of pollution load and its effect on the air pollution level in NCT of Delhi may be considered. The CPCB may constitute an expert Committee within three weeks which may give its report within six weeks thereafter."

In order to comply with the above directions, an Expert Committee, comprising of the following members, was constituted by CPCB on November 25, 2020 (**Annexure-2**):

- Mr. Mohan A Patil, Senior Director, Federation of Indian Chambers of Commerce & Industry (FICCI), New Delhi
- Dr Sameer Maithel, Director, Greentech Knowledge Solutions Pvt. Ltd (GKSPL), New Delhi
- Dr. Neeraj Jain, Principal Scientist, CSIR-Central Building Research Institute, Roorkee
- Er Pritpal Singh, Additional Director, Punjab State Council for Science and Technology (PSCST), Chandigarh
- Dr. Narender Sharma, Scientist 'E', Central Pollution Control Board (CPCB)

As per the directions of the Hon'ble NGT, the committee has to suggest ways and means, if any, by which sustenance of brick kilns activities may be viable. Keeping in view the Hon'ble NGT directions, the committee defined its scope of work as "to find ways and means by which brick kilns in the NCR region not only achieve the prescribed emission norms but could also operate to use resources efficiently to further reduce the environment footprint of the brick industry in order to remain environmentally sustainable and socio-economically viable in the long run'. The

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prescribed emission norms were taken as particulate matter concentration in stack as 250 mg/Nm³ at 17% O₂ concentration as proposed in the draft notification of MoEF&CC vide No. GSR 233 (E) dated 15/3/2018.

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2. Observations and Analysis:

The Expert Committee met four times including one site visit to a brick kiln and a meeting with the representatives of various brick kiln associations. As per details provided by State Pollution Control Boards to CPCB, NCR regions of Haryana, Uttar Pradesh and Rajasthan, have 2697 Nos. brick kilns based on Zig-zag technology, manufacturing around 1500 crore bricks/annum. As per studies carried out in India and other South Asian countries, a properly constructed and operated zig-zag brick kiln results in 20-25% reduction in fuel when compared to Fixed Chimney Bull Trench Kiln (FCBTK) Technology.

The joint committee considered the previous data and studies regarding brick kiln industry, conversion status of brick kilns to Zig Zag technology in NCR regions and brick kiln standards. The Expert Committee also looked into best practices being used in India and abroad, with regard to operation of brick kilns on various fuels and technologies. The feasibility of using cleaner fuels such as PNG/CNG/LPG etc. in the existing zig-zag type brick kilns, was also examined by the Expert Committee based on the available data.

The suggestions received from various brick kilns owners/associations, summarized in **Annexure-3** were discussed in the meeting held with Associations on 4.01,2021. In the meeting brick kiln Association informed that they have already invested 40-50 lacs per kiln for converting to zig-zag technology and they have limited capacity for making further major investments. However, the brick makers are also ready to implement practical options recommended by CPCB Expert Committee in the present set-up, to further reduce fugitive and source emissions.

2.1. Approach to Minimise Generation of Particulate Matter Emissions from Brick Kiln Stack/Chimney

The particulate matter emissions from brick kiln stacks are primarily due to incomplete combustion of coal or biomass fuels, leading to formation of black colored soot particles, which form majority of the particulate matter in the stack emissions. Coal contains about 15-35% volatile matter, which is lower

chain of hydrocarbons. This volatile matter gets released within seconds of firing the coal in the kiln. For combustion of this volatile matter, both primary air (from below the coal) and secondary air (above the coal) are required in appropriate proportion and quantity. If the air is not provided for combustion, part of this released volatile matter does not get burned or gets only partially burnt, which gives release to unburnt hydrocarbons (HC) and Carbon monoxide (CO). The unburnt hydrocarbons, once cooled to about below 600 °C, get condensed and form soot particles. This is an irreversible reaction and soot once formed, cannot be combusted. If the soot formation could be prevented or substantially reduced, the particulate matter emissions from brick kilns can be substantially reduced. Reduction in soot formation also means reduction in coal consumption.

The conversion from FCBTK to zig-zag technology helps in improving the combustion by providing better mixing of fuel and air and longer high temperature zone to burn off the volatile matter resulting in the reduction of particulate matter emissions. The results from various previous monitoring studies show significant reduction in particulate matter emissions in stack gases in zig-zag kilns as compared to FCBTK:

- A study by CPCB¹ reports SPM emissions from FCBTK (using coal and located in North India) to range between 102 to 688 mg/Nm³ and from High Draft zig-zag kiln (using coal and located in North India) to range between 49 and 116 mg/Nm³.
- A study by a joint group of researchers from USA and India² reports mean emission factor of 0.89 g of PM/kg of brick for FCBTK (mean of 5 kilns) and much lower 0.24 g of PM/kg of brick (mean of 3 kilns) for High Draft zig-zag kilns.
- A joint study by CPCB and HSPCB³ dated 22.1.2020, reports SPM emissions in Zig-zag kilns (using Coal located in North India) between

¹Presentation "Brick Kilns in India" by Mr J. S. Kamyotra, Director, CPCB at Anil Agarwal Dialogue 2015: Poor in Climate Change, India Habitat Centre, New Delhi, March 11 – 12, 2015. (<http://cdn.cseindia.org/userfiles/JS-kamyotra.pdf>)

²Uma Rajarathnam, Vasudev Athaly, Santhosh Raghavan, Sameer Maitheh, Dheeraj Lalchandani, Sonal Kumar, Ellen Baum, Cheryl Weyant, Tami Bond. Assessment of air pollutant emissions from brick kilns, Atmospheric Environment, 98 (2014) 549-553

³Joint study of CPCB and HSPCB conducted under the directions of Hon'ble NGT, in the matter of OA No. 1088/2018: Dinesh Chahal & Ors Vs. Union of India & Ors,

⁴Report of CPCB prepared under the directions of Hon'ble NGT in the matter of OA No. 1016/2019; Utkarsh Panwar vs. CPCB and Ors.

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107-541 mg/Nm³ and in FCBTK (using agro-residues located in North India) between 199-705 mg/Nm³

- A report of CPCB⁴ dated 06.07.2020, considered average SPM emission of 250 mg/Nm³ at 17% O₂ in Zig-zag kilns using coal.

The Expert Committee examined ways to further reduce emissions of particulate matter in stack gases from zig-zag kilns. Based on the deliberations in the committee and suggestions received from brick kiln associations the approach for further air pollution reduction from zig-zag kilns consists of two approaches:

- **Preventing/ Reducing air pollution generation at source** itself, which may include improving the efficiency of the combustion process, reduction in heat losses, use of internal fuels and use of cleaner fuels such as PNG/CNG/other gaseous fuels, etc.
- **Using an air pollution control device** such as a wet scrubber, bag filter, etc. to capture the particulate matter in the flue gases before they are discharged to the atmosphere.

2.2. Preventing/ Reducing Air Pollution Generation at Source in Existing zig-zag kilns

Adoption of Standard operating practices for zig-zag kiln operation:

Representations by brick kiln associations and presentations made by them during the January 4, 2021 meeting, revealed that a large number of brick kilns which have recently converted from FCBTK to zig-zag kiln technology, are not familiar with the standard operating practices and also face a problem of non-availability of trained workers (firemen and brick setters) to operate zig-zag kilns. Sample surveys and performance measurements conducted immediately after conversion from FCBTK to zig-zag kilns carried out in Bihar³& NCR⁴ corroborate the fact that all newly converted zig-zag kilns may not be following standard operating practices resulting in them not being able

³GKSPL 2018: Learnings from Bihar's Experience of Implementing Cleaner Brick Kiln Directive: A Case Study, Greentech Knowledge Solutions Pvt Ltd, Delhi. <https://www.gkspl.in/wp-content/uploads/2019/01/Learnings-from-Bihar-Experience-of-Implementing-Cleaner-Brick-Kiln-Directive-A-Case-Study.pdf>

⁴CSE 2018: Conversion of Brick Kilns in Delhi-NCR to Clean Technology: A Status Report, Centre for Science & Technology <https://www.cseindia.org/makeover-conversion-of-brick-kilns-in-delhi-ncr-to-a-cleaner-technology-8843>

to achieve the desired level of performance with respect to reduced air pollution, fuel savings and improved quality of fired bricks. The Expert Committee has compiled the Standard Operating Practices, and are presented in **Annexure-4** which covers the following aspects:

- Stacking of bricks in a zig-zag kiln
- Fuel preparation and fuel feeding practices in a zig-zag kiln
- Air leakage management in a zig-zag kiln
- Temp. measurement & instrumentation to control the operation of a zig-zag kiln
- Air flow and draught control in a zig-zag kiln.

The expert committee also deliberated on various measures as elaborated in **Annexure- 5**, to improve the combustion of fuel and thus reduction in source emissions:

- i. Optimising Combustion & Minimising Air Leakages by Using Instrumentation and Process Control System.
- ii. Increasing Settling of Dust in Flue Ducts (in-built Settling Chamber) by reducing Air Leakages.
- iii. Use of Internal Fuel.
- iv. Use of mechanized fuel feeding devices.

2.3. Preventing/ Reducing Air Pollution Generation at Source by Change of Brick Kiln Technology and/or shift to cleaner gaseous fuels

Tunnel Kiln Technology: Tunnel kiln is a continuous moving ware kiln in which the bricks are passed on cars through a long horizontal tunnel. The firing of products occurs at the central part of the tunnel. The main advantages of tunnel kiln technology lie in its ability to fire a wide variety of clay products, better control over the combustion/ firing process and high quality of the products. Due to the better control over the combustion process, the emission of particulate matter in stack gas is lower in tunnel kilns. After Second World War, the technology was widely adopted and lead to the transformation of European brick industry from several thousand small and

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scattered brick making units into few hundred large scale and highly mechanised tunnel kiln units. In Asia, China and Vietnam started adopting the technology during 1970's and now have several hundred tunnel kilns in operation. Depending on its design and construction a tunnel kiln to manufacture around 50,000 bricks per day can cost anywhere between Rs 7 - 15 crore in India. As per information available with the Expert Committee there are only 1-2 operating tunnel kilns in the NCR which are mainly producing Value Added Products.

PNG/CNG: Gaseous fuels like piped natural gas, compressed natural gas or biogas are cleaner fuels which results in less air pollution as well as they also help in reducing CO₂ emissions. Recently, Wienerberger India (a large international company involved in manufacturing of bricks), has converted their existing tunnel kiln located at Kunigal, Karnataka to natural gas firing. CPCB was also directed by Hon'ble NGT to look into alternate fuels such as PNG. In this regard, CPCB Regional Directorate, Bangalore was requested to study and conduct in depth monitoring of a PNG based brick kiln namely M/s Weinberger Building Material Solutions operating at Plot No. 1 & 2, Kunigal Industrial Area, Phase II, Gottigere Village, Kunigal, Karnataka. The study has been conducted by CPCB RD, Bangalore on 22-23 December, 2020 and the report is enclosed as **Annexure-6**. The techno-economics of supply of natural gas for brick firing will require a detailed study.

Air Pollution Control Devices (End-of-the Pipe Technologies): The Expert Committee is of the view that zig-zag technology itself is adequate to achieve the existing and proposed norms prescribed for brick kilns, if operated as per design parameters.

Further, the technology selection for an air pollution control device depends on characteristics of the pollutant(s) i.e. particle size, particle loading, required pollutant(s) removal efficiencies and flue gas properties like pressure, temperature, humidity, composition, reactivity etc. The various types of Air Pollution Control Devices (APCD) and their applications are tabulated as **Annexure-7**.

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2.4. Applied research/pilot testing for improvement in brick manufacturing process

Based on the discussions presented above, various suggestions have been made by the Expert Committee as elaborated in **Annexure-8**, for undertaking applied research to demonstrate and pilot test technical measures to improve brick manufacturing process and to reduce air pollution/improve resource efficiency.

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3. Summary of Observations:

The Expert Committee was directed by Hon'ble NGT, to suggest ways and means, if any, by which sustenance of brick kilns activities, may be viable. The summary of observations and analysis made by the Expert Committee in Section 2, so as to ensure environmentally sustainable and financially viable operation of brick kilns which have already been converted to zig-zag technology, in NCR districts of Haryana, Uttar Pradesh and Rajasthan is as follows:

- a) As per data available as on 16.12.2020 with CPCB based on the information received from respective SPCBs, out of total 4635 Nos. brick kilns in NCR, 2697 Nos. brick kilns (Uttar Pradesh: 1024 Nos.; Haryana: 1543 Nos. and Rajasthan: 216 Nos.) have been converted to Zig-zag technology, as on date (Table 1).

Table 1: Conversion status of brick kilns from Fixed Chimney Bull Trench Kiln (FCBTK) technology to Zig-zag technology in NCR Regions

S. No.	Name of State	Total No. of Brick Kilns	Total no. of brick kilns converted into Zig-Zag Technology
1	Uttar Pradesh	2216	1024
2	Haryana	2163	1543
3	Rajasthan	255	216
TOTAL		4634	2783

- b) The zig-zag kiln technology, if operated as per standard operating practices, are adequate to achieve both the existing norms of 750 mg/Nm³ SPM and the proposed stricter norms of 250 mg/Nm³ at 17% oxygen concentration (as per the draft notification of MoEF&CC vide No. GSR 233 (E) dated 15/3/2018).
- c) Several additional measures for incremental improvements can be undertaken to further reduce stack emission generation at source from existing zig-zag kilns as well as improve resource use efficiency so as to

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further reduce the environment footprint of the brick industry. These include, optimizing combustion & minimizing air leakages by using instrumentation and process control system; increasing settling of dust in flue ducts (in-built Settling Chamber) by reducing air leakages; use of VFDs for air flow and draught control; addition of internal fuel etc. These measures require further applied research/pilot demonstration, as elaborated in Annexure-5 and Annexure-8 of the report, before they can be recommended for large-scale implementation.

- d) As such, implementation of additional Air Pollution Control Devices (APCDs) are not required in zig-zag technology to meet the existing and proposed norm if operated as per design parameters as well as standard operating procedures. However, for further reduction in stack emission with special reference to reduce PM 10 and PM 2.5, suitable APCD may be designed and piloted.
- e) Regarding the use of PNG/CNG in brick kilns, there is only one reference of PNG based brick kiln in India i.e. M/s Weinberger Building Material Solutions operating at Village Kunigal, Karnataka installed at a cost of Rs. 150 Crores, using tunnel kiln technology, for producing hollow blocks. The Expert Committee is of the opinion that the conversion of Zig-zag kilns into PNG/CNG based tunnel kilns does not seem to be a viable option, at this stage.
- f) The measurement of stack emissions at 8D (Where D is the internal diameter of the chimney) level, as specified in USEPA/CPCB method may not be feasible in some brick kilns having large diameters. CPCB should relook into the current methodology of stack emission monitoring in brick kilns and come out with a guideline on how to conduct stack emission monitoring in zig-zag brick kilns. Such a guideline and subsequent monitoring using these guidelines are important to reassess/revalidate the emission load and contribution of particulate matter emissions by zig-zag brick kilns in ambient air environment.

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4. Recommendations of Expert Committee

The following mechanism is recommended by the Expert Committee, for operationalization of zig-zag type brick kilns in NCR regions:

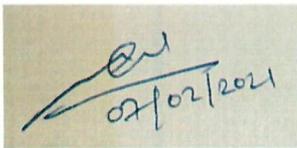
- i. The brick kilns which have already been converted to Zig-zag technology may only be allowed to operate, subject to the compliance of all the applicable environmental notifications, sitting guidelines, conditions of the consent to operate granted by respective State Pollution Control Boards (SPCBs) with special reference to control of fugitive dust emissions.
- ii. The new brick kilns be allowed to operate in NCR regions, as per directions issued by CPCB vide CPCB/IPC I-VI/PNG/2862-2870 dated November 27, 2020 (Copy attached as **Annexure-10**).
- iii. The permission to operate the brick kilns in the winter months must be subjected to the restrictions, if any, on the operation of industries, to control the concentration of particulate matter in the ambient air environment of Delhi NCR.
- iv. The CPCB in consultation with expert agencies/organisations should develop methodology for conducting stack emission monitoring in zig-zag brick kilns at the earliest. All brick kilns would be required to provide port holes and monitoring platform and ladders as finalized by CPCB.
- v. It is recommended that training programmes on standard operating practices may be organized by various brick kiln associations in collaboration with expert agencies in this field. CPCB may provide technical guidance to the brick kilns associations in this regard, if required. An outline of the training programme is provided in **Annexure-9**.
- vi. It is recommended to implement the following additional measures:
 - One night-vision CCTV camera to be installed and focused on the exit of brick kilns stack with connectivity to SPCBs & CPCB, to ensure visual monitoring of smoke emissions.

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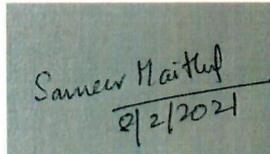
- Requisite number of ambient air quality monitoring stations (AAQMS) should be installed by State Pollution Control Boards in all the districts in accordance with the criteria developed by CPCB.

vii. The long term sustenance of the brick kilns in NCR depends on implementation of measures to further improve design and operation of existing zig-zag kilns for pollution prevention at source and improve resource use efficiency. The committee has given suggestions, based on which applied research and pilot demonstration can be taken up besides developing a Roadmap for time bound implementation.

This report is being filed by the Expert Committee through CPCB, for the consideration of Hon'ble National Green Tribunal.



(Mohan A Patil)
FICCI, New Delhi



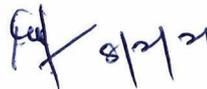
(Dr Sameer Maithel)
GKSPL, New Delhi



(Dr. Neeraj Jain)
CSIR-CBRI, Roorkee



(Er. Pritpal Singh)
PSCST, Chandigarh



(Dr. Narender Sharma)
CPCB, Delhi

Dated: February 7, 2021

Item No. 03

Court No. 1

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

(By Video Conferencing)

Original Application No. 1016/2019
(I.A. No. 306/2020, I.A. No. 308/2020, I.A. No. 310/2020, I.A. No.
311/2020, I.A. No. 312/2020, I.A. No. 313/2020, I.A. No.
339/2020, I.A. No. 340/2020 & I.A. No. 341/2020)

Utkarsh Panwar

Applicant

Versus

Central Pollution Control Board & Ors.

Respondent

Date of hearing: 15.10.2020

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

Applicant: Mr. Rohan Thawani, Advocate

Respondent: Mr. Raj Kumar, Advocate for CPCB
Mr. Pradeep Misra and Mr. Daleep Dhyani, Advocates for UPPCB
Mr. Rahul Khurana, Advocate for HSPCB
Mr. S.P. Singh, Senior Advocate with Mr. Raunak Parekh, Advocates
Mr. Rohit Sharma, Advocate
Mr. Neeraj Kumar Jain, Senior Advocate with Mr. Aniket Jain, Advocate
in I.A. No. 306/2020
Mr. Siddhartha Iyer, Advocate in I.A. No. 308/2020
Mr. Neeraj Kumar Sharma, Advocate in I.A. No. 310/2020 & 311/2020
Mr. Sanjay Upadhyay, Advocate in I.A. No. 312/2020 & 313/2020
Mr. Nalin Kohli, Advocate in I. A. No. 339/2020 & 340/2020
Mr. Dinesh Kumar Dakoria, Advocate in I.A. No. 341/2020

ORDER

The Issue

1. Question for consideration is permissibility of brick kilns run by 'Zig-Zag' technology in NCR till level of air pollution becomes normal. Other brick kilns (FCBTK) were already prohibited by the order of the Environment Pollution (Prevention and Control) Authority (EPCA) vide order dated 01.11.2019 to enforce GRAP, stipulating shutting of Brick kilns in NCR under severe conditions i.e. when PM_{2.5} and/or PM₁₀

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concentration goes beyond 250 $\mu\text{g}/\text{m}^3$ and/or 430 $\mu\text{g}/\text{m}^3$ respectively. This prohibition was not applied to brick kilns operated by 'Zig-Zag' technology on the assumption that such brick kilns did not adversely affect the air quality. According to the applicant, even brick kilns run by 'Zig-Zag' technology add to $\text{PM}_{2.5}$ and contribute about 10% of the air pollution in the NCR and should not be allowed atleast till GRAP is applicable.

Background and earlier proceedings

2. The matter has been effectively considered by the Tribunal on five occasions earlier to which a brief reference is necessary by way of background. The application was first taken up on 15.11.2019. The Tribunal directed that till air quality reaches normal, brick kilns even operating on zig zag technology may not be allowed to operate in NCR, pending an expert study by CPCB about the impact of operation of such brick kilns on the air quality.

3. The matter was considered second time on 18.12.2019 in the light of report of the CPCB dated 13.12.2019 that even zig zag technology was causing air pollution. The Tribunal directed further study to be carried out with reference to source emissions from different types of fuels and with the regard to the number of brick kilns which the carrying capacity of Air in the NCR could sustain. Operative part of the said order is as follows:-

*"4. In view of the above, while CPCB may conduct further study for assessment of different types of brick kilns with reference to source emissions from different types of fuels, having regard to the conclusion that average fugitive SPM values are almost same in FCBTK and Zig-Zag brick kilns, the interim order directing closure of brick kilns in NCR will continue till the next date. **Thereafter, brick kilns in NCR may be allowed only consistent with the***

carrying capacity and siting criteria, subject to GRAP, consent conditions and background concentration of ambient air quality.”

4. Further consideration was on 6.2.2020 (third time) in the light report of the CPCB dated 28.01.2020. The operative part of the said order is as follows:-

“3. Since brick kilns can be permitted only after ascertaining the carrying capacity as above, let a report about carrying capacity of the NCR region in above terms be furnished by CPCB before the next date by e-mail at judicial-ngt@gov.in.”

5. The brick kiln owners moved the Hon'ble Supreme Court and vide order dated 20.02.2020 in C.A. No. 1733-35/2020, it was observed that they could move this Tribunal. The matter was considered fourth time on 05.03.2020 in the light of report dated 04.03.2020. The brick kiln owners were duly heard in terms of order of the Hon'ble Supreme Court.

Extract from the order is as follows:-

“4. In view of the above, a report has been filed by the CPCB on 04.03.2020 as follows:

*“As per information provided by SPCBs, there are total 3278, 2854 and 19003 brick kilns in Haryana, Punjab and Uttar Pradesh respectively, out of which 1918, 701 and 1343 brick kilns have been converted to Zig-Zag technology. With regard to NCR regions, out of 2187, 2216 and 251 brick kilns in Haryana, Uttar Pradesh and Rajasthan respectively, **1504, 1032 and 127 brick kilns have been converted to Zig-Zag technology.***

Brick Kilns based on Zig-Zag technology using agro-residues are located only in NCR districts.

*Different types of activities with potential of air pollution, including operation of brick kilns in Delhi-NCR are regulated through a Graded Response Action Plan (GRAP) by Environmental Pollution Control Authority. **As per GRAP, Brick kilns in NCR are required to be shut under severe conditions i.e. when PM_{2.5} and/or PM₁₀ concentration goes beyond 250 µg/m³ and/or 430 µg/m³ respectively.***

*In view of the expected higher concentration of PM emissions during winter months, brick kilns in the NCR regions were kept closed during this period as per directions of EPCA. **However, now, looking into the***

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forecast of favourable meteorological conditions and expected improvement in the air quality, Environmental Pollution Control Authority (EPCA) has directed that operation of those brick kilns in NCR districts, which have converted to Zig-zag technology, be allowed, vide letter No. EPCA-R/2020/L-09 dated February 14, 2020 (Copy enclosed as Annexure-I).

Further, air quality data of 2019 in NCR, was examined. Analysis indicated that **PM_{2.5}** concentration in summer months (March-June) is lower (**Average 80 µg /m³**) in comparison to winter months (Average 173 µg /m³). Similarly, **PM₁₀** concentration in summer months (March-June) is lower (**Average 219 µg /m³**) in comparison to winter months (Average 283 µg /m³).

The past data of 2019 w.r.t. PM₁₀ & PM_{2.5} concentration in Delhi, is summarized in **Table 1:**

Table 1 : Monthly data of CAAQMs w.r.t. PM Concentration for 2019, in Delhi

Month	PM _{2.5} , µg/m ³	PM ₁₀ , µg/m ³
January	203	322
February	122	215
March	83	184
April	83	236
May	89	247
June	63	209
July	47	143
August	35	85
September	40	98
October	128	247
November	202	312
December	209	316

Therefore, in view of submission that 65 Nos brick kilns are proposed to be monitored in both NCR and Non-NCR regions, involving total 585 stack emissions' samples, in compliance of the directions of Hon'ble NGT in the matter of O.A. No. 1016/2019 and O.A. No. 1088/2018, it is humbly prayed as under:

- I. Brick Kilns based on Zig-Zag technology using agro-residues are located only in NCR districts and if these are to be monitored to assess the performance of brick kilns operating on agro-residues, under comparable situations, the Zig-Zag type brick kilns in NCR regions, which are presently dosed, may have to be made operational, to facilitate monitoring.
- II. Atleast 04 months' time period may be granted to CPCB, for Monitoring of 65 brick kilns in NCR and Non-NCR regions and submission of report covering **i) Impact of brick kilns operation on loss/degradation of top soil, ii) study involving Carrying Capacity Assessment of brick kilns with adequate samples in terms of number of brick kilns and days for which monitoring be conducted, iii) Evaluation of the performance of brick kilns against the background concentration and carrying capacity of**

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the area and iv) Impact on Brick Kilns operation on ambient air, in the matters of O.A. No. 1016/2019 and O.A. No. 1088/2018, after commencement of operation of brick kilns in NCR regions."

5. We have heard learned Counsel for the CPCB and for the brick kilns, including those who have filed applications for being implead as party in pursuance of order of Hon'ble Supreme Court dated 20.02.2020 in C.A. No. 1733-35/2020.

6. Learned Counsel for the CPCB submitted that having regard to the data of air quality, even though as per GRAP brick kilns are to be mandatorily shut throughout NCR only under 'severe conditions', no polluting activity, including brick kilns, can be permitted beyond 'carrying capacity' and air quality norms under the Air (Prevention and Control of Pollution) Act, 1981. On the other hand, the stand of the brick kilns is that unless the conditions are 'severe' to attract GRAP and unless prohibited by EPCA, 'Zig-Zag' technology brick kilns have right to operate irrespective of the air quality norms. Reliance has also been placed on norms for brick kilns under Schedule-I, Sr. No. 74 of Environment (Protection), Rules 1986. Alternatively, it is submitted that at such locations where air quality is within norms, brick kilns may be allowed. By way of example, it is stated that the ambient air quality data at Alwar, as on 18.02.2020, is within norms.

7. We do not find any merit in the contention that only in 'severe' conditions brick kilns can be prohibited even if the air quality is beyond permissible norms and the area has no assimilative or supportive capacity. Emission norms of individual brick kilns is not a conclusive factor for dealing with the issue, if the carrying capacity of the area does not allow the brick kilns in question. However, we do need to consider the submission that where air quality is within the norms and there is carrying capacity, brick kiln can be allowed.

8. In view of the above, it is necessary to look at the relevant data at different locations '24 hourly' and 'monthly average' during the relevant months. Since such data is maintained by the CPCB/PCBs, the CPCB may collect such data for corresponding months of March, April, May and June in the year 2019 and furnish the same before the next date. The break-up of location of the brick kilns District-wise may also be furnished to consider as to which of the brick kilns can be allowed after verification that such brick kilns are actually working on 'Zig-Zag' technology, pending further assessment of the carrying capacity by the CPCB, as already directed earlier vide order dated 06.02.2020."

6. Further order of the Tribunal is dated 23.03.2020 (on fifth time consideration) in the light of the report dated 16.03.2020 to the effect that the assimilative capacity of the air quality in the NCR was not able

to take load of the pollution caused by the brick kilns. The Tribunal directed the CPCB to undertake further studies in the matter in the light of the suggestions of the Brick Kiln owners and their association and also explore the use of cleaner fuel like natural gas instead of coal and determine the number of brick kilns could be allowed and conditions required to be followed. The operative part of the said order is as follows:-

“6. We have considered the above data which shows that in the corresponding months when brick kilns were operating, standard of air quality was not as per prescribed norms. Thus, the air quality of the area is unable to take further pollution load. In this regard, it may be noted that while considering the issue of operation of brick kilns in non-NCR area, where GRAP was not applicable as such, in O.A. No. 1088/2018, Dinesh Chahal & Ors. vs. Union of India & Ors., the Tribunal vide order dated 30.04.2019 observed that standards of ambient air quality are required to be maintained under Section 17(g) of the Air Act, 1981:

*“3. ... The matter was again considered on 21.02.2019 with reference to the **contention that the impugned order was only for Non-NCR to which order of CPCB or EPCA did not apply. The Tribunal held that even in Non-NCR, Standards of Ambient Air Quality laid down under Section 17 (g) of the Air Act are required to be followed. If the impugned order has been passed without undertaking any study on status of ambient air quality without any carrying capacity assessment to take the additional load at concerned areas and without any safeguards on ‘Precautionary’ principle, the same may not be justifiable having regard to the acknowledged adverse impact of operation of the brick kilns on the ambient air quality.** Reference was made to the Judgements of the Hon’ble Supreme Court in *M.C. Mehta v. Union of India*, (1998) 9 SCC 149, *M.C. Mehta v. Union of India* (2000) 7 SCC 422, *M.C. Mehta v. Union of India*, (2002) 4 SCC 378, *K. Guruprasad Rao v. State of Karnataka*, (2012) 12 SCC 736 wherein the Hon’ble Supreme Court directed closure or shifting of brick kiln industries and *M.C. Mehta v. Union of India*, (2001) 9 SCC 235 laying down that brick kilns may be allowed to operate after studying the impact on human population and vegetation.”*

7. Learned Counsel for the brick kiln operators, however, submit that prohibition on operation of brick kilns be lifted as some individual brick kilns meet the air quality emission standards laid down under the Environment (Protection) Rules, 1986 and the brick kilns are not the only source of pollution. Contribution of all the brick kilns taken together, to the air pollution, was about 3%. It was also

mentioned that as at present air quality norms are within limit in seven districts out of 15 districts of NCR.

8. As observed earlier, the question is not merely of an individual brick kiln not emitting pollution or the extent of contribution of the brick kilns taken separately, but of the capacity of the area being already air polluted and unable to take the load of pollution. When there is no carrying capacity in the area for further air pollution, we find it difficult to permit operation of the closed brick kilns to uphold the 'Sustainable Development' principle. When even without operation of the brick kilns the air quality is not within the norms, the impact of operation of the brick kilns cannot be ignored. Thus, we find it difficult to accept the submission that the individual brick kilns maintaining the prescribed standards for discharge of emissions are entitled to operate or that they be allowed to operate on the ground that pollution caused by the brick kilns is less than other pollution from other sources irrespective of carrying capacity of the area. The fact remains that brick kilns add to the air pollution and thereby affect right of citizens to breathe fresh air.

9. We may now consider another aspect of the matter i.e. impact of the brick kilns on the top soil. As noted in order dated 05.03.2020, CPCB has undertaken to look into this aspect and has not yet completed its study. As per available study, there is huge environmental cost in using top soil for making brick making.¹ Reference may also be made to a study on "The Impact of Brick Kiln operation to the degradation of topsoil quality of Agricultural Land".² There is further issue of unutilized fly ash adversely affecting the environment which may require barring red clay brick kilns. This is proposed in a draft notification of the MoEF&CC 25.02.2019 within 300 kms of coal or lignite based thermal power plants. No doubt the said notification is only a draft but the same is evidence of such step being necessary for sustainable development.

10. Main reason for air pollution by brick kilns is use of coal etc. as fuel. The pollution can be minimized if the fuel which is currently used is considered to be replaced by cleaner fuels like PNG by appropriate modification in design not adding to the PM load. Dealing with the air pollution caused in Morby Industrial Area in Gujarat on account of coal gasifiers in tile manufacturing, the Tribunal directed closing of coal gasifier industries without prejudice to such industries switching over to non-coal gasifiers, PNG or other such technology. It was directed³:

"25. Accordingly, we allow the applications and direct the GPCB to close all coal gasifiers industries and units operating with the help of coal gasifiers

¹ www.journals.sagepub.com/doi/abs/10.1177/0974929214521892# (Environmental Cost of using top-soil for brick making – a case study from India (MoEF, Gol project) (Published in Review of Market Integration, 2013) Vinish Kathuria, Professor, IIT Bombay – March 11, 2015.

² www.researchgate.net/publication/282431176_The_impact_of_brick_kiln_operation_to_the_degradation_of_topsoil_quality_of_agricultural_land.

³ Order dated 06.03.2019 in O.A. No. 20/2017 (WZ), Babubhai Ramubhai Saini vs. Gujarat Pollution Control Board & Ors.

without prejudice to such units switching over to non-coal gasifiers or PNG or technology consistent with the above report. The GPCB must initiate immediate steps for prosecution of the industries which have operated in violation of law and recover compensation for causing damage to the environment and public health."

11. Issue of allowing operation of brick kilns may give rise to following questions:

- (i). The use of cleaner fuels or any other alternative measures to be used to prevent air pollution.*
- (ii). Siting and carrying capacity.*

12. In view of the fact that there is no carrying capacity of the air quality in NCR region to permit any further addition to PM load by permitting unconditional operation of brick kilns using fuel which adds to PM load and since it may be necessary to consider the issue of utilizing fly ash, we require an expert opinion on following issues:

- (a) how brick kilns can be allowed in NCR without damage to the air quality;*
- (b) conditions subject to which it may be done;*
- (c) number of brick kilns to be allowed and criteria for fixing such numbers.*

13. Let CPCB look into the above issues and furnish a further report within one month for further directions in the matter. The applicants are free to put forward their viewpoint before CPCB."

Consideration during today's hearing

7. Accordingly, in above backdrop, the CPCB has given its report dated 06.07.2020. The CPCB considered suggestions/objections of the Brick Kiln Owner Association in terms of order of this Tribunal which have been summed up in the report as follows:-

"(a) The brick kilns are complying with the directions of CPCB w.r.t. shifting from the Old Fixed Chimney Bull Trench Kiln Technology to Zig-Zag Technology.

(b) The brick Kilns have been established as per siting criteria.

(c) The Hon'ble Supreme Court of India in Civil Appeal No. 1742-43 of 2020 (Diary No. 5935/2020) vide order dated 20/02/2020 requested Hon'ble NGT to decide the O.A. No. 1016/2019, in the

light of the provisions of the Graded Response Action Plan (GRAP) of MoEF&CC and EPCA order dated 14/02/2020.

(d) The brick kilns in NCR regions are required to be closed under Severe Category ($PM_{10} > 430 \text{ ug/m}^3$ or $PM_{2.5} > 250 \text{ ug/m}^3$) under GRAP.

(e) Brick Kilns based on Zig-Zag technology are less polluting and are complying with the both existing and proposed standards for stack emissions.

(f) PNG, CNG and industrial LPG are not available in majority of places where brick kilns are situated.

(g) The blanket ban on operation of brick kiln industries has affected livelihood rights of approximately one million people in the national Capital region.

(h) The brick Kiln industries are seasonal and hence only operate from January to June and indefinite closure for the want of study would cause and has already caused irreparable damage to the brick kiln industry.

(i) Utilization of fly ash may not be treated as a true alternative unless the harmful impacts of fly ash bricks are not studied.

(j) A report on "Source Apportionment of $PM_{2.5}$ and PM_{10} of Delhi NCR for identification of major sources" prepared by ARAI and TERI for Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, New Delhi, in the year 2016, reveals that brick kiln industry contributed only about 8% to the air pollution of Delhi and NCR. It was further found that the brick kilns shifting to Zig-Zag technology would further lead to reduction of 3%, 4% and 6 % in total $PM_{2.5}$, PM_{10} and SO_2 emissions. The contribution of the brick kilns is very less in Delhi and NCR after conversion to Zig-Zag technology.

(k) The utilization of fly ash in the manufacture of bricks is not only unfeasible because of several issues involved in the transportation of fly-as to brick- kilns. It poses several health hazards to the inhabitants residing in buildings made thereof, in addition to health hazards to laborers working at brick-kilns and on construction sites.

(l) Various kinds of industrial and other activities contribute together to saturate the carrying capacity of the region. It is submitted that saturation of the carrying capacity of Delhi-NCR cannot be the basis for denying permission to brick kilns to operate. This is particularly because brick kilns emissions are not amongst the main contributors to air pollution in Delhi-NCR.

(m) Any directions that prohibit brick kilns from operating in Delhi- NCR on account of saturation of the carrying capacity,

without first prohibiting the other more polluting activities, would be arbitrary and violative of Article 14 and Article 19(1)(g) of the Constitution of India.

(n) The brick kilns may be allowed to operate at par with other activities that together contribute to the carrying capacity of Delhi-NCR, subject to the conditions of the Consent to Operate and guidelines issued by the regulatory bodies so as to avoid fugitive dust emissions.

(o) The directions issued by the EPCA from time to time are sufficient to ensure that the brick kilns operate in Delhi-NCR without any damage to the air quality.

(p) The brick kilns that do not comply with the conditions of the Consent to Operate and other guidelines issued by the regulatory bodies from time to time may also be closed down with immediate effect.

(q) The brick kilns, which have adopted the zig-zag technology, may be permitted to operate in Delhi-NCR.”

8. Thereafter, the CPCB has referred to the District wise carrying capacity with reference to the monthly average of Continuous Ambient Air Quality Monitoring Stations (CAAQMS) PM₁₀ values in the ambient air during the months of March 2019 – June, 2019 and October 2019 – February, 2020 were analysed for NCR districts of Haryana, UP and Rajasthan. Report further refers to the statistic of zig zag type brick kilns in the NCR region and emission load by the brick kilns. With a view to calculate carrying capacity, following components were considered:-

- “i. Estimation of Existing Pollution Load w.r.t***
- ii. Estimation of Assimilative Carrying Capacity w.r.t PM₁₀***
- iii. Estimation of Supportive Carrying Capacity w.r.t PM₁₀”***

9. The data with reference to the above parameters are as follows:-

“Table 6: Total Existing Plylio Load, Assimilative Carrying Capacity and Supportive Carrying Capacity in NCR Districts of Haryana

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Table 6(a):

S.No.	Name of District	Total PM ₁₀ Load, Kg (x)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Bhiwani	210232	367562	503745	475659	478478	457212	368260	271515	380314	
2	Far id (Ballabgarh)	96701	134048	187497	158420	104164	100606	118395	94829	112797	
3	Gurugram	103785	194307	227513	191961	165102	177733	150341	102872	127176	
4	Jhajjar	102704	177460	252854	209516	171112	158039	115148	93204	131063	
5	Jind	174279	282559	418543	418918	307558	335718	204744	144806	199372	
6	Karnal	161280	280186	355607	341349	358809	337093	233508	NA	221082	
7	Mahendragarh	104445	190597	212532	206095	174814	136050	106895	117563	127985	
8	Nuh(Meyvap)	80625	159404	177216	157403	134979	129861	90049	NA	119077	
9	Palwal	93895	189977	204889	222688	15299	164475	111147	81141	129514	
10	Panipat	65936	140221	243718	153134	236609	212180	209735	62096	184177	
11	Rewari	106798	182019	248205	253637	232004	203641	153915	139921	193558	
12	Rohtak	NA	123118	169389	179357	16888	166483	173986	141889	NA	
13	Sonipat	117771	241036	335584	332458	237579	170100	151606	263718	208357	
14	CharkhiDadd	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Table 6(b):

S.No.	Name of District	Assimilative Carrying Capacity, Kg (y)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Bhiwani	238900	287158	387496	389885	297192	239378	206887	220744	277602	
2	Faridabad (Ballabgarh)	37050	44534	60095	60466	46090	37124	32085	34234	43052	
3	Gurugram	62900	75606	102024	102653	78248	63026	54471	58120	73090	
4	Jhajjar	91700	110223	148737	149654	114075	91883	79412	84731	106555	
6	Jind	135100	162390	219132	220483	168064	135370	116997	124832	156986	
6	Karnal	126000	151452	204372	205632	156744	126252	109116	116424	146412	
7	Mahendragarh	94950	114130	154009	154958	118118	95140	82227	87734	110332	
8	Nuh(Mewat)	75350	90571	122218	122971	93735	75501	65253	69623	87557	
9	Palwal	67550	81195	109566	110242	84032	67685	58498	62416	78493	
10	Panipat	63400	76207	102835	103469	78870	63527	54904	58582	73671	
11	Rewari	79700	95799	129273	130070	99147	79859	69020	73643	92611	
12	Rohtak	87250	104875	141520	142392	108539	87425	75559	80619	101385	
13	Sonipat	106100	127532	172094	173155	131988	106312	91883	98036	123288	
14	Charkhi Dadri	69050	82998	111999	112699	85898	69188	59797	63802	80236	

Table 6(c):

S.No.	Name of District	Supportive Carrying Capacity, Kg (z) i.e (y-x)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Bhiwani	28668	-80404	-116249	-85775	-181287	-217834	-161372	-50771	-102713	
2	Faridabad (Ballabgarh)	-59651	-89514	-127402	-97954	-58074	-63482	-86309	-60595	-69744	
3	Gurugram	-40885	-118701	-125489	-89308	-86855	-114707	-95870	-44752	-54086	
4	Jhajjar	-11004	-67236	-104116	-59862	-57037	-66156	-35735	-8473	-24508	
5	Jind	-39179	-120169	-199410	-198435	-139493	-200348	-87747	-19973	-42386	

6	Karnal	-35280	-128734	-151235	-135717	-199065	-210841	-124392	NA	-74670
7	Mahendragarh	-9495	-76467	-58523	-51136	-56697	-40910	-24668	-29829	-17653
8	Nuh (Mewat)	-5275	-68834	-54998	-34432	-41244	-54361	-24796	NA	-31520
9	Palwal	-26345	-108801	-95323	-112446	-68906	-96790	-52648	-18725	-51021
10	Panipat	-2536	-64014	-140884	-49665	-157739	-148653	-154830	-3515	-110506
11	Rewari	-27098	-86219	-118932	-123567	-132857	-123782	-84895	-66279	-100946
12	Rohatak	NA	-18244	-27870	-36965	-61359	-79059	-98428	-61270	NA
13	Sonipat	-11671	-113504	-163489	-159303	-105591	-63787	-59724	-165682	-85069
14	Charkhi Dedri	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 7: Total Existing PM₁₀ Load, Assimilative Carrying Capacity and Supportive Carrying Capacity in NCR Districts of Uttar Pradesh

Table 7(a):

S.No.	Name of District	Total PM ₁₀ Load, Kg (x)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Bagpat	106341	208801	281760	316913	187339	201855	148718	58589	161943	
2	Bulandshahr	417360	604712	640366	913084	687684	655548	472794	481530	537402	
3	Gautam Budh Nagar	117303	187227	227695	266759	220084	213880	189846	134448	166100	
4	Ghaziabad	127332	217534	241911	315557	214135	203194	175104	124736	160290	
8	Hapur	55440	97578	153620	69300	98525	96883	74017	79279	46399	
6	Muzaffamagar	304608	537164	562334	706434	501088	616458	301971	368488	421485	
7	Meerut	182073	218780	277018	281278	391558	337182	289200	243545	289922	
8	Shamli	81088	97476	135096	124187	113792	107556	103462	NA	NA	

Table 7(b):

S.No.	Name of District	Assimilative Carrying Capacity, Kg (y)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Bagpat	66050	79392	107133	107794	82166	66182	57199	61030	76750	
2	Bulandshahr	225600	271171	365923	368179	280646	226051	195370	208454	262147	
3	Gautam Budh Nagar	64100	77048	103970	104611	79740	64228	55511	59228	74484	
4	Ghaziabad	58950	70858	95617	96206	73334	59068	51051	54470	68500	
5	Hapur	33000	39666	53526	53856	41052	33066	28578	30492	38346	
6	Muzaffamagar	200400	240881	325049	327053	249298	200801	173546	185170	232865	
7	Meerut	127950	153796	207535	208814	159170	128206	110805	118226	148678	
8	Sham li	58379	70172	94691	95275	72623	5849,6	50556	53942	67836	

Table 7(c):

S.No.	Name of District	Supportive Carrying Capacity, Kg (z) i.e (y-x)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Bagpat	-40291	-129409	-174627	-209120	-105173	-135673	-91519	2441	-85193	
2	Bulandshahr	-191760	-333541	-274442	-544905	-406937	-429497	-277425	-273075	-275255	
3	Gautam Budh Nagar	-53203	-110179	-123725	-162147	-140343	-149652	-134336	-75220	-91616	
4	Ghaziabad	-68382	-146676	-146294	-219351	-140801	-144126	-124053	-70266	-91790	

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5	Hapur	-22440	-57912	-100094	-15444	-57473	-63817	-45439	-48787	-8053
6	Muzaffarnagar	-104208	-296283	-237286	-379381	-251791	-415658	-128424	-183318	-188620
7	Meerut	-54123	-64984	-69483	-52463	-232388	-208976	-178396	-125319	-141244
8	Sham li	-22709	-27305	-40406	-28913	-41168	-49060	-52905	NA	NA

Table 8: Total Existing Plylio Load, Assimilative Carrying Capacity and Supportive Carrying Capacity in NCR Districts of Rajasthan

Table 8(a):

S.No.	Name of District	Total PM ₁₀ Load, Kg (x)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Alwar	574030	1052603	1291274	1053064	807916	793494	674908	669780	740055	
2	Bharatpur	347021	636335	780620	636614	488413	479694	408006	404905	447389	

Table 8(b):

S.No.	Name of District	Assimilative Carrying Capacity, Kg (y)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Alwar	419000	503638	679618	683808	521236	419838	362854	387156	486878	
2	Bharatpur	253300	304467	410853	413386	315105	253807	219358	234049	294335	

Table 8(c):

S.No	Name of District	Supportive Carrying Capacity, Kg (z) i.e (y-x)									
		Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
1	Alwar	-155030	-548965	-611656	-369256	-286680	-373656	-312054	-282624	-253177	
2	Bharatpur	-93721	-331869	-369767	-223228	-173308	-225888	-188648	-170856	-153054	

10. It was concluded from the above data that there was no supporting carrying capacity to operate brick kilns during the entire brick kilns operating season. However, with regard to Districts where supporting carrying capacity was available in particular months such number was worked out for Haryana, UP and Rajasthan as follows:-

“Table 9: Number of brick kilns which can be operated in NCR Districts of Haryana during March-June.

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S.No.	Name of District	Load in Excess of Assimilative Carrying Capacity				Total No of Zig Zag type Brick Kilns	'No of Zig Zag type Brick Kilns, which can be operated			
		March	April	May	June		March	April	May	June
1	Bhiwani	-28668	80404	116249	85775	132	161	52	16	46
2	Faridabad (Ballabhgarh)	59651	89514	127402	97954	85	25	-5	-42	-13
3	Gurugram	40885	118701	125489	89308	6	-35	-113	-119	-83
4	Jhajjar	11004	67236	104116	59862	387	376	320	283	327
5	Jind	39179	120169	199410	198435	111	72	-9	-88	-87
6	Karnal	35280	128734	151235	135717	92	57	-37	-59	-44
7	Mahendragarh	9495	76467	58523	51136	42	33	-34	-17	-9
8	Nuh (Mewat)	5275	68834	54998	34432	62	57	-7	7	28
6	Palwal	26345	108801	95323	112446	110	84	1	15	-2
10	Panipat	2536	64014	140884	49665	87	84	23	-54	37
11	Rewari	27098	86219	118932	123567	76	49	-10	-43	-48
12	Rohtak	NA	18244	27870	36965	49	NA	31	21	12
13	Sonipat	11671	113504	163489	159303	265	253	151	102	106
14	Charkhi Dadri	NA	NA	NA	NA	29	NA	NA	NA	NA

Note: CAAQMS and AOD values for Charkhi Dadri were not available;

*Negative Values indicate that no brick kiln can be operated

Table 10: Number of brick kilns which can be operated in NCR Districts of Haryana during October- February.

S.No.	Name of District	Supportive Carrying Capacity, Kg					Total No of Zig Zag type Brick Kilns	'No of Zig Zag type Brick Kilns, which can be operated				
		October	November	December	January	February		October	November	December	January	February
1	Bhiwani	-181287	-217834	-161372	-50771	-102713	132	-181	-218	-161	-51	-103
2	Faridabad (Ballabhgarh)	-58074	-63482	-86309	-60595	-69744	85	-58	-63	-86	-61	-70
3	Gurugram	-86855	-114707	-95870	-44752	-54086	6	-87	-115	-96	-45	-54
4	Jhajjar	-57037	-66156	-35735	-8473	-24508	387	-57	-66	-36	-8	-25
5	Jind	-139493	-200348	-87747	-19973	-42386	111	-139	-200	-88	-20	-42
6	Karnal	-199065	-210841	-124392	NA	-74670	92	-199	-211	-124	NA	-75
7	Mahendragarh	-56697	-40910	-24668	-29829	-17653	42	-57	-41	-25	-30	-18
8	Nuh (Mewat)	-41244	-54361	-24796	NA	-31520	62	-41	-54	-25	NA	-32
9	Palwal	-68906	-96790	-52648	-18725	-51021	110	-69	-97	-53	-19	-51
10	Panipat	-157739	-148653	-154830	-3515	-110506	87	-158	-149	-155	-4	-111
11	Rewari	-132857	-123782	-84895	-66279	-100946	76	-133	-124	-85	-66	-101
12	Rohtak	-61359	-79059	-98428	-61270	NA	49	-61	-79	-98	-61	NA
13	Sonipat	-105591	-63787	-59724	-165682	-85069	265	-106	-64	-60	-166	-85
14	Charkhi Dadri	NA	NA	NA	NA	NA	29	NA	NA	NA	NA	NA

*Negative Values indicate that no brick kiln can be operated

The month-wise number of brick kilns which can be operated within the assimilative capacity during March-June and October- February are presented in Table 11 and Table 12 respectively, for NCR districts of Uttar Pradesh.

Table 11: Number of brick kilns which can be operated in NCR Districts of Uttar Pradesh during March-June.

S.No.	Name of District	Load in Excess of Assimilative carrying Capacity				Total No of Zig Zag type Brick Kilns	*No of Zig Zag type Brick Kilns, which can be operated			
		March	April	May	June		March	April	May	June
1	Bagpat	40291	129409	174627	209120	340	300	211	166	131
2	Bulandshahr	191760	333641	274442	644906	200	8	-134	-74	446
3	Gautam Budh Nagar	63203	110179	123726	162147	66	12	-46	-69	-97
4	Ghaziabad	68382	146676	146294	219361	79	11	-68	-67	-140
6	Hapur	22440	67912	100094	16444	62	30	-6	-48	NA
6	Muzaffarnagar	104208	296283	237286	379381	146	42	-160	-91	-233
7	Meerut	64123	64984	69483	62463	70	16	6	1	18
8	Shamli	22709	27306	40406	28913	80	67	63	40	61

*Negative Values indicate that no brick kiln can be operated

Table 12: Number of brick kilns which can be operated in NCR Districts of Uttar Pradesh during October-February.

S.No.	Name of District	Supportive Carrying Capacity, Kg					Total No of Zig Zag type Brick Kilns	*No of Zig Zag type Brick Kilns, which can be operated				
		October	November	December	January	February		October	November	December	January	February
1	Bagpat	-105173	-135673	-91519	2441	-85193	340	-105	-136	-92	2	-85
2	Bulandshahr	-406937	-429497	-277425	-273075	-275255	200	-407	-429	-277	-273	-275
3	Gautam Budh Nagar	-140343	-149652	-134336	-75220	-91616	65	-140	-150	-134	-75	-92
4	Ghaziabad	-140801	-144126	-124053	-70266	-91790	79	-141	-144	-124	-70	-92
5	Hapur	-57473	-63817	-45439	-48787	-8053	52	-57	-64	-45	-49	-8
6	Muzaffarnagar	-251791	-415658	-128424	-183318	-188620	146	-252	-416	-128	-183	-189
7	Meerut	-232388	-208976	-178396	-125319	-141244	70	-232	-209	-178	-125	-141
8	Shamli	-41168	-49060	-52905	NA	NA	80	-41	-49	-53	NA	NA

*Negative Values indicate that no brick kiln can be operated

The month-wise number of brick kilns which can be operated within the assimilative capacity during March-June and October- February are presented in Table 13 and Table 14 respectively, for NCR districts of Rajasthan.

Table 13: Number of brick kilns which can be operated in NCR Districts of Rajasthan during March-June.

S.No.	Name of District	Load in Excess of Assimilative Carrying Capacity				Total No of Zig Zag type Brick Kilns	*No of Zig Zag type Brick Kilns, which can be operated			
		March	April	May	June		March	April	May	June
1	Alwar	155030	548965	611656	369256	70	-85	-479	-542	-299
2	Bharatpur	93721	318168	311467	120320	60	-34	-258	-251	-60

*Negative Values indicate that no brick kiln can be operated

Table 14: Number of brick kilns which can be operated in NCR Districts of Rajasthan during October-February.

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S.No.	Name of District	Supportive Carrying Capacity, Kg					Total No Tag Zag	No of Zig Zag type Brick Kilns, which can be				
		October	November	December	January	February		October	November	December	January	February
1	Alwar	-286680	-373656	-312054	-282624	-253177	70	-2867	-3737	-3121	-2826	-2532
2	Bharatpur	-173308	-225888	-188648	-170856	-153054	60	-1733	-2259	-1886	-1709	-1531

Negative Values indicate that no brick kiln can be operated”

11. Finally, it has been concluded:-

“2.3. CPCB's Opinion:

CPCB was directed by Hon'ble NGT to give an expert opinion on the following:

(a) How brick kilns can be allowed in NCR without damage to the air quality;

(b) Conditions subject to which it may be done;

(c) Number of brick kilns to be allowed and criteria for fixing such numbers.

Following is the submission of CPCB on the above points:

i) Based on the evaluation of the data and estimation of the carrying capacity as explained in the previous section, there is no assimilative capacity available in the ambient air environment in the NCR districts of Haryana, Uttar Pradesh and Rajasthan for simultaneous operation of all the existing brick kilns, even after adopting Zig-zag technology. Based on the available assimilative capacity, some brick kilns may operate.

*ii) An effort was made to estimate the number of brick kilns which can be operated, within the assimilative capacity of the ambient air environment. The outcome of the month-wise and district-wise estimation w.r.t. the number of brick kilns which can be operated within the assimilative capacity without any negative effect on the ambient air is summarized in **Table 15**. In the districts, where ambient air quality data for the past is not available, due to non-availability of CAAQMS or AOD, the data of the districts having comparable population and geographical area, may be used for estimating the number of brick kilns which can be operated without affecting the ambient air quality, by the respective State Pollution Control Boards, while doing such exercise.*

Table 15: *Month-wise and District-wise estimation of the number of brick kilns which can be operated in NCR districts of Haryana, Uttar Pradesh and Rajasthan, without affecting ambient air quality.*

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S.No.	Name of District	Total No of Zig Zag type Brick Kilns	Month-wise No of Zig Zag type Brick Kilns, which can be operated without affecting the ambient air quality i.e within Assimilative Carrying Capacity									
			Mar-19	Apr-19	May-19	Jun-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	
STATE- HARYANA												
1	Bhiwani	132	161	52	16	46	0	0	0	0	0	0
2	Faridabad (Ballabhgarh)	85	25	0	0	0	0	0	0	0	0	0
3	Gurugram	6	0	0	0	0	0	0	0	0	0	0
4	Jhajjar	387	376	320	283	327	0	0	0	0	0	0
5	Jind	111	72	0	0	0	0	0	0	0	0	0
6	Karnal	92	57	0	0	0	0	0	0	0	NA	0
7	Mahendragarh	42	33	0	0	0	0	0	0	0	0	0
8	Nuh (Mewat)	62	57	0	7	28	0	0	0	0	NA	0
9	Palwal	110	84	1	15	0	0	0	0	0	0	0
10	Panipat	87	84	23	0	37	0	0	0	0	0	0
11	Rewari	76	49	0	0	0	0	0	0	0	0	0
12	Rohtak	49	NA	31	21	12	0	0	0	0	0	NA
13	Sonapat	265	253	151	102	106	0	0	0	0	0	0
14	Charkhi Dadri	29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

STATE- UTTAR PRADESH

1	Bagpat	340	300	211	165	131	0	0	0	2	0
2	Bulandshahr	200	8	0	0	0	0	0	0	0	0
3	Gautam Budh Nagar	65	12	0	0	0	0	0	0	0	0
4	Ghaziabad	79	11	0	0	0	0	0	0	0	0
5	Hapur	52	30	0	0	NA	0	0	0	0	0
6	Muzaffarnagar	146	42	0	0	0	0	0	0	0	0
7	Meerut	70	16	5	1	18	0	0	0	0	0
8	Shamli	80	57	53	40	51	0	0	0	NA	NA

STATE- RAJASTHAN

1	Alwar	70	0	0	0	0	0	0	0	0	0
2	Bharatpur	60	0	0	0	0	0	0	0	0	0

iii. However, the Zig-Zag type brick kilns may be asked to comply with the proposed Particulate matter standards of 250 mg/Nm³ at 17 % O₂ w.r.t. stack emissions of Particulate Matter (PM). State Pollution Control Boards may ensure operation of only permitted number of Zig-Zag type brick kilns and compliance of PM emission norms of 250 mg/Nm³ at 17 % O₂.

iv. The examination of the month-wise and district-wise carrying capacity, indicates that Zig-zag type brick kilns in NCR districts should preferably be operated in summer

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months only, unless or until there is improvement in environmental condition through reduction in PM₁₀ emissions by various sources which contribute towards PM₁₀ emissions in Delhi NCR, leading to availability in the supportive carrying capacity.

The reduction in PM₁₀ emissions by all the contributing sources of PM₁₀ emissions in Delhi-NCR becomes more significant in view of the fact that, the findings of a study on "Source Apportionment of PM_{2.5} and PM₁₀ of Delhi NCR for identification of major sources" prepared by Automotive Research Association of India (ARAI) and The Energy and Resources Institute (TERI) for Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, New Delhi, in the year 2016, indicates that that brick kiln industry contributed about 5 & 7% w.r.t. PM₁₀ emissions in Winter and summer respectively, in ambient air of Delhi and NCR. Further reduction of 4% in total PM₁₀ was expected after conversion to Zig-Zag technology, which has now been implemented by brick Kilns in Delhi-NCR.

v. The selection of brick kilns which can be operated, should be made in such a manner that there is distance of 500 mtr between two operational brick kilns, so as to ensure minimum localized impact on the ambient air

vi. In the study conducted by CPCB in the matter of O.A. No. 1088 of 2018 (I.A. No. 98/2019, 100/2019, 101/2019, 119/2019 & 266/2019); Dinesh Chahal & Ors. Vs Union of India & Ors., it was observed that stack emissions are three time higher during start-up of firing process, irrespective of firing technology, which lasts for around 7 days. **Therefore, it is recommended that even if there is enough supportive carrying capacity to operate all the zig-zag type brick kilns in any district, the start-up firing may be allowed in three batches of 33% of the total Zig-Zag type brick kilns which can be operated, with a gap of 7 days within two batches. This is to ensure that PM₁₀ emission load in the ambient air mostly remains within assimilative carrying capacity.**

vii. **In view of the carrying capacity limitations simultaneous operation of all the brick kilns may not be advisable, therefore, staggered permission for operation may be given to the existing brick kilns in such a way that only estimated number of brick kilns in area operate during any given time.**

viii. **However, all Zig-Zag brick kilns may be considered to perform upstream activities such as green brick manufacturing, stacking of green bricks, etc. during non-firing period.**

ix. **In the districts, where ambient air quality data for the past is not available, due to non-availability of CAAQMS, the data of the districts having comparable population and geographical area, may be used for estimating the number of brick kilns which can be operated without affecting the ambient air quality.**

x. ***In order to control fugitive dust emissions, adequate measures such as sprinkling of water must be taken and compliance of the conditions of the Consent to Operate/guidelines issued by concerned SPCB must be ensured.***

xi. References w.r.t. use of Piped Natural Gas (PNG), as fuel in brick manufacturing are available, but in Tunnel type brick Kilns. It is, therefore, recommended that a techno-economic feasibility study may be conducted by an expert agency, for making an assessment w.r.t. use PNG and other cleaner fuels such as internal fuels, with different types of firing technologies, for making brick manufacturing sustainable and environmental friendly, at locations where such fuels are available.”

12. Applications have been filed on behalf of the brick kilns owners to oppose the conclusion of the CPCB. CPCB has filed response on 13.10.2020 thereto reiterating its recommendations.

13. The substance of the objection to the report of CPCB with regard to the methodology for permitting the carrying capacity and emission load was not proper. In this regard, I.A. No. 60/2020, I.A. No. 306/2020, I.A. No. 308/2020, I.A. No. 310/2020, I.A. No. 311/2020, I.A. No. 312/2020, I.A. No. 313/2020, I.A. No. 339/2020, I.A. No. 340/2020 & I.A. No. 341/2020 have been filed. Response to all the said applications filed by the CPCB is as follows:-

“2. That the averments contained in para-3, are regarding submission of the applicant saying report of the CPCB as unusable for taking any decision due to alleged errors, inconsistencies and gaps. In this regard CPCB does not agree to the observations of the applicant and clarifications/justifications of various issues raised by the applicant are submitted in the subsequent sections of this affidavit.

3. That in reply to the averments contained in para- 4 to 7, it is submitted that emission load of 1000 Kg emission load per brick kiln is not an assumed or theoretical value, but the actually measured value based on the monitoring of brick kilns carried out by CPCB in compliance of the orders of Hon'ble NGT in the matter of O.A. No. 1088/2018; Dinesh Chahal vs. Union of India. CPCB has revisited all the calculations and confirm that these calculations are technically correct.

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The data considered in the report submitted to Hon'ble NGT by CPCB , for calculation of emission load, based on the actual monitoring performed by CPCB in the matter of OA No. 1088/2018; Dinesh Chahal & Ors. Vs Union of India & Ors., is as follows:

Average stack height: 34 mtr; Average stack diameter: 4 mtr (At the point, where monitoring was done i.e port hole); Flue gas velocity: 4 mtr/Sec (At the point, where monitoring was done i.e. port hole); Ts, K: 325; Ps, mm of Hg: 745; Average O2%: 18.86; Average CO2: 2.10

This issue is further discussed technically in the subsequent Section, in reply to averments made the applicant on the same issue in para 8-13.

4. That in reply to the averments contained in para-8 to 15, it is submitted that:

- The emission load of 1000 kg/day/per brick kilns considered by CPCB is not an assumed value but measured value based on the stack monitoring of the brick kilns in the Hon'ble NGT matter of O.A. No. 1088/2018; Dinesh Chahal vs. Union of India.
- All the calculations made by CPCB in the report submitted to Hon'ble NGT in this matter are based on the monitoring of the actual current working of the brick kilns during study conducted by CPCB in compliance of the orders of Hon'ble NGT.
- The data considered in the report submitted to Ho'ble NGT by CPCB, for calculation of emission load, based on the actual monitoring performed by CPCB in the matter of OA No. 1088/2018 ; Dinesh Chahal & Ors. Vs Union of India & Ors., is as follows:

Average stack height: 34 mtr; Average stack diameter : 4 mtr (At the point, where monitoring was done i.e port hole); Flue gas velocity : 4 mtr/Sec (At the point, where monitoring was done i.e. port hole); Ts, K: 325; Ps, mm of Hg: 745; Average O2%: 18.86; Average CO2: 2.10

- The CPCB is in agreement with all the standard formulae, equations and examples quoted by the expert hired by the applicant. In response to claim of the applicant that emission load can be simply calculated using the following formula and also that only two variables are required to be known for this purpose i.e. Concentration of PM in stack gases and volume of stack gases:

$$\text{Emission Load} = \frac{\text{Concentration of PM in stack gases (mg/Nm}^3\text{)}}{\text{Volumetric flow rate of stack gases}}$$

CPCB is of the view that the formula reproduced by the applicant is correct. However, it is important to mention here that to get volumetric flow rate of the stack gases (one of the variable for calculation of emission as highlighted by the applicant), measurement of four other parameters viz. stack diameter, stack area at the point where emissions were monitored, temperature of flue gas, pressure and velocity of flue gases passing through stack during required during stack monitoring.

The flow of flue gas obtained through actual measurement by CPCB during stack monitoring of brick kilns is much higher than claimed by the applicant based on theoretical calculations and previous reports in this regard. CPCB has revisited its calculations and confirm that all the calculations made in the report are technically correct.

In view of the above explanation, comparison of contribution of brick kilns based on such extrapolated emission loads with the values obtained through source apportionment studies, as done by the applicant on Page No. 1569 of the I.A. 60 of 2020, will lead to abnormal and unjustified conclusion. Therefore, the conclusion drawn by the applicant by making such comparison of two different methodologies, is not correct and unjustified.

According to the applicant, the fundamental assumption of 1000 Kg emission/day/brick kiln has affected all aspects of the report submitted by CPCB. It has already been explained in the above sections that this is not assumed value but the actual measured value. The data considered in the report submitted to Hon'ble NGT by CPCB, for calculation of emission load, based on the actual monitoring performed by CPCB in the matter of OA No. 1088/2018 ; Dinesh Chahal & Ors. Vs Union of India & Ors., is as follows:

Average stack height: 34 mtr; Average stack diameter : 4 mtr (At the point, where monitoring was done i.e port hole); Flue gas velocity : 4 mtr/Sec (At the point, where monitoring was done i.e. port hole); Ts, K: 325; Ps, mm of Hg: 745; Average O2%: 18.86; Average CO2: 2.10

The following is the methodology followed to arrive at the outcome of number of brick kilns which can be operated under the available carrying capacity:

For the Months of March-June, 2019:

As per report of CPCB, all the zig-zag type brick kilns were in operation during March-June, 2019. Further, since, for the months of March — June, 2019, there was negative supportive capacity (Emission load in excess of assimilative capacity), we have to calculate the number of brick kilns, which are required to shut to bring the emission load within the assimilative capacity. The number of brick kilns required to be shut was calculated by dividing the excess load by the emission load of one brick kiln. The number of brick kilns, which can be operated in such cases was determined as follows:

No. of brick kilns which can be operated = Total number of Zig-Zag brick kilns Operational in that particular month — (Negative Supportive Carrying Capacity/ Emission Load from one brick Kiln)

Suppose, we have to reduce the emission load by 1000 Kg, to bring the emission load within assimilative capacity, the formula has been used by CPCB in the report:

*No. of brick kiln required to shut = reduction in load required/emission load of one brick kiln
No. of brick kiln required to shut = 1000/1000 i.e 1 brick kiln*

So, to reduce the emission load by 1000 Kg, we need to shut only one brick kiln

For the Months of October, 19-February, 20:

As per CPCB's report, the brick kilns were not in operation and CPCB was required to calculate the number of brick kilns which can be operated based on the available Carrying Capacity as per following formula:

*Total number of brick kilns which can be operated:
Supportive Carrying Capacity of the district for a particular month/Emission load from one brick kiln.*

Despite no brick kilns in operation during October-February, there was no supportive capacity and hence no brick kilns can be operated irrespective of emission load from brick kilns."

Discussion on the Issues raised

14. We have heard the learned counsel in support of such objections. Substance of their submission is that methodology in assessing carrying capacity and pollution load is not correct. There is no certainty in the report and without such certainty the right to trade cannot be affected. If the brick kilns are not operating, bricks will be transported which will add to the pollution. Some brick kilns are at far locations which do not affect the air quality. There are other sources of pollution and prohibition of brick kilns activities will be violative of right of equality.

15. We are unable to find any substance in the objections. CPCB has duly explained that the Carrying Capacity is based on monthly average data on PM₁₀ generated from CAAQMS and where no such data was available, Aerosol Optical Depths were extrapolated to PM. Further, carrying capacity has been assessed by taking mixing heights into consideration and comparing with identical air shed of districts geographical area and dispersion air volume conditions. With regard to

emission load, the load is based on actually monitored values taking stack diameter, velocity, temperature and pressure of flue gases and standard of 250 mg/Nm³ at 17% O₂. Overall fact is that entire NCR has no carrying capacity to take load of the pollution of the brick kilns as already levels of PM₁₀ and PM_{2.5} are exceeding daily/annual standards. As per Table 15 of the Report, no brick kiln has scope to operate except, some may, during March to June.

16. Other issues raised are no longer res integra and are covered against the objectors by the law laid down by the Hon'ble Supreme Court. Reference may be made to some of the judgements dealing with the issue.

Supreme Court judgments dealing with Air quality of NCR, Precautionary principle, control of pollution from one source when there are multiple sources and enforcement of environment norms where right to trade is pleaded

17. In Arjun Gopal & Ors. v. UOI & Ors.⁴, it was observed that the residents of NCR faced severe air quality standards which were worst in the World. It had serious adverse health impact. Life of citizens in NCR had been brought to virtual standstill. The Capital was smoked into an environmental emergency of unseen proportions. It will be appropriate to extract some observations from the judgment:-

"4. The onset of winter and the festival/marriage season this year, presented to the residents of NCR severe concerns regarding the air quality standards. According to reports, the air quality standards in early November of this year were the worst in the world. It is reported that the PM_{2.5} levels recorded were "beyond scale" values (see India's Air Quality Among World's Worst Over Diwali Weekend: Report. 4-11-2016, Hindustan Times). The report indicates that 24-hour average of PM_{2.5} levels in South Delhi in 2016 were 38% higher than on the Diwali night of 2015. The day after Diwali, these levels were twice as high as the day after Diwali in 2015, crossing 650 µg/m³, which is 26 times above the WHO's standards or levels

⁴(2017) 1 SCC 412

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considered safe. Shockingly, on the morning of 1-11-2016, Delhi woke up to an average $PM_{2.5}$ level of over $700 \mu\text{g}/\text{m}^3$ — some of the highest levels recorded the world over and 29 times above WHO standards. The report further states that the WHO guideline for 24-hour average $PM_{2.5}$ levels is $25 \mu\text{g}/\text{m}^3$ and with an annual average $PM_{2.5}$ level of $122 \mu\text{g}/\text{m}^3$, Delhi's air is the worst among global megacities with dense populations. We have particularly referred to the $PM_{2.5}$ levels because of the extreme effects and near invisibility of this type of particulate matter. $PM_{2.5}$ or particulate matter 2.5 ($PM_{2.5}$), refers to tiny particles or droplets in the air that are two-and-one-half microns or less in width. It may be noted that the widths of the larger particles in the $PM_{2.5}$ size range would be about thirty times smaller than that of a human hair. These particles primarily emanate from vehicle exhausts and other operations that involve the burning of fuels such as wood, heating oil or coal, and of course, use of fire crackers.

5. In India, air quality standards are measured in terms of the Air Quality Index (hereinafter "AQI"). The AQI was launched in India on 17-10-2014 by the Ministry of Environment and Forests. According to the press release of the Press information Bureau of the same date, it consists of a comprehensive set of parameters to monitor and assess the air quality. The AQI considers eight pollutants (PM_{10} , $PM_{2.5}$, NO_2 , SO_2 , CO , O_3 , NH_3 , and Pb), and based on the levels of these pollutants six categories of AQI ranging from "Good" to "Severe" have been prescribed. The index also suggests the health effects of the pollution categorywise. The gradation of AQI and its health impact is extracted below:

Table 1

AQI	Associated Health Impacts
Good (0-50)	Minimal impact.
Satisfactory (51-100)	May cause minor breathing discomfort to sensitive people.
Moderately polluted (101-200)	May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.
Poor (201-300)	May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease.
Very Poor (301-400)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
Severe May (401-500)	May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.

Table 2

AQI Category, Pollutants and Health Breakpoints								
AQI category (Range)	PM_{10} 24-hr	$PM_{2.5}$ 24-hr	NO_2 24-hr	O_3 8-hr	CO 8-hr (mg/m^3)	SO_2 24-hr	NH_3 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-

								0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5-1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1-10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very poor (301-400)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800	3.1-3.5
Severe (401-500)	430+	250+	400+	748+*	34+	1600+	1800+	3.5+

6. Reports indicate that AQI in Delhi was much above the severe standard, shooting off the AQI 500 mark on many days this November. On the day after Diwali, it was more than 14 times the safe limits (see Delhi's Pollution Levels Peaks at 14-16 Times Safe Limits, 31-10-2016, The Hindu). The adverse health effects of these hazardous levels of pollution are only too evident from the table given above. We do not intend to refer to the multiplicity of reports and data on this front.

7. The hazardous levels of air pollution in the last few weeks has spared very few from its ill effects. The life of the citizens of NCR was brought to a virtual standstill, not to speak about the plight of the thousands of mute flora and fauna in NCR. Schools were declared shut, denizens of the city advised to stay indoors, construction activities stopped, power stations shut and ban imposed on burning of garbage and agricultural waste. The fall in air quality has had a significant impact on people's lifestyle as well. The rising costs to protect against air pollution are substantial. It has come to our notice that people are queuing up to purchase protective masks and air purification systems in the wake of dense smog all over the NCR. In short, the capital was "smogged" into an environmental emergency of unseen proportions.

8. The adverse effects of these extreme levels of air pollution spare no one — the young, the old, the infirm and even the future generations. A study of the data of the Global Health Depository of the World Health Organisation reveals that India has the world's highest death rate from chronic respiratory diseases and that about 1.5 million people in India die annually due to indoor and outdoor pollution (see Delhi Wakes up to an Air Pollution Problem it cannot Ignore, 15-2-2015, The New York Times). The Kolkata-based Chittaranjan National Cancer Institute (CNCI), in a study commissioned and handed over to the Central Pollution Control Board, found that key indicators of respiratory health, lung function to palpitation, vision to blood pressure, of children in Delhi, between four and 17 years of age, were worse off than their counterparts elsewhere. It also found that more than 40% of the school children suffer from lung damage (see Landmark Study Lies Buried, 2-4-2015, The Indian Express). We note with apprehension that there are nascent

studies that suggest that pollution can lower children's IQ, hurt their test scores and increase the risks of autism, epilepsy, diabetes and even adult-onset diseases like multiple sclerosis (see Holding Your Breath in India, 29-5-2015, The New York Times).

9. It has been brought to our notice that the severe air pollution in the NCR is leading to multiple diseases and other health related issues amongst the people. It is said that the increase in respiratory diseases like asthma, lung cancer, bronchitis, etc. is primarily attributable to the worsening air quality in the NCR. The damage being caused to people's lungs is said to be irreversible. Other health related issues like allergies, temporary deafness are also on the rise. Various experts have pointed towards multiple adverse effects of air pollution on human health like premature deaths, rise in mortality rates, palpitation, loss of vision, arthritis, heart ailments, cancer, etc.

10. When we refer to these extreme effects, we are not merely referring to the inconvenience caused to people, but to abject deprivation of a range of constitutionally embedded rights that the residents of NCR ought to have enjoyed. Needless to state, the grim situation of air quality adversely affected the right to education, work, health and ultimately, the right to life of the citizens, and this Court is constitutionally bound to address their grave concerns. May we remind ourselves, that this is not the first time that this Court was impelled into ensuring clean air for the citizens of the capital region (see M.C. Mehta v. Union of India [M.C. Mehta v. Union of India, (1998) 6 SCC 60] , [M.C. Mehta v. Union of India, (1998) 9 SCC 589] , M.C. Mehta v. Union of India [M.C. Mehta v. Union of India, (1998) 8 SCC 648] and M.C. Mehta v. Union of India [M.C. Mehta v. Union of India, (1998) 8 SCC 206]).”

18. In the context of banning sale of crackers having adverse impact on the air quality, it was held that **even if there were several sources of pollution, a particular polluting activity could be prohibited.** No equality could be pleaded in this regard. Right to trade was not absolute and could be restricted for protection of Environment which was a specific Directive Principle of State Policy enforcement of which was a reasonable restriction on fundamental right to trade. The 'Precautionary Principle' of environmental law allows prohibition of a polluting activity even in absence of scientific certainty. Relevant extract are as follows:-

“37 The aforesaid findings are sufficient to negate the arguments of the opposite side that there is absence of scientific

study about the adverse effect of firecrackers during Diwali. In environmental law, "precautionary principle" is one of the well-recognised principles which is followed to save the environment. It is rightly argued by the petitioners that this principle does not need exact studies/material. The very word "precautionary" indicates that such a measure is taken by way of precaution which can be resorted to even in the absence of definite studies. In *Vellore Citizens' Welfare Forum [Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647]*, this Court explained the principle in the following manner: (SCC pp. 658 & 660, paras 11 & 14-16)

"11. Some of the salient principles of "Sustainable Development", as culled out from Brundtland Report and other international documents, are Inter-Generational Equity, Use and Conservation of Natural Resources, Environmental Protection, the Precautionary Principle, Polluter Pays Principle, Obligation to Assist and Cooperate, Eradication of Poverty and Financial Assistance to the developing countries. We are, however, of the view that "the precautionary principle" and "the polluter pays principle" are essential features of "Sustainable Development". The "precautionary principle" — in the context of the municipal law — means:

(i) Environmental measures — by the State Government and the statutory authorities — must anticipate, prevent and attack the causes of environmental degradation.

(ii) **Where there are threats of serious and irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.**

(iii) The "onus of proof" is on the actor or the developer/industrialist to show that his action is environmentally benign.

14. In view of the abovementioned constitutional and statutory provisions we have no hesitation in holding that the precautionary principle and the polluter pays principle are part of the environmental law of the country.

15. Even otherwise once these principles are accepted as part of the Customary International Law there would be no difficulty in accepting them as part of the domestic law. It is almost an accepted proposition of law that the rules of Customary International Law which are not contrary to the municipal law shall be deemed to have been incorporated in the domestic law and shall be followed by the courts of law. To support we may refer to H.R. Khanna, J.'s opinion in *ADM, Jabalpur v. Shivakant Shukla [ADM, Jabalpur v. Shivakant Shukla, (1976) 2 SCC 521]*, *Jolly George Varghese case [Jolly George Varghese v. Bank of Cochin, (1980) 2 SCC 360]* and *Gramophone Co. case [Gramophone Co. of India Ltd. v. Birendra Bahadur Pandey, (1984) 2 SCC 534 : 1984 SCC (Cri) 313]*.

16. The constitutional and statutory provisions protect a person's right to fresh air, clean water and pollution-free environment, but the source of the right is the inalienable common law right of clean environment. ..."

38. The precautionary principle accepted in the aforesaid judgment was further elaborated in *A.P. Pollution Control Board case [A.P. Pollution*

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Control Board v. M.V. Nayudu, (1999) 2 SCC 718] as under: (SCC pp. 732-34, paras 31-35)

“31. The “uncertainty” of scientific proof and its changing frontiers from time to time has led to great changes in environmental concepts during the period between the Stockholm Conference of 1972 and the Rio Conference of 1992. In *Vellore Citizens' Welfare Forum v. Union of India* [*Vellore Citizens' Welfare Forum v. Union of India*, (1996) 5 SCC 647] a three-Judge Bench of this Court referred to these changes, to the “precautionary principle” and the new concept of “burden of proof” in environmental matters. Kuldip Singh, J. after referring to the principles evolved in various international conferences and to the concept of “sustainable development”, stated that the precautionary principle, the polluter pays principle and the special concept of onus of proof have now emerged and govern the law in our country too, as is clear from Articles 47, 48-A and 51-A(g) of our Constitution and that, in fact, in the various environmental statutes, such as the Water Act, 1974 and other statutes, including the Environment (Protection) Act, 1986, these concepts are already implied. The learned Judge declared that these principles have now become part of our law. The relevant observations in *Vellore case* [*Vellore Citizens' Welfare Forum v. Union of India*, (1996) 5 SCC 647] in this behalf read as follows: (SCC p. 660, para 14)

‘14. In view of the abovementioned constitutional and statutory provisions we have no hesitation in holding that the precautionary principle and the polluter pays principle are part of the environmental law of the country.’

The Court observed that even otherwise, the abovesaid principles are accepted as part of the customary international law and hence there should be no difficulty in accepting them as part of our domestic law. In fact, on the facts of the case before this Court, it was directed that the authority to be appointed under Section 3(3) of the Environment (Protection) Act, 1986

‘shall implement the “precautionary principle” and the “polluter pays principle”’.

The learned Judges also observed that the new concept which places the burden of proof on the developer or industrialist who is proposing to alter the status quo, has also become part of our environmental law.

32. The *Vellore* [*Vellore Citizens' Welfare Forum v. Union of India*, (1996) 5 SCC 647] judgment has referred to these principles briefly but, in our view, it is necessary to explain their meaning in more detail, so that courts and tribunals or environmental authorities can properly apply the said principles in the matters which come before them.

33. **A basic shift in the approach to environmental protection occurred initially between 1972 and 1982. Earlier, the concept was based on the “assimilative capacity” rule as revealed from Principle 6 of the Stockholm Declaration of the U.N. Conference on Human Environment, 1972. The said principle assumed that science could provide policy-makers with the information and means necessary to avoid encroaching upon the capacity of the environment to assimilate impacts and it presumed that relevant technical expertise would be available when environmental harm was predicted and there would be sufficient time to act in order to avoid such harm. But in the 11th Principle of the U.N. General Assembly Resolution on World**

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Charter for Nature, 1982, the emphasis shifted to the "precautionary principle", and this was reiterated in the Rio Conference of 1992 in its Principle 15 which reads as follows:

'Principle 15.—In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for proposing cost-effective measures to prevent environmental degradation.'

34. In regard to the cause for the emergence of this principle, Charmian Barton, in the article earlier referred to in "The Status of the Precautionary Principle in Australia" [(1998) 22 Harvard Environmental Law Review 509 at p. 547] says:

'There is nothing to prevent decision-makers from assessing the record and concluding that there is inadequate information on which to reach a determination. If it is not possible to make a decision with "some" confidence, **then it makes sense to err on the side of caution and prevent activities that may cause serious or irreversible harm.** An informed decision can be made at a later stage when additional data is available or resources permit further research. To ensure that greater caution is taken in environmental management, implementation of the principle through judicial and legislative means is necessary.'

In other words, the inadequacies of science is the real basis that has led to the precautionary principle of 1982. It is based on the theory that it is better to err on the side of caution and prevent environmental harm which may indeed become irreversible.

35. The principle of precaution involves the anticipation of environmental harm and taking measures to avoid it or to choose the least environmentally harmful activity. It is based on scientific uncertainty. Environmental protection should not only aim at protecting health, property and economic interest but also protect the environment for its own sake. Precautionary duties must not only be triggered by the suspicion of concrete danger but also by (justified) concern or risk potential. The precautionary principle was recommended by the UNEP Governing Council (1989). The Bomako Convention also lowered the threshold at which scientific evidence might require action by not referring to "serious" or "irreversible" as adjectives qualifying harm. However, summing up the legal status of the precautionary principle, one commentator characterised the principle as still "evolving" for though it is accepted as part of the international customary law, 'the consequences of its application in any potential situation will be influenced by the circumstances of each case'. (See First Report of Dr. Sreenivasa Rao Pemmaraju — Special Rapporteur, International Law Commission dated 3-4-1998, paras 61 to 72.)"

(emphasis in original)

39. In such cases which pertain to the protection of environment, thrusting of "onus of proof" on the developer/industrialist in Vellore Citizens' Welfare Forum [Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647] was also elaborated by the Court in the following manner: (A.P. Pollution Control Board case [A.P. Pollution Control Board v. M.V. Nayudu, (1999) 2 SCC 718] , SCC pp. 734-35, paras 36-38)

"36. We shall next elaborate the new concept of burden of proof referred to in Vellore case [Vellore Citizens' Welfare Forum v. Union of India, (1996)

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5 SCC 647] at p. 658. In that case, Kuldip Singh, J. stated as follows: (SCC p. 658, para 11)

'(iii) The "onus of proof" is on the actor or the developer/industrialist to show that his action is environmentally benign.'

37. It is to be noticed that while the inadequacies of science have led to the "precautionary principle", the said "precautionary principle" in its turn, has led to the special principle of burden of proof in environmental cases where burden as to the absence of injurious effect of the actions proposed, — is placed on those who want to change the status quo (Wynne, "Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventive Paradigm" [(1992) 2 Global Environmental Change 111 at p. 123]). This is often termed as a reversal of the burden of proof, because otherwise in environmental cases, those opposing the change would be compelled to shoulder the evidentiary burden, a procedure which is not fair. Therefore, it is necessary that the **party attempting to preserve the status quo by maintaining a less polluted state should not carry the burden of proof and the party who wants to alter it, must bear this burden.** (See James M. Olson, "Shifting the Burden of Proof: How the Common Law can Safeguard Nature and Promote an Earth Ethic" [(1990) 20 Environmental Law 891 at p. 898] .) (Quoted in "The Status of the Precautionary Principle in Australia" [(1998) 22 Harvard Environmental Law Review 509 at p. 547] at pp. 519, 550.)

38. The precautionary principle suggests that where there is an identifiable risk of serious or irreversible harm, including, for example, extinction of species, widespread toxic pollution in major threats to essential ecological processes, it may be appropriate to place the burden of proof on the person or entity proposing the activity that is potentially harmful to the environment. (See Report of Dr Sreenivasa Rao Pemmaraju, Special Rapporteur, International Law Commission, dated 3-4-1998, Para 61.)"

(emphasis in original)

41. It may be stressed that in Vellore Citizens' Welfare Forum case [Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647], this Court had banned the tanneries when it was found that they were causing immense damage to the environment. Thus, environment protection, which is a facet of Article 21, was given supremacy over the right to carry on business enshrined in Article 19(1)(g). We state at the cost of repetition that right to health, which is recognised as a facet of Article 21 of the Constitution and, therefore, is a fundamental right, assumes greater importance. It is not only the petitioners and other applicants who have intervened in support of the petitioners but the issue involves millions of persons living in Delhi and NCR, whose right to health is at stake. However, for the time being, without going into this debate in greater details, our endeavour is to strive at balancing of two rights, namely, right of the petitioners under Article 21 and right of the manufacturers and traders under Article 19(1)(g) of the Constitution.

44. Applying the aforesaid principle, in the first blush it may appear that the aforesaid argument has substantial force in it. However, that would be only one side of the picture as there are two contra-arguments which are sufficient to take the sheen out of the aforesaid plea. First aspect is that the argument of economic hardship is pitched against right to health and life. **When the Court is called upon to protect the right to life, economic effect of a particular measure for the protection of such**

right to health will have to give way to this fundamental right. Second factor, which is equally important, is that the economic loss to the State is pitched against the economic loss in the form of cost of treatment for treating the ailments with which people suffer as a result of burning of these crackers. Health hazards in the form of various diseases that are the direct result of burning of crackers have already been noted above. It leads to asthma, coughing, bronchitis, retarded nervous system breakdown and even cognitive impairment. Some of the diseases continue on a prolonged basis. Some of these which are caused because of high level of PM_{2.5} are even irreversible. In such cases, patients may have to continue to get the medical treatment for much longer period and even for life. Though there are no statistics as to what would be the cost for treating such diseases which are as a direct consequence of fireworks on these occasions like Diwali, it can safely be said that this may also be substantial. It may be more than the revenue which is generated from the manufacturers of the crackers. However, we say no more for want of precise statistical data in this behalf."

Carrying Capacity Concept

19. Carrying capacity is a facet of sustainable development. It is inherent in 'Precautionary Principle' as well as in 'Inter-generational Equity'. In *MC Mehta v. UOI & Ors.*⁵, construction activity in the catchment area of Badkhal were directed to be restricted/regulated to the level of Carrying capacity. It was observed that:-

"Preventive measures have to be taken keeping in view of the carrying capacity of the ecosystem operating in the environmental surroundings under consideration."

20. In *Vellore Citizens' Welfare Forum v. UOI & Ors.*⁶, it was observed that quality of human life is to be improved within the carrying capacity to supporting ecosystem. Relevant extract is as follows:-

"10..... During the two decades from Stockholm to Rio "Sustainable Development" has come to be accepted as a viable concept to eradicate poverty and improve the quality of human life while living within the carrying capacity of the supporting ecosystems. "Sustainable Development" as defined by the Brundtland Report means "Development that meets the needs of the present without compromising the ability of the future generations to meet their own needs". We have no hesitation in

⁵(1997) 3 SCC 715

⁶(1996) 5 SCC 647

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holding that "Sustainable Development" as a balancing concept between ecology and development has been accepted as a part of the customary international law though its salient features have yet to be finalised by the international law jurists."

21. These observations are reiterated in (2006) 6 SCC 371.⁷

Pollution from Brick kilns – shifting from coal to Natural gas as fuel

22. In M.C. Mehta (Taj Trapezium Pollution) v. UOI & Ors.⁸, the Hon'ble Supreme Court held that pollution caused by brick kilns in Taj Trapezium area was harmful to the Taj. Brick kilns within radius of 20 km were directed to be closed/relocated and replacement of the fuel by natural gas was suggested.⁹

CNG replaced for diesel as fuel, closing Thermal Plant and controlling carbon emitting activities to control pollution

23. In M.C. Mehta v. UOI & Ors.¹⁰ the issue for consideration was vehicular pollution on account of use of diesel considering the constitutional obligation, adverse impact of air pollution on health, the Hon'ble Supreme Court directed allocation of CNG and replacement of diesel vehicles of CNG.¹¹ In M.C. Mehta v. UOI & Ors.,¹² various directions were issued to deal with the adverse air quality in Delhi including phasing out of old vehicles, **closing Badarpur Thermal Power Station** increasing Metro frequency, stopping burning of waste, vacuum cleaning of roads.

⁷ Para 66 to 76

⁸ (2001) 9 SCC 235

⁹ Para 1 & 2

¹⁰ (2002) 4 SCC 356

¹¹ Para 1,3,11,21 to 24, 26 & 29

¹² (2016) 4 SCC 269

Tribunal’s Approach to the subject

24. The Tribunal has a mandate to follow these principles under Section 20 read with Section 15 of the National Green Tribunal Act, 2010 and can issue appropriate directions for enforcement of these principles, as laid down in Mantri Techzone Pvt. Ltd. v. Forward Foundation and Ors.,¹³ and the Director General (Road Development) NHAI v. Aam Aadmi Lok Manch.¹⁴ Environmental rule of law requires strict enforcement of these principles as laid down in *Hanuman Laxman Aroskar v. UOI*.¹⁵

25. This Tribunal in O.A. No. 681/2018, vide order dated 21.08.2020, dealt with the remedial measures for restoration of air quality in 122 Non-attainment cities, including Delhi where air quality is generally beyond norms. The Tribunal directed stopping polluting activities, including brick kilns and assessment of carrying capacity of urban areas to take policy decisions to control polluting potential activities beyond carrying capacity. The Tribunal observed:-

“3. The Tribunal noted the concern arising from such large scale air pollution which grapples the country in spite of statutory mechanism under the Air Act, directions of the CPCB under section 18(1)(b), dated 29.12.2015 and directions of the Hon’ble Supreme Court for control of vehicular pollution¹⁶, industrial and construction sector pollution¹⁷, power sector pollution¹⁸ and

¹³ 2019 SCC online SC 322, Para 43-47
¹⁴ AIR 2020 (SC) 3471, Para 75
¹⁵ (2019) 15 SCC 401
¹⁶ Rural Litigation and Entitlement Kendra, Dehradune and Others Vs State of U.P. Others (1985) 2 SCC 431, M.C. Mehta v. Union of India (2001) 3 SCC 756, M.C. Mehta v. Union of India (1998) 6 SCC 63, M.C. Mehta v. Union of India (2002) 4 SCC 356, M.C. Mehta v. Union of India (1998) 6 SCC 60
¹⁷ M.C. Mehta v. Union of India (1997) 2 SCC 353, M.C. Mehta v. Union of India and Shriram Foods and Fertilizer Industries and Anr. (1986) 2 SCC 176, Rural Litigation and Entitlement Kendra, Dehradun v. State of U.P. (1985) 2SCC 431, Mohd. Haroon Ansari v. District Collector (2004) 1 SCC 491, Union of India v. Union Carbide Co. (1989) 1 SCC 674, M.C. Mehta v. Union of India (1992) 3 SCC 256, Sterlite Industries (India) Ltd. etc. v. Union of India & Ors.(2013) 4SCC 575 , M.C. Mehta v. Union of India (2004) 6 SCC 588, M.C. Mehta v. Kamal Nath (2000)6 SCC 213
¹⁸ Consumer Education and Research Centre v. Union of India (1995)3 SCC 42, Dahanu Taluka Environment Protection group and Ors. v. Bombay Suburban Electricity Supply Company Ltd. and Ors (1991) 2SCC 539

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agricultural sector pollution¹⁹ and orders of this Tribunal dealing with the said issues²⁰. The Tribunal also referred to a Comprehensive Action Plan (CAP) for air pollution control for NCR prepared in pursuance of order of the Hon'ble Supreme Court dated 06.2.2017 by the Environment Pollution (Prevention and Control) Authority (EPCA) in consultation with the CPCB and Delhi Pollution Control Committee (DPCC) on 05.04.2017²¹ and Graded Response Action Plan (GRAP) notified by the MoEF&CC on 12.01.2017 stipulating specific steps for different levels of air quality such as **improvement in emission and fuel quality and other measures for vehicles, strategies to reduce vehicle numbers, non-motorised transport network, parking policy, traffic management, closure of polluting power plants and industries including brick kilns, control of generator sets, open burning, open eateries, road dust, construction dust, etc.²²**

4. Implementation of prescribed norms in the light of legal provisions and court directions remains a challenge. The consequence is that India is being ranked high in terms of level of pollution compared to many other countries with enormous adverse impact on public health. Most victims are children, senior citizens and the poor.²³

5. The GRAP categorises levels of pollution as severe plus, severe, very poor, moderate to poor. The action to be taken in such situations includes stopping entry of trucks, stopping construction activities, odd and even scheme of private vehicles, shutting of schools, closing of brick kilns, stone crushers, hot mix plants, power plants, intensifying public transport services, mechanized cleaning of road, and sprinkling of water, stopping the use of diesel generator sets, enhancing parking fees, etc.

6. The MoEF&CC has by various notifications put restrictions on activities in Coastal areas, Flood plains, Taj corridor Eco-sensitive zones, etc. in view of ecological sensitivity and impact of such activities on environment if such activities are carried out in unregulated areas. This needs to be extended to the NACs in view of impact on public health and environment to give effect to the 'Precautionary' and 'Sustainable Development' principles."

7to 13..xxx.....xxxx.....xxx

¹⁹ Arjun Gopal and Ors v. Union of India and Ors (2017) 16 SCC 280, Dr. B.L Wadhwa v. Union of India and Ors (1996) 2 SCC 594

²⁰ Vardhman Kaushik v. Union of India and Ors. O.A no. 21 of 2014, Vikrant Kumar Tongad v. Environment Pollution (Prevention and Control) Authority and Ors, O.A No. 118 of 2013, Satish Kumar v. Union of India and Ors, O.A. No. 56 (T_{HC}) OF 2013, Smt. Ganga Lalwani V. Union of India and Ors. O.A No. 451 of 2018

²¹ Report No.71, EPCA-R/2-17/L-21, Comprehensive Action Plan for air pollution control with the objective to meet ambient air quality standards in the National Capital Territory of Delhi and National Capital Region, including states of Haryana, Rajasthan and Uttar Pradesh.

²² S.O.118(E), Notification, Ministry of Environment, Forest and Climate Change

²³ <https://www.thehindu.com/sci-tech/energy-and-environment/india-ranks-177-out-of-180-in-environmental-performance-index/article22513016.ece>, <https://www.ndtv.com/delhi-news/delhis-air-pollution-has-caused-of-death-of-15-000-people-study-1883022>.



14. According to the CPCB, draft framework has been prepared and SA study completed in four States (for 05 cities). Study was under progress in 14 States (for 54 cities), and at proposal stage in 10 States (for 37 cities). Methodology for carrying capacity has been shared with State PCBs/PCCs. Twelve (12) States/UTs have given the details of the carrying capacity and the remaining have yet to take necessary steps. CC/SA studies are pre requisite for meaningful planning to enforce environmental law. This pre-requisite should have been undertaken long ago. Air quality norms have been statutorily laid down under the Air (Prevention and Control of Pollution) Act, 1981 as well as the Environment (Protection) Act, 1986 and such norms are being flagrantly violated, which has been made by the Parliament a criminal offence. If the rule of law has to have meaning and guilty are to be punished, the policies of the State have to be based on scientific studies to contain polluting activities within the scope of Carrying Capacity.”

26. Dealing with the issue of air pollution in manufacture of tiles at Morbi in Gujrat, vide order dated 6.3.2019 OA 20/17 Babubhai v GPCB, this Tribunal directed closure of industries operating with coal unless they shifted to natural gas. This was referred in the earlier order of this Tribunal in the present matter. It was further observed that while under the orders of the Hon'ble Supreme Court, GRAP was laid down providing for closing of specified activities on crossing of air quality norms as laid down in the GRAP, the same did not debar consideration of further situations requiring closure/regulation.

Conclusion

27. Thus, in view of report of the CPCB, at this stage it is not possible to vacate direction not to permit operation of brick kilns in NCR beyond the carrying capacity found by the CPCB. All applications of the brick kiln owners seeking rejection of CPCB report and vacation of interim order against operation of brick kilns, without air quality assimilative capacity permitting such activity will stand rejected subject to further exploring viable options, including change to clean fuel like natural gas. We are conscious that brick kilns may be necessary. Object of this order

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is not to stop any legitimate business activity but to enforce the right to breathe fresh air which is right to file. The source apportionment studies, placed on record, show that brick kilns contribute 5-7% PM. Air pollution Control devices to be installed by the polluting sources including the brick kilns need to comply not only the consent standards but are also the Ambient Air Quality norms and available assimilative capacity of the region. If the right to fresh air is not enforced, the consequences of brick kilns beyond carrying capacity of the air quality in the area are disastrous in terms of deaths and air borne diseases. This will be contrary to the mandate of the Constitution and the environmental law, particularly the principle of 'Sustainable Development'. It is well established that deteriorated ambient air quality in terms of PM₁₀ and PM_{2.5} affects respiratory system particularly, the lungs which may make individuals more vulnerable to get other related fatal diseases.²⁴

28. Accordingly, we direct CPCB to constitute a Committee of five experts to suggest ways and means, if any, by which sustenance of brick kilns activities may be viable. It will be open to CPCB to nominate in-house or other Experts. The CPCB may also explore viability of PNG as replacement of coal and other best practices in terms of fuel used, at other places or in other Countries. It will be open to the brick kilns owners/associations to give any other suggestions or alternatives for consideration by CPCB in spirit of collaboration with a view to find a solution within two weeks from today. Subject to the report of the expert

²⁴ <https://airqualitynews.com/2020/08/13/the-link-between-air-pollution-and-covid-19/http://www.babushahi.com/full-news.php?id=107487>

Committee finding it viable, possibility of permitting operation of brick kilns, having regard to the extent of pollution load and its effect on the air pollution level in NCT of Delhi may be considered. The CPCB may constitute an expert Committee within three weeks which may give its report within six weeks thereafter. Further report may be furnished in the matter before the next date by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF.

In view of above discussion, all interlocutory applications will stand disposed of.

List for further consideration on 11.01.2021.

Adarsh Kumar Goel, CP

S. P. Wangdi, JM

Dr. Nagin Nanda, EM

October 15, 2020
Original Application No. 1016/2019
A



CPCB/IPC-V/NGT/OA_1016/2020

November 25, 2020

Office Order

Sub: Constitution of Expert Committee in compliance of Hon'ble NGT order dated 15/10/2020, in OA. No. 1016 of 2019; Utkarsh Panwar Vs Central Pollution Control Board &Ors; to suggest ways and means, if any, by which sustenance of brick kilns activities may be viable- reg.

The Hon'ble NGT, PB, New Delhi, vide its order dated 15.10.2020, in the matter of O.A. No.1016 of 2019; Utkarsh Panwar Vs Central Pollution Control Board &Ors, directed as follow:

"Accordingly, we direct CPCB to constitute a Committee of five experts to suggest ways and means, if any, by which sustenance of brick kilns activities may be viable. It will be open to CPCB to nominate in-house or other Experts. The CPCB may also explore viability of PNG as replacement of coal and other best practices in terms of fuel used, at other places or in other Countries. It will be open to the brick kilns owners/associations to give any other suggestions or alternatives for consideration by CPCB in spirit of collaboration with a view to find a solution within two weeks from today. Subject to the report of the experts Committee findings it viable, possibility of permitting operation of bricks kilns, having regard to the extent of pollution load and its effect on the air pollution level in the NCT of Delhi may be considered. The CPCB may constitute an Expert Committee within three weeks which may give its report within six weeks thereafter. Further report may be furnished in the matter before the next date by email at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF.

In order to comply the above directions, an Expert Committee, Comprising of the following members, is hereby constituted:

1. Er. Pritpal Singh, Additional Director, Punjab State Council for Science and Technology
2. Dr. Neeraj Jain, Principal Scientist, CSIR-Central Building Research Institute
3. Mr. Mohan A Patil, Senior Director, Federation of Indian Chambers of Commerce & Industry
4. Dr. Sameer Maithel, Director, Greentech Knowledge Solutions Pvt. Ltd
5. Dr. Narender Sharma, Sc 'E', CPCB (Member Convener)

Terms of Reference (TOR) of the Expert Committee:

1. The Committee shall look into the issues raised and finalise the report within the stipulated time frame.
2. The Expert Committee shall meet as and when required.
3. The Expert Committee shall submit its report within the time frame prescribed by Hon'ble NGT.
4. Nodal Officer will coordinate with the members of the Joint Committee for conducting meetings and field visits.
5. The payment for TA/DA and sitting fee shall be made/reimbursed against the receipt of claim in accordance with the Hon'ble NGT Order dated 20.4.2017 in O.A. No. 24 of 2011. The expenditure in this regard will be met from the Budget head "NGT 25%" at CPCB.
6. The Committee shall invite any other member as a "Special Invite" as and when required.

This issue with approval of Competent Authority.

(S.K Gupta)
AD & DH,IPC-V

Copy to:

1. PS to CCB : for information of CCB, please
2. PS to MS : for information of MS, please
3. DH -Law, CPCB : for information, please
4. DH, F&A : for information, please

Annexure-3

SUMMARY SHEET

Suggestions received from various Brick Kiln Owners and Associations

S.No.	Name and Address	Technical suggestions received
1	Shri Parmendar Kumar Tomar 1219/3 Suraj Vihar, Civil Line, South Muzzaffarnagr-251002	<p>The suggestion is to incorporate Multistage Cyclone Dust Collector followed by Multistage Wet Scrubber using lime stone, in the existing Zig Zag type brick kilns for removal of 95-99% PM₁₀ and PM_{2.5}.</p> <ul style="list-style-type: none"> It is proposed to achieve SPM emission at the level of 50 ug/m³. As claimed, there will be no discharge of solid waste or liquid effluent and both solid & liquid waste will be recycled back in the green brick manufacturing process. Mr. Tomar has proposed to get this technology implemented in his brick kilns, if permitted by NGT, with the above conditions of achievement of SPM norms of < 50 ug/m³ and Zero Liquid Discharge. This was also confirmed by him over telephone. He is also ready to present this proposal before the Expert Committee, if required.
2	Shri Sanjeev Kumar, Karnal Haryana	<p>The suggestion is to incorporate Spray Chamber/ Spray-Tower Wet Scrubber.</p> <p>EPA Document No, EPA-452/F-03-016 is provided by him which says that:</p> <ul style="list-style-type: none"> Technology is based on the removal of air pollutants by internal or diffusion impaction, reaction with a sorbent or reagent slurry, or absorption into liquid solvent. These types of scrubbers are applicable for particulate matter, including PM less than or equal to 10 micrometers in aerodynamic diameter, PM less than or equal to 2.5 micrometer in aerodynamic diameter and hazardous air pollutants in particulate form and inorganic fumes, vapors and gases, it may also use to control volatile organic compounds, hydrophilic VOC. The collection efficiencies of PM range from 70 to greater than 99 percent. To control inorganic gases efficiencies range from 95 to 99 percent. SO₂ removal efficiencies vary from 80 to greater than 99 percent, depending upon the type of reagent used and spray tower design. VOC removal efficiencies vary for each pollutant solvent system and with the type of absorber used. The typical efficiency range is from 50 to 95 percent.
3	Shri Tushar Jindal, House No. 103, Sector 13, Urban Estate	<p>The suggestion is to incorporate wet scrubber techniques, which has efficiency to remove 90-99% for Sulphur emissions, particulate matter and other pollutants.</p>

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	<p>Karnal, Haryana-132001</p>	<ul style="list-style-type: none"> As claimed in the suggestion received, the wet scrubber technique is one of the most efficient technique among the red and orange category air polluting industries. It has efficiency to remove 90-99% sulphue emissions, particulate matter and other pollutants. <p>A write-up downloaded from the website of Envitech Inc(https://www.envitechline.com/brick_kiln) has been provided by him, which mentions that an optimally designed wet scrubber will have the following:</p> <ul style="list-style-type: none"> Quencher to pre-cool the gas stream. Soda Ash or cauric used as scrubbing liquor. Reflux damper or VFD on the fan motor for precise kiln draft control. Chevron style mist eliminator to achieve greater than 99.9% drop removal efficiency. Integrated waste water evaporator for sludge disposal.
<p>4</p>	<p>Sri Surender Singh Chauhan President, NCR Brick & Tile Manufacturers Association, Camp Office: 468, Sector -9, Faridabad, Haryana</p>	<p>He has suggested the following:</p> <ul style="list-style-type: none"> Single man coal feeding Properly crushed coal feeding with smaller spoon. Need to explore the following through intensive study: Dust collection filter in Shunt, Carbon Settling Chamber (Gravitational Chamber), Wet Scrubbers, Increased ID fan capacity, Reheating of flue gases etc. Before considering any proposal for switching over to PNG/CNG it is important to ensure continuous availability of the gas, time frame for laying of distribution network for supply of gas and its supply, for which commitment of Ministry of Petroleum is required. The switch over by the brick manufacturers can be considered once the required infrastructure is developed by the refineries for supply of gas. A study would also be required to assess the compatibility of use of PNG/CNG as fuel in the existing brick kilns for optimum energy utilization and impact on the quality of bricks. Consideration shall also be given for examining the reasons for closure of 2 such projects with BPCL, which are M/s Raghav Bhatta Company and M/s Ganga Ent Udyog. Both these kilns were test fired by Gas in collaboration with BPCL. Also suggesting good house-keeping practices for fugitive dust emissions. Brick Kiln industry can self-restrain its firing process during the winter season to avoid any further contribution to the pollution load, which is already at a very high level. However, the brick kiln industry should be allowed to start its firing process tentatively by the end of January onwards. He also suggested use of Agriculture residue as a fuel, both as internal and external fuel. Also suggesting use of agro-residues in Zig-zag brick kilns after converting to briquettes. Suggested that few pilot projects should be initiated by CPCB with the expert institutions, with due assistance and participation of brick kiln associations.

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5	Shri Ajit Yadav, President Haryana Pradesh Brick Kiln Owners Association	<ul style="list-style-type: none">• Suggested to consider the following for zig-zag type brick kilns:• Wet scrubbers are the most effective APCD for remove PM and other pollutants from flue gases. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, or by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants. PM or gases are collected in the scrubbing liquid.• In conjunction with wet scrubbers, the provision of dust collection filter in shunt and carbon settling chamber, will not only reduce PM emissions from zig-zag high draft kilns to negligible levels, but will also help to remove other pollutants from gas emissions.• Though even at this stage, it is submitted that there is no other single cost effective and time effective step which will attain the objective laid out by the Hon'ble NGT, than the introduction of these APCDs.• In those regions where the use of agricultural residue and internal fuel is possible, the adoption of these practices will further improve air quality. Instead, the refined burning and use of this residue in zig-zag kilns (either in the form of briquettes or otherwise), especially when APCDs are in place, should be promoted. However, it is critical to note that agricultural residue is not available in some regions, and so its use may kindly not be mandated.• Use of internal fuel in green bricks will also reduce emissions by reducing amount of fuel required for brick making. However, once again this is not possible in all regions because the characteristics of brick earth is different in all over the country, and it is not possible to mix internal fuel with the brick earth in some regions for the purpose of brick making, due to low bonding capacity of the brick earth. Use of internal fuel requires mechanized and electricity powered extruders and pugmills.• Switch over of the any industry to an alternate fuel such as PNG/CNG is a long term process, which requires the large investments and creation of gas supply infrastructure and technology, as has been demonstrated in the conversion of commercial vehicles to CNG in the NCR regions. In the case of brick kilns, the switch over presents these other following challenges as well: This option has few limitations as the technology for firing of Firing of PNG/CNG in brick kilns is not standardized. Further, the same also involves the associated issues of availability of PNG/CNG and high production cost. On calorific value basis, the cost of PNG/CNG is typically 2-3 times more compared to that of coal or biomass fuels. The use of PNG/CNG is expected to lead to significant increase in the cost of firing of bricks and brick prices, which will consequently affect numerous down-stream industries and activities.• The switch over by the brick manufacturers to cleaner fuel will be possible once the required infrastructure has been developed by the gas suppliers for the supply of gas and technology and finance is made available to brick manufacturers.• Before considering adoption of any of the above options available for further reducing emissions it is important to assess the associated impacts on brick quality specific energy consumption, additional energy and water demand, compatibility with the layout
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		<p>of the kiln, availability of the cleaner fuel, emission reduction benefits etc. such assessment would need an intensive study from an intensive study from an institute/ organization having knowledge and experience in dealing with and studying brick kilns as well as pollution such as Punjab state council for science and Technology or Central Building research institute.</p> <ul style="list-style-type: none"> • Also suggested for improvement in firing practices and housekeeping similar to what has been suggested by NCR Brick & Tile Manufacturers Association <p>Requested to give an opportunity of personal hearing before the committee to be constituted and to present further material for consideration.</p>
6	<p>Shri Rattan Ganeshgarhia Executive President, Rajasthan All Rajasthan Brick Kiln Association</p>	<ul style="list-style-type: none"> • The following suggestions have been made: • Brick kiln industry can use agricultural residue as a fuel which can help to reduce emissions and can also improve the quality of brick itself. It can be used in two ways, one as an external fuel for firing of brick and another from mixing it with clay as an internal fuel. Agriculture residue are already used in power plants as green fuel in Rajasthan and other states. • All FCBTK brick kilns are using mustard straw/husk, cotton straw, rice straw, rice husk, sugarcane bagasse etc as fuel in all Rajasthan, Haryana, Punjab & Western Uttar Pradesh since 1999 & all zig-zag brick kilns are using this as fuel in Bharatpur, Alwar, Rajasthan from 2018. • Agricultural residues can be used in zig-zag technology brick kilns in loose or by converting them into biomass based briquettes which increase the calorific value and will further reduce the surface burning of agriculture residue as a fuel. • Use of internal fuel in green bricks will also reduce emissions by reducing amount of fuel required for brick making. However, once again this is not possible in all regions because the characteristics of brick earth is different in all over the country, and it is not possible to mix internal fuel with the brick earth in some regions for the purpose of brick making, due to low bonding capacity of the brick earth. Use of internal fuel requires mechanized and electricity powered extruders and pugmills. • Switch over of the any industry to an alternate fuel such as PNG/CNG is a long term process, which requires the large investments and creation of gas supply infrastructure and technology, as has been demonstrated in the conversion of commercial vehicles to CNG in the NCR regions. In the case of brick kilns, the switch over presents these other following challenges as well: This option has few limitations as the technology for firing of Firing of PNG/CNG in brick kilns is not standardized. Further, the same also involves the associated issues of availability of PNG/CNG and high production cost. On calorific value basis, the cost of PNG/CNG is typically 2-3 times more compared to that of coal or biomass fuels. The use of PNG/CNG is expected to lead to significant increase in the cost of firing of bricks and brick prices, which will consequently affect numerous down-stream industries and activities. • Currently the zig-zag green brick setting is exclusively designed to assist in settling of bigger particles in flue gases and act as APCD

		<p>(Air Pollution Control Devices). Wet scrubbers are the most effective APCD for remove PM and other pollutants from flue gases. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, or by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants. PM or gases are collected in the scrubbing liquid.</p> <ul style="list-style-type: none"> • In conjunction with wet scrubbers, the provision of dust collection filter in shunt and carbon settling chamber, will not only reduce PM emissions from zig-zag high draft kilns to negligible levels, but will also help to remove other pollutants from gas emissions. • The feasibility of any air pollution control system will be determined by the systems efficiency in further reduction of PM, additional energy and water requirement, containment of APCD, increase ID fan capacity, need for reheating of flue gas, CAPEX & OPEX for which an intensive study/field research is required. Though even at this stage, it is submitted that there is no other single cost effective and time effective step which will attain the objective laid out by the Hon'ble NGT, than the introduction of these APCDs. • Also suggested for improvement in firing practices and housekeeping similar to what has been suggested by other Associations. • It is important to look into the season of winters as the problem of pollution is out of control in NCR and its adjoining areas because of harvesting of agriculture crop and burning of agriculture residue, cultivation of agriculture fields, Dussehra and Diwali festival, Change in atmosphere and low temperature and wind speed. Therefore, Brick Kilns can self-restrain its firing practices during winter season. However, the brick kiln should be allowed to start its firing process • The switch over by the brick manufacturers to cleaner fuel will be possible once the required infrastructure has been developed by the gas suppliers for the supply of gas and technology and finance is made available to brick manufacturers. • Before considering adoption of any of the above options available for further reducing emissions it is important to assess the associated impacts on brick quality specific energy consumption, additional energy and water demand, compatibility with the layout of the kiln, availability of the cleaner fuel, emission reduction benefits etc. such assessment would need an intensive study from an intensive study from an institute/ organization having knowledge and experience in dealing with and studying brick kilns as well as pollution such as Punjab state council for Science and Technology or Central Building research institute.
7	Sri Vijay Kumar Goel General Secretary All India Brick & Tile	Requested that constituted committee should comprise real experts having domain knowledge of brick kilns, adequate manufacturing experience, well versed with processes.

	Manufacturers Federation, Zone VI-A , 3 rd Floor, India Habitat Centre, Lodhi Road, New Delhi	
8	M/s Surya Bhatta Co., Sonapat (Through MoEF&Cc)	<p>The suggestion is to incorporate Protection Environment Pollution Control Technology (PEPT). It uses clay earth and flyash for making bricks. PEPT using the internal combustion technology is performed with the heat energy itself internal burning due to mixing of flyash and clay earth, without using any external fuel except during start-up. It is submitted that M/s Surya Bhatta is located at village Sheikhpura, Tehsil Ganaur, Sonapat engaged in manufacturing of bricks.</p> <p>The following claims have been made by the M/s Surya Bhatta Co.:</p> <ul style="list-style-type: none"> • This technology make use of Pond Ash from thermal power plant/ NFL upto 50%, which saves the use of clay for manufacturing of embossed bricks. • In this, the firing tunnel is constructed with induced draft system and no use of external fuel. Bricks are loaded in zig-zag pattern in tunnel. The tempered material is fed into vacuum extruder for continuous column production during feeding in tunnel. The green bricks are set on wood planks that are mechanically loaded on the drying cars for drying, after that green brick manually loaded on to the drying car, which is then transported into the drying tunnel by means of hydraulic pusher Hot Air for drying is funneled into the tunnel from the annular kiln. The drying cycle is about 24 hrs. The dried green bricks are unloaded mechanically by use of conveyor belt. The speed of firing is 1.25 m/h at a sintering temperature of about 950-1050 C. the fired bricks are unloaded and conveyed through e-rickshaw to stacking yard. • It needs 400 KW electric connection and transformer as the main fuel used for brick kilns is electricity. It also need mixing machine, extruder machine, bricks wire cutting machine, E-rickshaw. • This technology improves energy efficiencies in two ways: through internal combustion of injected fuel in brick and the application of heat optimization techniques in a minimum heat loss chamber in the combustion zone of the kiln. • It uses motor draft fan, which produce 7850 m³/h air volume instead of chimney and electric draft fan. • Reduction in the use of clay upto 50% helps in conservation of clay earth. • Since there is complete combustion of fuel, there is no generation of particulate matter. The smoke is generated due to moisture held by pre-heated bricks for which chimney of height only 10 meter is required. • According to the results of analysis done by an NABL accredited lab of Panipat, the PM was 55.67mg/Nm³ at 12% CO₂.

		<ul style="list-style-type: none"> Also requested that their technology may be verified from any prime institute in order to certify that benefits over use of other technology including zig-zag.
9.	<p>Shri Omvir Singh Bhati President Jila Ent Nirmata Samiti Gautam Budh Nagar U.P.</p>	<p>Suggested the following:</p> <p>Wet scrubbers The provision of dust collection filter in shunt and carbon settling chamber.</p> <p>Agriculture Residue and Internal Fuel</p> <p>Improvement in Firing Practices</p> <ul style="list-style-type: none"> Single man coal feeding for proper combustion of fuel Properly crushed coal feeding with smaller spoons ensures efficient burning of coal All brick kilns using agriculture residue will ensure that there shall not be any surface burning by adopting appropriate methods <p>It is submitted that switch over of the any industry to an alternate fuel such as PNG/CNG is a long term process, which requires the large investments and creation of gas supply infrastructure and technology, as has been demonstrated in the conversion of commercial vehicles to CNG in the NCR regions. In our view, the switch over by the brick manufacturers to cleaner fuel will be possible once the required infrastructure has been developed by the gas suppliers for the supply of gas and technology and finance is made available to brick manufacturers. Two units were set up so far by BPCL in Mathura and Palwal were failed inspite of regular gas supply.</p>
10.	<p>Innovative Brick Manufacturers Association Jhajjar, Haryana</p>	<p>Suggested the following methods for reducing the fugitive dust emissions:</p> <ul style="list-style-type: none"> Preparation of Clay by adding internal fuel and water at Centralized location with the use of JCB and mechanized Clay mixing machine. Providing sprinkler system along all the unpaved paths through which loading is done. Covering ash with tarpaulin Water sprinkling during coal crushing, etc. <p>Suggested to follow the below mentioned techniques/measures to minimize any type of emissions to negligible level from Brick Kiln:</p> <ul style="list-style-type: none"> Wet Scrubber Internal Fuel Shed



Annexure-4

Standard Operating Procedures for Induced Draft Brick Kiln with Zigzag Firing

A. Brick Setting:

- Green brick setting in induced draft brick kilns with zigzag firing is one of the most important parameter in efficient operation of kiln and it impacts fuel consumption, brick quality & emissions from stack.
- Even number of chambers (consisting of 4 -5 lines + 1 closing perforated wall) of equal size should be stacked along the miana wall. Chambers setting can be done using following mechanism:

Brick setting in chamber	
No. of lines in chamber	6 lines (5 lines + 1 closing wall)
Setting of Columns	<ul style="list-style-type: none"> • Width of column nearest to the miana & outer wall= 9"x9" (4 bricks) • width of other columns 18"x9" (6 bricks)
Gap/ distance between two line	4.5"
Gap/ distance between two columns	4.5"
The no. of columns in one line should be even	18 columns =2 columns of 9" width alongside wall) + 16 columns of 18" width
Daily fire travel rate	3 chambers
No. of chambers in the straight trench or along the central island length	Even chambers (28-36 chambers) as per space condition or industry's choice

- The width of chamber should be decided considering the size of green brick and the chamber width should be kept uniform throughout the brick setting.

B. Fuel Selection & Preparation:

- Coal size should be powder to 5mm, which is done using coal crusher
- The coal shall be stored in the well ventilated enclosure.
- Coal crusher should be operated in enclosed structure to contain emissions
- Calorific Value of fuels should be got analyzed frequently and fuel feeding rate to be decided as per GCV of the fuel.
- No banned fuel like pet coke, carbon black, plastic, rubber etc. should be used.

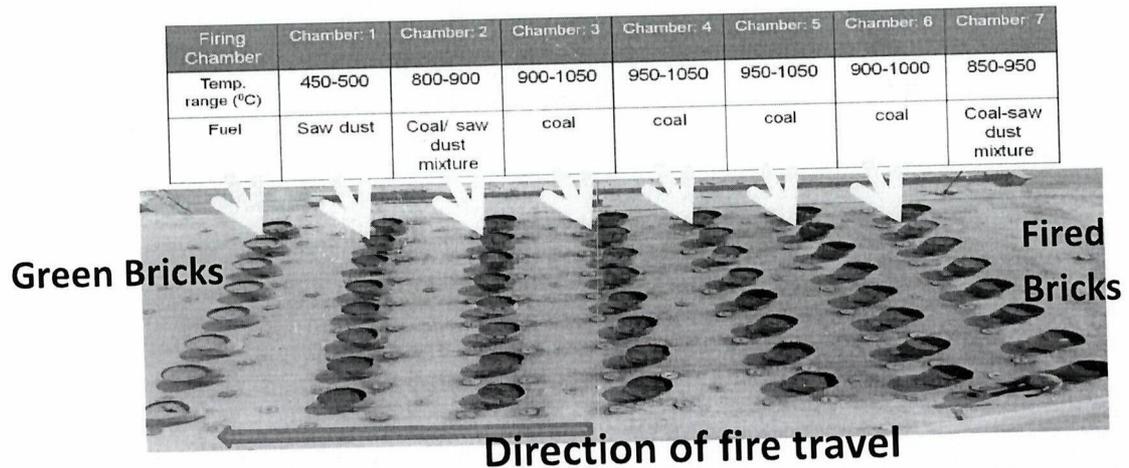
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C. Heat loss & leakages:

- The temperature at the top of conventional feed-hole cover has been observed between 200-300°C indicating heat loss through feed-hole covers. These feed-hole covers should be replaced with insulated feed hole covers thus bringing down the temperature to maximum 100-125°C.
- Minimum 10" ash layer should be laid over the brick settings to provide thermal insulation to the surface and control leakages from kiln's top.
- Miana walls, outer walls and central flue walls should be plastered with mud mortar before start of every season to avoid leakages
- Manhole covers and shunts should be properly insulated with ash layer to prevent leakages.
- Fan casings, inlet & outlet duct of fan should be regularly checked for any leakages as it can severely hamper the kiln operation
- The stack flue, main flue and side flue should be inspected regularly and kept clean. With the consistent deposition of ash in the flue system, its area gets reduced considerably, resulting in the loss of draught and increase on fan load.
- Double walls should be constructed around the kiln and the gap should be used to fill the ash produced from the kiln.

D. Fuel feeding & operating practices

- Better firing practice is to be encouraged which means that coal should be charged in small quantities over larger durations. Firemen should be instructed to feed the coal for minimum three-four times in one hour, at regular interval or single man continuous feeding of coal should be opted. The spoon size should be kept between 100-200 gms. It would ensure more efficient burning of coal and lower the emissions to a great extent.
- The coal feeding should be done in 6-7 chambers (i.e. 36-48 feet) simultaneously with recommended spoon size. This ensures proper burning of fuel as the volatiles would release heat in combustion zone itself. This will give sufficient time to the previously charged coal to burn before next charge is fed in the same hole.
- For maintaining the desired temperature in different zones the fuel recipe using coal alone or with a mix of locally available low grade carbonaceous materials such as wooden chips or saw dust should be used. The recipe should always be according to the quality of coal/ biomass to be used.



E. Instrumentation:

- The temperature profile in the combustion chambers should be monitored regularly using non-contact type pyrometer/ thermometer.
- It is recommended to maintain a log of temperature profile in each chamber every two-three hours. This would ensure better control over firing practices.
- The shrinkage of bricks during combustion should also be monitored regularly. Shrinkage in brick settings should be adjusted as per the shrinkage observed in first quality bricks.
- A scientifically designed fan would ensure lesser power consumption & uniform draft. It is recommended to install Variable Frequency Drive (VFD) along with fan motor to have proper control over the operating speed of fan. A U-tube manometer can also be installed on suction side of fan to monitor/regulate the air flow.

Annexure-5

Measures to improve the combustion of fuel and thus reduction in source emissions

- 1. Optimising Combustion & Minimising Air Leakages by Using Instrumentation and Process Control System:** Presently, many zig-zag brick kilns have installed Variable Frequency devices (VFD) to vary the speed (rpm) of ID Fans for controlling the draft (air flow) within the brick kiln. The draft can also be controlled manually by operating dampers in the flues. While the use of VFD results in better control over the draft and improves efficiency; the use of dampers to control the draft results in leakages of air and wastage of energy. It is therefore strongly recommended that the draft be controlled by use of VFD only.

Measurement of Oxygen percentage in flue gas can also be used to ensure precise control of the air/fuel ratio. The intent is to minimize the amount of excess air rising through the stack which results in lower operating costs by using less fuel. A continuous oxygen indicator cum controller can be used to control ID fan rpm to optimize combustion air supply and flue gas volume. A trial was done by the Expert Committee members during the field visit on December 20, 2020, by reducing the ID fan rpm by about 10%. It showed substantial improvement in the kiln operation, in terms that the Oxygen percentage at Shunt location reduced by 3-4%, thereby the excess air due to air ingress/leakages and corresponding total flue gas volume reduced by over 40%. The short study was promising, however longer trials will be required to develop an oxygen monitoring cum VFD control system, which will help in improving the combustion, reducing air leakages and reduced emissions.

- 2. Increasing Settling of Dust in Flue Ducts (in-built Settling Chamber) by reducing Air Leakages:** The flue duct system (side and central duct) which connect the trench to the chimney are perceived to act like a settling chamber (as pollution control device). Typically, a settling chamber is effective if the gas velocity is kept low, in the range of 1 to 2 m/sec (like in ESP of thermal power plants, which has an additional electrical charge to increase settleability of particulates), then it can settle substantial particulate matter in the long length of ducts. If the velocity is higher, then the efficiency of settling chamber drops exponentially. Any air ingress, between combustion zone and stack will increase the gas flow and hence the gas velocity in flue ducts. During visit of expert committee to a brick kiln on December 20, 2020, it was found that a large quantity of air is leaking in between the combustion zone and the chimney, and the gas velocity in central duct (at midway between shunt and stack) was measured to be about 4.6 m/sec at 54 °C temperature (**Refer Annexure -5a**). Should the air leakages be reduced to an extent that O₂% is under 15-16%, the gas volume will be about 50% or less of existing and the gas velocity would approach 2 m/sec, which is in the desired range for settling of particulates in the duct settling chamber.

So, reducing air leakages in the flue gases would benefit, apart from improved productivity of the kiln by increased waste heat recovery and reduced fuel consumption, it would reduce gas volume and hence lower gas velocity and increased efficiency of settling chamber, which will reduce stack emissions substantially. It is

recommended, that the Air leakages in the kiln, between combustion zone to stack be reduced by adopting suitable modifications in design & operation of the brick kilns.

3. **Use of Internal Fuel:** Addition of powdered coal, fly ash and other industrial wastes like boiler ash helps in reducing the quantity of fuel burned externally in the kiln and helps in reduction of pollution of particulate matter. The mixing of internal fuels is widely used in countries like China and Vietnam. In India also it is widely practiced in Central and Western regions. The amount and type of internal fuel that can be added depends on the clay properties as well as on the availability and the cost of the internal fuel. Internal fuels are being added in small quantities in some zigzag kilns in the NCR region. The addition of internal fuel cannot be done manually and requires appropriate mixing machinery.

As per information provided to the committee, M/s Surya Bhatta Co., Sonipat is making bricks by mixing powdered coal and/or pond ash. The kiln is reportedly using an extruder for shaping the bricks and using a Hoffmann Kiln for firing the bricks. The analysis reports of stack monitoring conducted by M/s Surya Bhatta Co. from external NABL accredited laboratory has also been shared indicating emission level of 56 mg/Nm³ with a total emission PM load of 125 kg/day. As the kiln is not operational, the Expert Committee could not visit and assess the performance and techno-economics of the kiln. Use of internal fuel is a promising option for both reduction in air pollution, saving of fuel and also saving of clay

4. **Use of mechanized fuel feeding devices:** The coal or fuel feeding in zig-zag kilns is carried manually by firemen. At a time, coal is fed by one or two firemen. Usually, the feeding of coal is not continuous, coal is fed for around 8-10 minutes followed by a non-feeding interval of 15-20 minutes after which again the coal/fuel feeding is repeated. A graph of carbon monoxide and carbon dioxide concentration in a zig-zag kiln is shown in **Figure 1**. It can be observed that the burning of accumulated fuel give rise to periodic higher concentration of carbon dioxide and carbon monoxide. The concentration levels return to the base value after the accumulated coal has burned. Similar pattern is expected to be followed for the emission of particulate matter, with larger particulate matter coinciding with higher concentration of carbon monoxide.

The results show that a continuous feeding of properly sized fuel along with secondary air in a zig-zag kiln will reduce both coal consumption as well as emissions by ensuring cleaner combustion. Various types of mechanized coal stoking systems or solid fuel burners can be employed for the purpose. Some solid fuel burner includes a fuel crushing and distribution unit which delivers solid fuel mixed with positive airflow ensuring perfect and consistent firing. The use of mechanical coal feeding systems can reduce the air pollution from zig-zag kilns but can also improve immensely the working conditions of the firemen. Currently the firemen walk on the kiln surface (surface temperature 80-120 °C) for feeding fuel and hence are exposed to excessive heat. However, no mechanical feeding system is in operation in a zig-zag kiln and development work is required. Zig-zag kiln offer some specific challenges for the use of feeders as they do not have permanent roof as well as the number of feeding holes is large.

2018

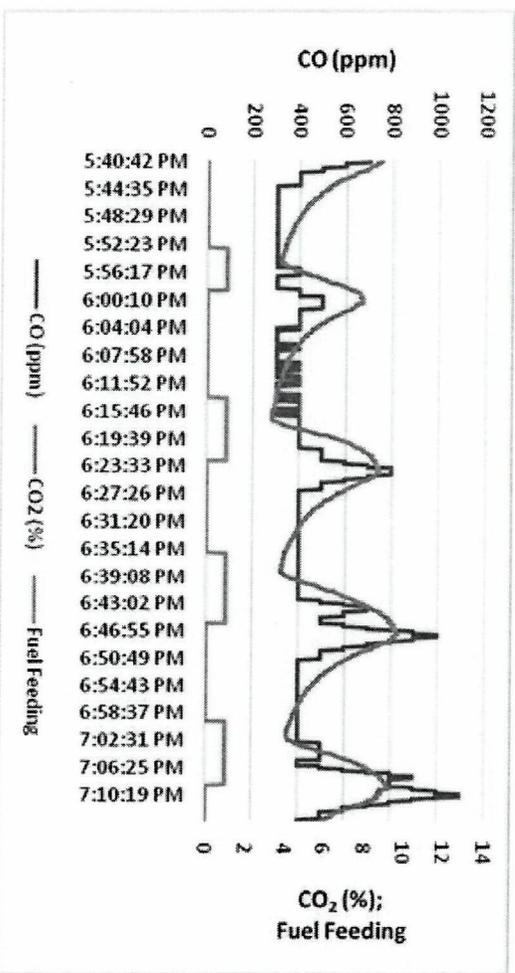


Figure 1. Graph showing relationship between the emissions and fuel feeding pattern in a zig-zag kiln¹

¹GKSPL 2018: Report on Performance Assessment of Induced Draught Zigzag Brick Kilns, Greentech Knowledge Solutions Pvt Ltd, New Delhi

Annexure-5a : Measurements on Brick Kiln (December 20,2020)

1. Objective

To find ways and means of improving brick kiln operations, it was required to know the existing status of operations of the brick kiln. The required values are the quantity of coal fired, the composition of coal, actual flue gas volume, the quantity of air available for combustion and the quantity of air leaking in the flue gases after combustion zone, draft available which directly decides the maximum quantity of air that can be sucked into the kiln system, O₂% at various locations to know quantity of air leakages, etc. This information was not readily available and hence committee members decided to do measurements.

The main objective of the measurements was:

- Estimation of flue gas flow rate at different points in the kiln by carrying out flue gas analysis also leading to the estimation of air leakages between the combustion zone and the chimney.
- Estimation of flue gas flow rate in the central duct of the kiln through velocity measurement using a pitot tube and to measure the impact of reducing ID fan rpm on the gas flow rate.

Estimation of flue gas flow rate & leakage based on flue gas analysis

2. Calculation of Theoretical Stoichiometric Air requirement for US steam coal

The kiln was using the imported US steam coal (GCV 7247 kcal/kg). The kiln provided a recent coal sample test report (M/s SGS lab dated 02/12/2020). The proximate analysis (Table 1) given in the test report was converted to ultimate analysis (Table 2) as per BEE guidelines and the theoretical stoichiometric air requirement has been calculated, which works out to be 8.15 Nm³/kg coal (Table 3).

Table 1. Proximate Analysis

Proximate Analysis of US STEAM COAL	
Parameters	Value
% Carbon	50.77
% Volatile Matter (VM)	35.75
	0
% Ash	7.59
% Moisture	5.89

Table 2. Estimated Ultimate Analysis

Parameter	Value
%C	70.55
%H	4.73

4.4

%N ₂	1.39
Sulphur	2.06
Ash	8.35
Moisture	5.89
Inherent Oxygen	7.03
GCV-kcal/kg	7247

Table 3 Calculation of theoretical stoichiometric air requirement

Parameters	Value	Unit
Oxygen Required for combustion of Carbon	188.4	kg/100 kg of fuel
Oxygen Required for combustion of Hydrogen	37.8	kg/100 kg of fuel
Oxygen Required for combustion of Sulphur	2.06	kg/100 kg of fuel
Total Oxygen Required for Combustion of 100 kg fuel	228.3	kg/100 kg of fuel
Oxygen Already Present in 100 kg of Fuel	7.03	kg/100 kg of fuel
Net oxygen required for Combustion of 100 kg fuel	221.24	kg/100 kg of fuel
Quantity of dry air required (As air has only 23 % oxygen by weight)	961.93	kg of air/100 kg of fuel
Theoretical Stoichiometric Air Requirement for 1 kg of fuel	9.62	kg of air/kg of fuel
	8.15	Nm ³ of air/kg of fuel
Theoretical Stoichiometric Air Requirement	8.15	Nm ³ of air/kg of fuel

3. Flue Gas Measurements, Estimation of Air Flow & Leakage at Location A, B & C

Please refer Figure 2. Flue gas analysis was carried out at

- Point A located in the pre-heating zone (2 m distance from the fuel feeding zone)
- Point B located in the pre-heating zone (8 m distance from the fuel feeding zone)
- Point C at shunt (12 m distance from the fuel feeding zone)

The flue gas analysis (O₂%, CO ppm, Temperature) was recorded for 15-25 minutes at each location. The measured average oxygen concentration, temperature, calculated excess air % and calculated gas flow rate is given in Table 4. Please note that the calculated gas flow rate is given for two coal feeding rates of 100kg/h and 150 kg/ h. The results show that the excess air percentage increase from 16.55% at point A to 18.30% at point C, which means that the gas flow almost doubles between point A and point C, due to leakage of cold air into the kiln. The results also show that the estimated flue gas flow rate at point C (where the flow enters the central flue duct) using stoichiometric calculations, at coal feed rate of 150 kg/h, is around 9500 Nm³/h.

Table 4 Measured Oxygen and calculated Flow Rate

	Point A	Point B	Point C
Average Oxygen (%)	16.55 %	17.64%	18.30%

Excess Air (%)	372%	525 %	678%
Calculated Flow rate (Nm ³ /hr) at the estimated coal feeding rate of 100 kg/hr	3847	5095	6340
Calculated Flow rate (Nm ³ /hr) at the estimated coal feeding rate of 150 kg/hr	5770	7642	9511
Temp (°C)	547	78	59.5

Estimation of flue gas flow rate in the central duct of the kiln through velocity measurement using a pitot tube

4. Velocity Measurement at Point D & Estimation of Gas Flow Rate

As proper porthole was not available in the chimney at 4 to 8 D location, the possibility was explored whether the measurements could be done at an alternative location, before chimney. Accordingly, the underground duct between shunt and ID Fan was identified as alternative measurement location which satisfied the minimum straight length of 6D plus from the last disturbance (location D) for measuring gas velocity, gas flow, Oxygen % , gas temp and static pressure and the measurements were carried out. Though there were limitations in arrangements available for the measurements, fairly uniform values of velocity pressure could be measured during measurements at various traverse points, it could be said that the gas flow was close to laminar flow as more than 6 D straight distance was available from the last disturbance and hence the values measured can be considered fairly reasonable & representative values.

The cross-section area of the underground duct was calculated as 1.178 m². The measured and calculated values are presented in Table 5. Based on the measurements, following results are obtained:

- At ID fan operating @649 rpm, the flue gas flow rate (Normalized at 25 °C) at point D was calculated as 17,706 Nm³/hr.
- At ID fan operating @576 rpm, the flue gas flow rate (Normalized at 25 °C) at point D was calculated as 9,320 Nm³/hr.

It can be observed that reducing the rpm of the ID fan by around 10%, results in almost 50% reduction in the gas flow rate.

Table 5. Measurements at Point D

Pressure measured at traverse points (mmWC)	Measurement at location D at ID Fan @649 rpm		Measurement at location D at ID Fan @576 rpm (Reduced rpm)	
	Left side of the duct	Right side of the duct	Left side of the duct	Right side of the duct
1	1.4	1.6	0.1	0.1
2	1.6	1.5	0.2	0.4
3	1.5	1.6	0.4	0.5
4	1.6	1.6	0.7	0.4

Uo2

	5	1.7	1.7	0.8	0.5
	6	1.8	1.7	0.8	0.7
Avg pressure (mmWC)		1.60	1.62	0.50	0.43
Ambient temperature (oC)		27	27	27	27
Pitot tube coefficient		0.85	0.85	0.85	0.85
Calculated Gas Volume (Nm³/hr)		17660	17752	9653	8987
		Average	17706	Average	9320
Avg Velocity (m/s)			4.57		2.5

Conclusions

The measured values have been analysed and interpreted to arrive at the conclusions and recommendations by the committee towards improving brick kiln operations. These recommendations could be further substantiated by few more such measurements with proper arrangements like proper porthole, repeated sets of measurements, etc.

The following important conclusions were made, from these measurements:

1. The velocity of flue gas in the underground ducts, in m/sec
2. The quantity of Gas Volume, in m³/hr
3. The O₂% & flue gas temperature at various locations, between combustion zone and the chimney (at locations A, B, C & E)
4. Draft available at the underground duct (location D) at existing fan speed and with 10% reduced speed
5. The reduced quantity of flue gas velocity & gas volume after reducing the Fan speed by 10% by reducing frequency of the available VFD device.
6. Theoretical quantity of air required for combustion of the coal fuel fed to the kiln, based on lab analysis report values made available to committee by the kiln owner.
7. Quantity of air leakages between combustion zone and the chimney.
8. Estimation of quantity of coal fired kg/h, based on the measured gas volume at measured O₂%.

The conclusions and recommendations made by the expert committee are based on the above-mentioned measurements, analysis and interpretation. The set of measurements not only provide an estimation of the gas flow rate at various points in the kiln using two different approaches. They also show that air leakage is a major operational problem in zig-zag kilns and also the potential of a VFD control strategy based on oxygen concentration measurement for both leakage and gas flow control in zigzag kilns.

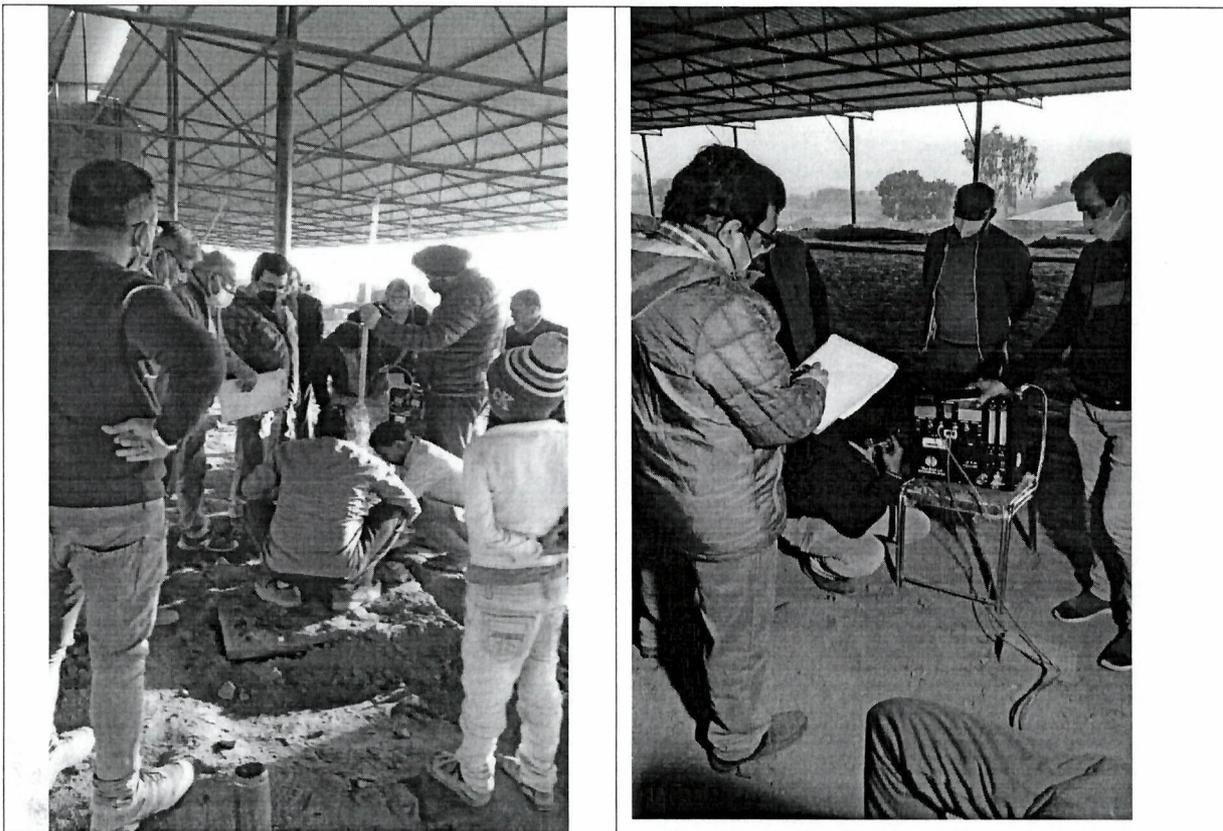


Figure 1 Measurement of velocity at Point D.

Yeo

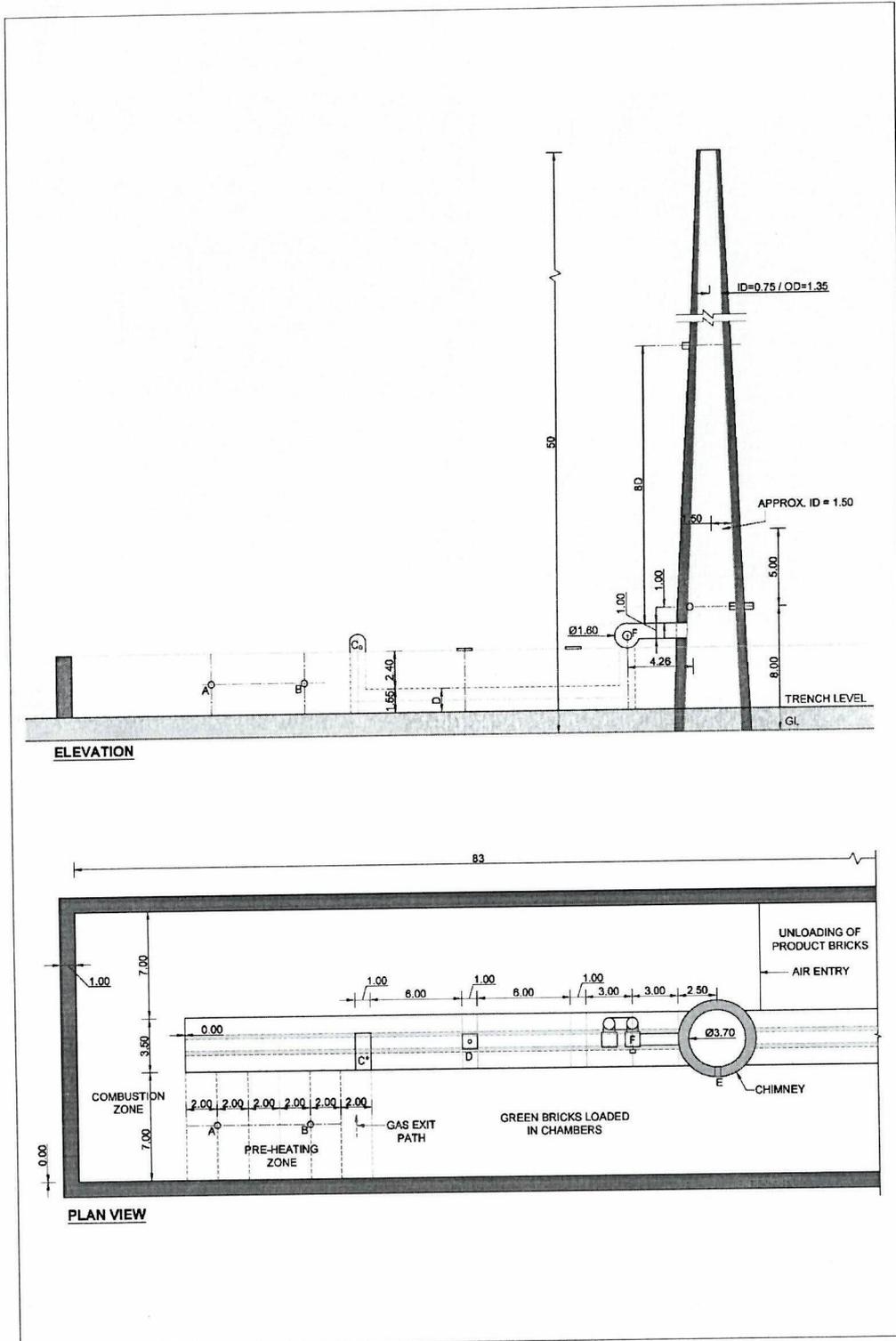


Figure 2 Sketch of the Kiln showing the measurement locations



**REPORT ON BRICK MANUFACTURING PROCESS IN
M/S WIENERBERGER BUILDING SOLUTIONS PRIVATE LIMITED,
KIADB INDUSTRIAL AREA, KUNIGAL, KARNATAKA**

1.0 Background

Hon'ble NGT vide Orders dated 15.10.2020 in the matter of O.A No. 1016/2019; Utkarsh Panwar Vs Central Pollution Control Board & Ors., directed CPCB to explore viability of PNG use in brick kilns as replacement of coal and other best practices in terms of fuel used, at other places or in other countries. In this regard, a five member Expert Committee constituted by Hon'ble NGT for supervising the use of clean fuel like PNG in the Brick kilns, identified a unit namely M/s Wienerberger Building Material Solutions operated at Plot No. 1 & 2, Kunigal Industrial Area, Phase II, Gottikere Village, Kunigal, Karnataka which is using PNG as a fuel in brick manufacturing process (as this is the only unit in the country running on PNG as per available information). CPCB, Delhi vide letter no. CPCB/IPC-V(SS1)/Brick Kiln/2020/2396 dated 27.10.2020 informed RD, Bengaluru that a detailed study of process as well as associated environmental aspects be conducted in the unit and information in the prescribed format may also be provided to the Expert Committee in the matter.

2.0 Industry Visit and Monitoring:

RD, Bengaluru conducted a preliminary survey jointly with Regional office, KSPCB on 27.11.2020, to discuss about the process, to collect required information in the prescribed format and further to plan and predetermine the monitoring locations for carrying out monitoring of fugitive emissions and stack emissions. Subsequently, monitoring of fugitive and stack emissions in the Brick Kiln was conducted, jointly with Regional Office, KSPCB, Tumkur on 22.12.2020 and 23.12.2020. The following officials/staff of CPCB, RD, Bengaluru and Regional office, KSPCB, Tumkur conducted the above visit/monitoring;

- Smt Selvi P K, Scientist D, CPCB, RD-Bengaluru
- Sh A Gnanavelu, Scientist C, CPCB, RD-Bengaluru
- Sh C Sudhagar, JSA, CPCB, RD-Bengaluru
- Dr Ashok, Assistant Engineer, KSPCB, RO-Tumkur

3.0 Objective of the Study:

Hon'ble NGT directed CPCB to carryout detailed process study to explore the viability of PNG use in Brick Kiln as replacement of coal and other best practices in terms of fuel used and the study was carried out with following objectives:

- Detailed Brick Manufacturing Process for making Building materials (viz., perforated bricks, building blocks etc.)

- Assessment of viability and Energy efficiency in terms of replacement of fuel as PNG
- Feasibility and Cost Efficiency in replacement of fuel as PNG
- Pollution Control Measures and techniques for abatement of pollution
- Best Management Practices and Cleaner options in Brick kiln process

4.0 Introduction

Brick kilns are primarily classified into two categories: (i) Intermittent Kilns and (ii) Continuous Kilns. In intermittent kilns, bricks are fired in batches and can be further sub-divided into two categories: without chimney, which do not have any stack/chimney to guide the flue gases (examples: Clamp, Scove and Scotch kilns), and with chimney, which have a stack/chimney to create draught for releasing the flue gases at a higher level in the atmosphere (Examples: Downdraught kiln and climbing kilns). In both types, bricks and fuel are stacked in layers and the entire batch is fired at once. After the fire dies down, the bricks are allowed to cool. The kiln is then emptied, refilled again with raw bricks, and a new fire is started for the next batch of bricks. Thus, the heat contained in the hot flue gases, in the fired bricks and in the kiln structure is lost. These kilns have low fuel efficiency and pollute the atmosphere.

In Continuous kilns, the fire is always burning; the bricks are loaded, dried and preheated, fired and cooled simultaneously in different chambers in the kiln. These continuous kilns are sub-divided into two categories: moving fire kilns and moving ware kilns. In a moving-fire kiln, the fire progressively moves around a closed kiln circuit with the help of a chimney or suction fan, while the bricks remain stationary (Examples: the Hoffman kiln, Fixed Chimney Bull's Trench Kiln, and the Habla zig-zag Kiln). In a moving ware kiln, the fire remains stationary, while the bricks and air move in counter-current paths (examples: **the tunnel kiln** and the vertical shaft brick kiln). These kilns vary in efficiency, emissions, and productivity.

Based on the direction of air flow with respect to the brick setting in the kiln, brick kilns can be also classified as up-draught kilns, down-draught kilns and cross-draught kilns. The Hoffman kiln, fixed chimney Bull's trench kiln and tunnel kiln are examples of cross draught kilns. In cross draught kiln, air flows horizontally through the brick stacking. The air movement is caused by either the draught created by the chimney (natural draught) or the draught provided by a fan (forced draught). These are also called horizontal draught kilns.

In brick kilns, generally, solid fuels such as coal, wood, sawdust; agricultural residue like mustard stalk, rice husk, coffee husk; industrial wastes and bye-products like used rubber tyres, and pet-coke are used. Bricks can also be fired using natural gas, diesel, and biogas.

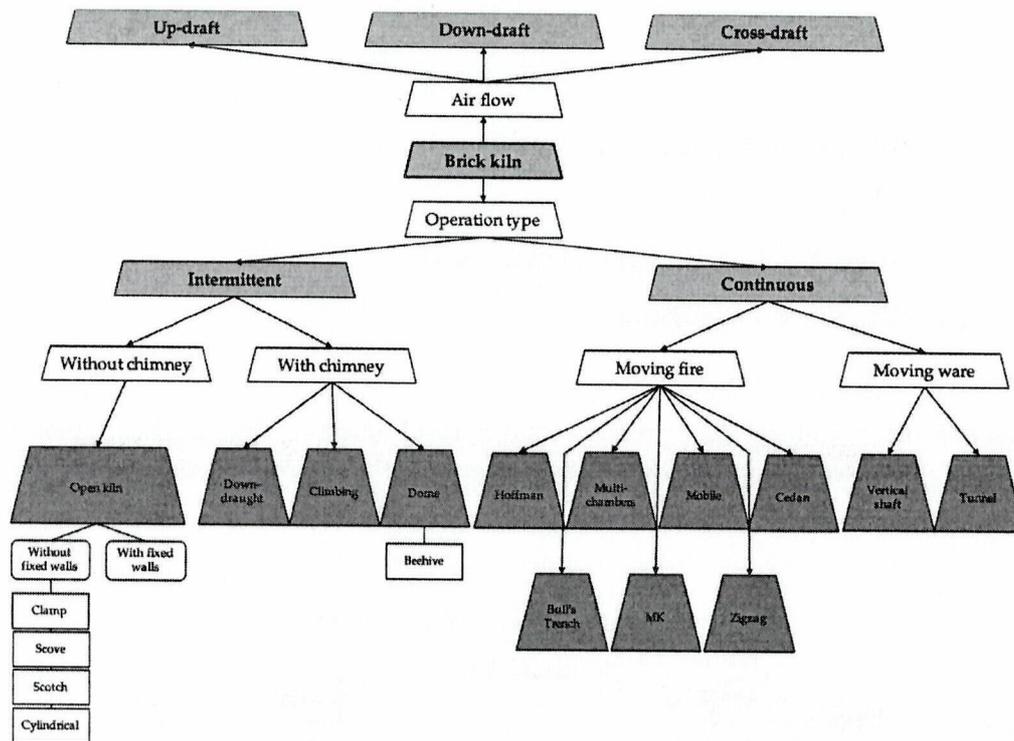


Figure 1. Classification of Brick Kilns

It has been estimated that in India, 74 percent of total brick production is through BTKs and 21 percent through Clamps. Based on the direction from the Central Pollution Control Board in 1996 (with a deadline on June 2001) several MCBTKs were converted to FCBTKs.

5.0 Plant description:

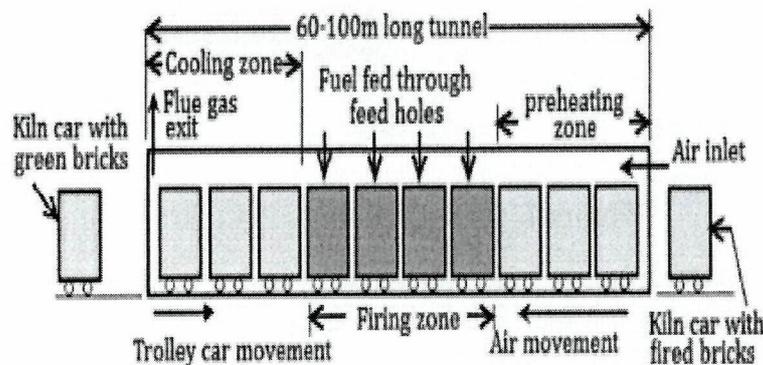
M/s Wienerberger Building Materials Solutions Private Limited, a Brick Manufacturer founded in 1819 in Vienna, Austria, is having 204 plants spread across 30 countries, is engaged in using natural, eco-friendly building material of international quality standards. The unit located in Plot No. 1 & 2, Kunigal Industrial Area, Phase II, Gottikere Village, Kunigal, Karnataka has Tunnel kiln, a continuous moving ware kiln technology. Wienerberger at Kunigal is the production facility, 70 kms from Bangalore, is Austria-based Wienerberger's first Asian manufacturing unit. The fully automated, state-of-the-art facility manufactures bricks called porotherm perforated clay bricks. The environment friendly production unit runs 365 days a year, producing 450 tonnes of bricks per day. Quality is ensured by the latest European production equipments 24 hour factory production control with in-house laboratory for chemical and physical tests of raw materials and finished products. The unit makes different types of horizontal and vertical perforated light weight clay bricks. The porotherm horizontally perforated light weight clay bricks has following advantages:

- Weighs 60 % less than conventional walling material

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- Compressive strength $\geq 3.5 \text{ N/mm}^2$
- Density of approx. $700\text{-}800 \text{ kg/m}^3$
- Conveniently large and light weight bricks
- Excellent thermal insulation
- Low water absorption $\sim 15\%$

Brick is a 100 % natural clay product with natural additives like coal ash, rice husk and granites slurry. No toxic or any chemical additives are used, thereby free from toxic gases.



The specifications and technical details of the tunnel kiln technology operated using PNG in M/s Wienerberger Building Material Solutions Pvt Ltd., Kunigal, Karnataka is provided in **Annexure I**.

About Tunnel Kiln Technology:

The tunnel kiln based technology was developed around the mid-19th century in Germany, and widely adopted in several countries after the Second World War. A tunnel kiln is a long horizontal tunnel of 60 to 150 m, in which green bricks are set on "kiln cars" and are driven continuously through a long stationary firing zone. The kiln cars can be moved along the tunnel continuously or at fixed intervals, with air supply and extraction systems provided at several points along the kiln structure. Generally green bricks are produced by mixing powdered fuel with clay. The firing of bricks occurs at the central part of the tunnel, where the bricks and air move in opposite direction and the temperature is regulated at $900\text{-}1300^\circ \text{C}$. The firing zone usually extends up to 8 cars. The fuel (granulated/pulverized coal) is fed into the firing zone of the kiln through feed holes provided in the kiln roof. The duration of the firing cycle can range from 30 to 72 hours. There are three distinct zones in the tunnel kiln: firing zone where the fuel is fed and combustion occurs; preheating zone (in front of the firing zone) where the green bricks are pre-heated by

the hot flue gases coming from the firing zone; and brick cooling zone (at the exit end of the kiln) where fired bricks are cooled by the cold air flowing into the kiln. There is counter current heat transfer in the kiln between the bricks and the air. Cold air enters from the exit end of the kiln and gets heated while cooling the fired bricks. After combustion, the hot flue gases travel towards the car entrance end and part of the heat is used to dry the green bricks entering the kiln. Hot gases are extracted from the tunnel kiln at several points along the length of the kiln and are supplied to the drying chamber. In some of the kilns, there is also provision of a hot air generator to supplement the requirement of hot air for drying. The flue gases from the drying part of the tunnel are released into the atmosphere through a chimney.

Tunnel kilns are low in labour demand but require high electricity and capital costs. They can produce 42,000-50,000 bricks per day; and the bricks require 3-5 days for drying and firing to be completed. The tunnel kiln is considered to be the most advanced brick making technology. Its main advantages is its ability to fire a wide variety of clay products, better control over the firing process and high quality of the products. It has a mechanized and highly automated process, which results in minimal emissions. Tunnel kiln emits ~80% lower particulate matter and negligible black carbon as compared to FCBTK. This is mainly because of better combustion and use of internal fuel. The emission of CO is higher in the case of tunnel kiln probably due to incomplete combustion of internal fuel. Tunnel kiln can be used to fire all types of products such as solid bricks, hollow/ perforated bricks, roof and floor tiles.

However, tunnel kiln is expensive to construct, and requires reliable power/ electricity supply. In addition, the average specific energy consumption (SEC) is 1.4 MJ/kg of fired bricks, which is slightly higher as compared to other continuous kiln technologies. This is mainly because the SEC also includes the energy utilized for the drying of bricks in the tunnel dryer. The capital cost of tunnel kiln is substantially higher as compared to FCBTK mainly because of mechanization of brick production processes and considerably larger production.

The quality of the fired bricks is a function of several parameters. The important amongst them are: Quality and characteristics of the green bricks Characteristics of the firing process, e.g., the heating and cooling rate, the maximum temperature reached and the duration of the soaking period. Many countries have notified standards in order to define the quality of clay fired bricks. Usually the standards classify bricks on the basis of three properties – compressive strength, water absorption and efflorescence. In the same kiln or the same batch of fired bricks, the quality of fired bricks may vary due to differences in the temperature profiles and the duration of the soaking period. A good brick firing kiln should have as uniform temperature as possible throughout its cross-section so that the quality of fired bricks is uniform and the percentage of good quality bricks are high.

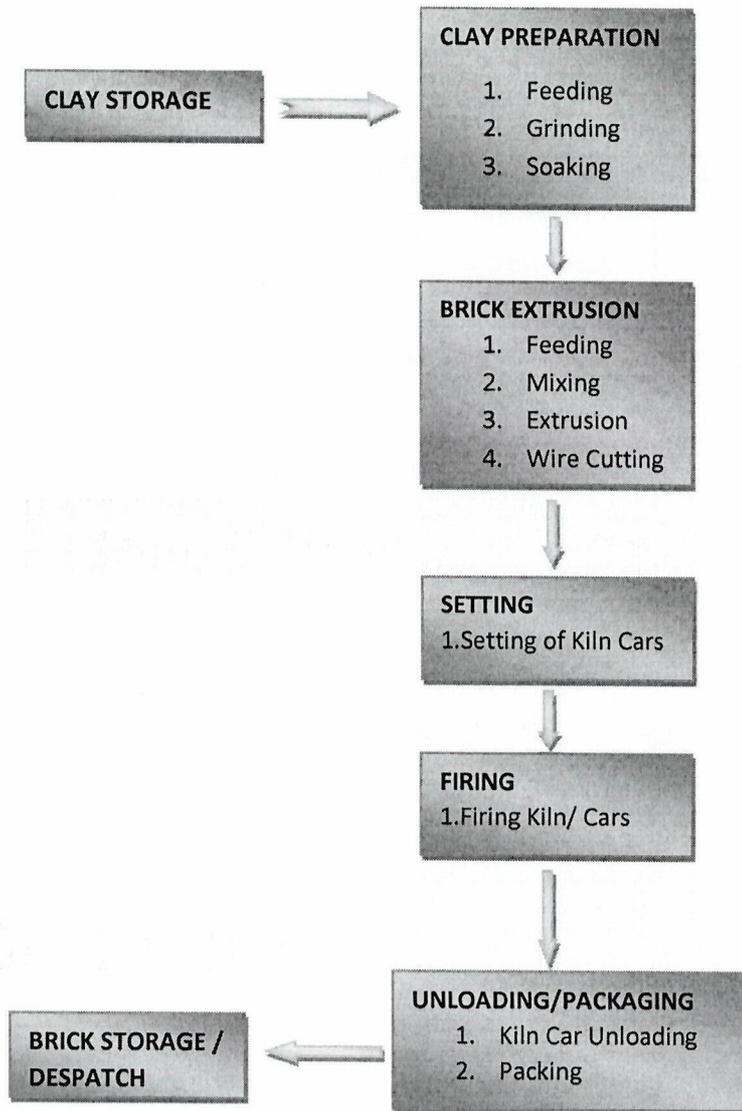
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6.0 Process description:

The manufacturing process of the wire cut bricks involves the following:

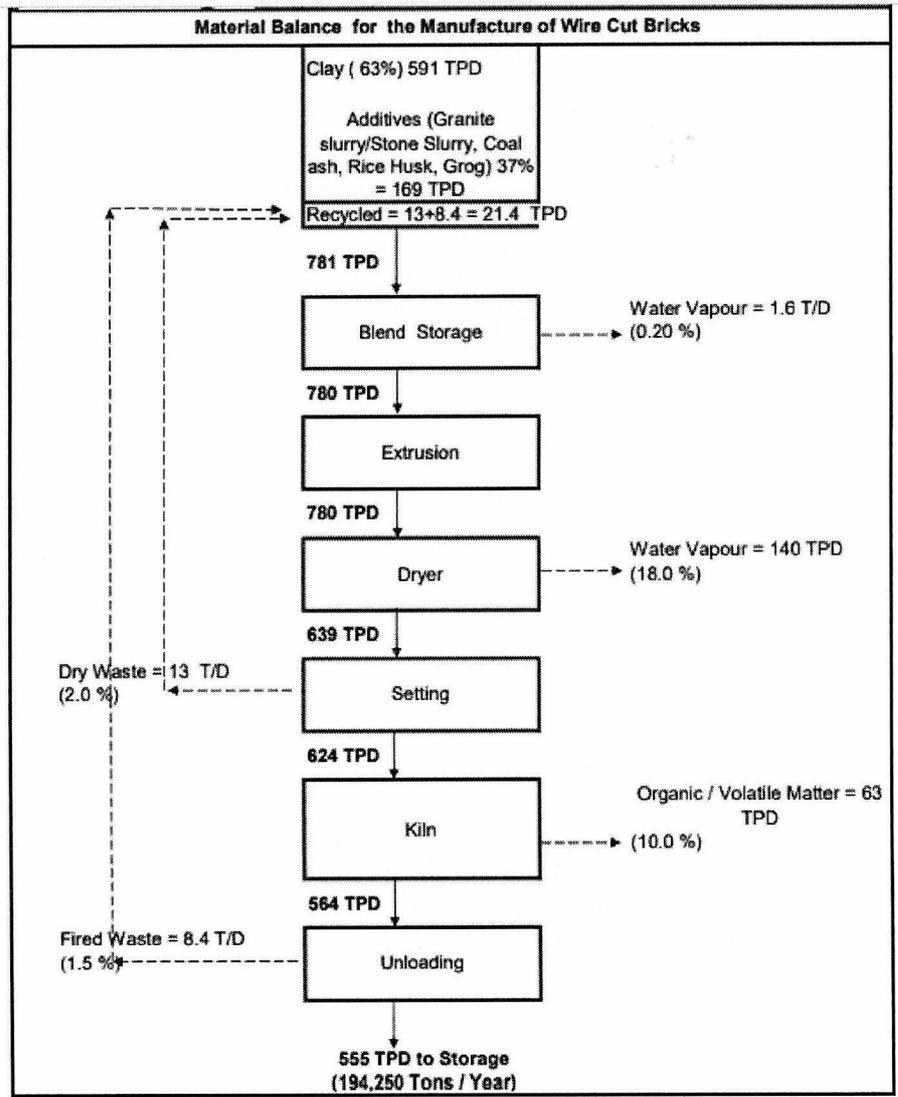
- Excavation and Storage of Clay - As a first step, the assessment of the quality of raw material (Clay) is done by experienced geologists. The approved clay is excavated by the clay suppliers and transported to the plant and is laid in layers on stockpile to ensure consistency.
- Preparation of Clay - The clay from the stockpile and the prepared additives are shovelled into the box feeders by means of a loader to get the blend mix. The blend mix consists of water, clay, sand / granite slurry, saw dust. The components are mixed to the correct consistency. The mixture is fed into the Pan Mill, Roller Mills to get it homogenized. The homogenized clay is conveyed to clay stock (soaring) and is finally conveyed into the extruder through screen feeder and double shaft mixer.
- Extrusion - During this step the brick mass is pushed through a die and then cut into individual bricks. The 'green' (wet bricks) are put to trays and automatically transferred to the dryer cars which move in to the Chamber dryer.
- Drying - Drying process takes place up to 18 to 20 hours for thinner bricks and up to 24 hours for thicker bricks. Moisture content of a brick drops from 20 % to 3%. After the process of drying the bricks are unloaded from the dryer cars and are automatically transferred on to the setting machine and then to the Kiln cars by means of robots and the kiln cars move into the Tunnel kiln.
- Firing - The firing cycle takes for 30 - 40 hours in the Tunnel kiln, which is usually heated by Natural gas / LPG gas or coal at temperature ranging from 900°C - 950°C. During the process of firing under the controlled temperature, pressure and quality of flow, the bricks get the strength. The tunnel kiln works with counter current principle. Thermal energy is added in the pre-heater and firing zone and is taken out from the cooling zone and the same is reused in the dryer.
- Unloading/packaging - the bricks are unloaded from the kiln car and packed in to bundles automatically
- Storage/Delivery - packed bricks are taken outside the plant by forklifts and stored in the stock yard and then the bundles will be dispatched on First in First out (FIFO) basis.

The flow diagram of the manufacturing process is given below:



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7.0 Material Balance:



The principal index for an energetic assessment is the Specific Energy Consumption (SEC), which is measured in MJ/kg. The global trend is to make bricks with more energy-efficient processes. This leads to lower pollutant emissions, improved fuel quality, and reduced fuel consumption. Some consideration is also given to changes in the design of the standard brick, particularly the use of perforations within the brick. These improve the heat transfer during firing and require less energy per brick because they weigh less. Being lighter, they are also cheaper to transport than a solid brick of the same size. The Specific Energy Consumption of the tunnel kiln process in the unit has been estimated and reported as 152 Kcal/Kg (thermal).

As the unit is planning for further stabilising the plant process in terms of fuel and product quantity, the techno-economic feasibility of the change in fuel needs to be prepared after complete stabilization in comparison with the coal/petcoke process adopted earlier.

8.0 Emission Monitoring and Control Measures:

The flue gas monitoring was carried out at the stack attached to the tunnel kiln as per the standard protocol and procedures. The results are provided in Table 1 below:

S No	Parameters	Results	Standard prescribed by KSPCB in the Consent to Operate	Method
1.	Particulate Matter	125 mg/Nm ³	150 mg/Nm ³	IS 11255 (Part 1 & 3):1985 RA - 2018 & 2019
2.	SO ₂	02 PPM	-	-
3.	NO ₂	00 PPM	-	-
4.	CO	658 PPM	-	-

The above values are indicative only and may not be representative of true value as the porthole was located just 7 m away from the disturbance point due to maintenance work going on in the actual flue gas exhaust fan suction system to the stack.

The concentration of Particulate Matter (PM) measured in the stack as 125 mg/Nm³ is complying with the standards prescribed by Karnataka SPCB, however may not be representative due to fact that the exhaust fan at the bottom of the stack was observed to be under maintenance during sampling. Further, the exhaust fan arranged temporarily for suction from the stack is located 7 m away from the Porthole, which is violating the specifications of the Emission Regulations guidelines (Part III) i.e sampling ports shall be located at least 8 times chimney diameter downstream and 2 times up stream from any flow disturbance.

The unit was then advised to follow the guidelines for locating sampling port in accordance with the Emission Regulations, 1985 (Part III).

Fugitive emissions in four locations viz., Raw Material Storage and Feeding Area; Clay Preparation and Milling Area; Extruder and Setting Area; Unloading and Packing Area.

Location	Parameter	Results	Method
Raw Material Storage, Handling and Feeding Area		746	IS 5182 PART 4:1999

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Clay Preparation and Milling Area	SPM ($\mu\text{g}/\text{m}^3$)	10924	
Extruder Setting Area		2583	
Unloading and Packing Area		396	
<i>In the clay preparation area it was observed that the conveyor belts / systems carrying coal ash, clay etc. are open and roof top ventilators equipped were not found to be efficient to control the fugitives.</i>			

The concentration of dust emission (fugitives) were monitored using High Volume Sampler and was found to be $10924 \mu\text{g}/\text{m}^3$, maximum in the Clay preparation and milling area. The fugitives in the clay preparation and milling area may be attributed to open conveyor system carrying loose materials (clay and coal ash etc.) from the box feeders. The unit may arrange to provide high efficient suction system and closed conveyor system for controlling fugitives in the clay preparation and milling area especially.

9.0 Observations:

- 1.0 The Brick kiln manufacturing process is an automated process having capacity i.e 450 to 555 MT/day, however the feeder section and clay preparation handles large quantities of free (loose) materials like coal ash, rice husk, clay particles and stone/granite slurry etc. Therefore, there observed generation of considerable dust / fugitive emissions into the working environment.
- 2.0 Also, fugitive emissions were also been observed in the Extruder Setting Area and Unloading / Packing Area which are reported as 2583 and $396 \mu\text{g}/\text{m}^3$ respectively.
 The cause for the fugitive emissions may be attributed to two causes:
 - (a) Less efficient roof top ventilators installed in the clay preparation and mill section;
 - (b) Open conveyance system for carrying the loose materials to the mill (Pan mill and Roller mill);
 - (c) Brick Material and grogs handling and;
 - (d) Refractory/kiln car cleaning in other areas.
- 3.0 The unit has not provided details of HW (Used oil) generation, storage and disposal, however it has informed that used oil is generated from the machineries equipped in the plant. The unit has not obtained authorization for generation and handling of HW (as the unit claims that most of the used oils is reused for chain lubrication). Further, some quantity of accumulated waste oil (attributed to the

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effect of COVID-19 and lower production) were disposed to scrap vendor (which is KSPCB authorized unit).

- 4.0 Biomass namely cashew nut shell is being used for hot air generation using heat exchangers to supply heat to dryers in the drying section as per requirements, in addition to heat recovery from tunnel kilns. The stack attached to the biomass hot air generator is found to be directly emitting exhaust air without APCD, as it is claimed by the unit that cashew nut shell has ash content of 1 to 2 %.
- 5.0 Concentration of Particulate Matter is found to be 125 mg/Nm³, which may be attributed to usage of organic materials (rice husk), coal ash (unburnt carbon) and clay materials as fuel in brick making and firing.
- 6.0 Major source of wastewater generation is from domestic washings in the plant (i.e 6.3 KLD) and is being treated using Sewage Treatment Plant for reuse in toilet flushing and vegetation as per Consent, however no accountability of water consumption and wastewater generation/treatment are maintained using flow meters. The unit has also informed that no permission from CGWA is required for extraction of Ground Water (Borewell).
- 7.0 The unit has concreted floor for raw material storage and handling in the feeder section to reduce emissions during vehicle movement in the area. Further, the floor is also sprinkled with water to arrest dust emissions into the environment in vehicle movement area near raw material storage.

10.0 Recommendations:

- 1.0 The unit has been informed that fugitives emissions may be controlled in clay preparation area by covering the conveyors carrying loose materials and by installing high efficient suction system.
- 2.0 NOC and permission to be acquired for extraction of Ground Water (Borewell). Further, water consumption and wastewater generation is required to be recorded using flow meters.
- 3.0 The stack and porthole has to be modified in accordance with the Emission Regulations, 1985 Part III and if found appropriate the unit may provide two portholes as per the specifications of the aforesaid Emission Regulations.
- 4.0 Notifications vide G.S.R 1(E) dated 01.01.2010 specifies that Biogasifier shall be installed if roasted shells (cashew nut) is used as fuel and stipulates standards for PM. Therefore, the unit shall meet the standards for PM from hot air generator installed in the unit in accordance with the above notification.
- 5.0 Authorization is required for generation, storage and handling of HW(used oil) from KSPCB and the same is required to be stored in dedicated HW storage area.

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Annexure I

1	General Information		Verification Documents/ Photographs
i	Date of monitoring/visit	27.11.2020 (Preliminary Visit); 22.12.2020 & 23.12.2020 (In-depth Monitoring)	
ii	Name & address of the Unit monitored	Wienerberger India Private Limited, Plot No 1&2, Kunigal Industrial Area Phase II, Gottigere Village, Kunigal 572 130	
iii	Details of Contact Person	Jagadeesha D J, Plant Incharge (9901456001)	
iv	Geographical Location	Latitude:13.03454 Longitude:77.07977	
v	Year of Commissioning	2009	
vi	Status of Operation	Operational (Continuous & Automated system)	
vii	Technology Provider	Weinerberger AG, Austria	
viii	Production Capacity Per day as per Consent to Operate	199,992 TPA Installed - As per consent (199992 TPA) Operational - operated 20 to 30 % less than the installed capacity	
ix	Actual Production	450 TPD (approx)	
x	Category and Scale of Operation	Large Orange	
xi	Initial date of firing/ operation	Feb 2009	
xii	Shape of the Kiln	Rectangular (Tunnel kiln)	
xiii	Length of the Kiln	142 meters	
xiv	Width of Kiln	5.2 meters	
xv	Miyana Height from ground level	Not Applicable	
xvi	Number of Workers	225	
xvii	Number of Vehicle	08 (Tipper 01; Wheel loader 02; Cleaning machine vehicle 01 Material handling vehicle Fork lifts 03; Excavator 01)	
2	Details of NOC & Permissions		
i	Consent Status	Consent No. PCB/SEO-CTA/CFO/2017/345 dated 18.11.2017 issued by Karnataka SPCB to manufacture Wire cut Bricks, valid for the period up to 30.09.2021. (information sent to KSPCB for change of fuel to PNG on 24/07/2020)	Copy enclosed
ii	Category of Project as per EIA Notification, 2006	Not applicable	



iii	Type of mining	Open Cast mining
iv	Mining method Mechanical or Manual	Mechanical
v	Area of Mining Lease (Hectare)	8.09371 Hectares (20 acres)
vi	Capacity of mining Lease (TPA)	119,196
vii	Valedictory Period of mining lease	10 years (obtained from Department and Mines and Geology since 2011)
viii	Maximum depth of mining: Permitted Actual	1.5 m (Actual & Permitted)
ix	Land under cultivation/agricultural/barren	Lakes / Tanks (dry) during Non-rainy season (Sep - May)
x	Preservation of Top Soil: Permitted Actual	Not applicable
xi	Reclamation of excavated area: Permitted Actual	Not applicable
xii	Water source & Consumption & Permission of CGWA, if, use of Ground Water	71000 litres/day (from Borewell) of water is extracted and used, of which 90% is used for production; Permission of CGWA is not applicable (as informed by the unit).
xiii	Waste Water generation	6.3 KLD (domestic); industrial wastewater generation is nil. Around 70 % of the waste water generated (4410 litres/day) is treated, recycled back in the toilet flush and vegetation.
3	Details of Stack and Port Hole and Platform	
i	Stack Shape	Round/ circle
ii	Stack Height	40 meters
iii	Location of Porthole	7 meters from the inlet of chimney 14.95 m from ground
iv	Platform Provided	Yes
v	MOC of Stack	Steel
vi	Stack Dimension/Diameter at monitoring point (Porthole)	2000 mm/ 2 meters (Porthole 75 mm)
4	Details of Fuel Used	
i	Fuel Used	Natural Gas since 17 th July 2020
ii	Calorific Value	8800 +/- 5% (ncv) Specific Energy Consumption of the fuel (PNG) used in the process is 152 Kcal/kg (Thermal)

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		[Note: Earlier, Coal (Indonesian coal / bituminous coal - calorific value of 6200 to 6500 Kcal/Kg) was used before 2017 and subsequently pet coke was used (calorific value of 8200 Kcal/Kg) was procured from M/s MMRPL Mangalore between 2017 to 2020.]		
iii	Consumption Per day	7500 SCM/day (PNG)		
iv	Fuel feeding measurement during monitoring time	Fuel Consumption Rate - 350 SCM/hr		
v	Fuel feeding method	Piped Natural gas		
vi	Any other fuel used, if used- NOC for the same and method of feeding, APCD installed	Biomass (dried cashew nut shells - GCV of 4,800 Kcal/Kg to 5100 Kcal/Kg; 1 to 2% Ash content) for Hot Air Generator (for drying unit at 65 °C 24hrs)		
vii	Suppliers of fuel	MEIL (M/s Megha Engineering and Infrastructures Limited)		
5	Flue Gas Monitoring w.r.t. O₂			
i	Oxygen at the time of monitoring start	Oxygen in the flue gas - 13.11 %		
ii	Oxygen during monitoring			
6	Firing Mechanism			
	Details of firing mechanism	Tunnel kiln with natural gas firing, cycle time is between 28 hours to 36 hours, Maximum temperature set is 900°C.		
7	Green Brick Manufacturing			
i	Composition	Tank Clay (60 to 65 %), Granite slurry, Coal Ash (5 to 7 %), Rice Husk (5 %), Grog (4 to 6%), Mine Clay (10 to 1 %) (by volume).		
ii	Mixing: Mechanical or Manual	Mechanical		
iii	Moulding: Mechanical or Manual	Mechanical		
iv	Drying Process	Chamber drying at 65°C (12 chambers) The Fuel used for drying or aging = Biomass fired namely, cashew nut shell and the biomass has GCV of 4,800 Kcal/Kg to 5100 Kcal/Kg and Ash Content ranging from 1% to 2%.		
v	Average weight of Green Bricks	420x 215x 215 mm, 420 x 162 x 215 mm, 420 x 160 x 215 mm (15 kg)	Product details / Manual attached as Enclosure II.	
vi	Size	420x 215x 215 mm, 420 x 162 x 215 mm, 420 x 160 x 215 mm		
8	Final Product			
iv	Average Size	400x200x200 mm; 400x150x200 mm; 400x100x200 mm		
v	Average Weight	11 kg, 8.3 kg, 6.2 kg		
9	Detail of APCD			
i	Gravity Settling Chamber	Emissions into Stack attached to Tunnel Kiln (after shift of technology into PNG).		

		<p>Note: The exhaust fan for suction at the stack was found to be under maintenance and a temporary suction arrangement was made at 7 m below the porthole.</p> <p>Earlier, the flue gas was emitted through the stack equipped with Flue Gas Desulphurisation (FGD) to cut down sulphur emissions due to coal/petcoke usage till July 2020. Then the flue gas was passed through bag filter assembly before letting out into atmosphere. However the above were discontinued and dismantled in view of NG;</p> <p>In addition to above, dust collectors attached to drying chambers and roof top ventilators in the clay preparation area are also installed to cut down fugitives.</p>		
ii	Any Other, if any	<p>01 Biomass hot air generator with heat exchanger (height - 15 m); 03 DG sets with stack (height - 40 m)</p>		
10	Compliance of conditions of Consent to Operate w.r.t. Dust Control process			
i	Fuel Storage	No fuel storage (piped NG)		
ii	Raw Material storage	Fugitives controlled by sprinkling water on vehicle movement area		
iii	Pavements of the approached road	Concrete Roads		
iv	Green belt area Permitted Actual	>33 % green belt (as claimed by the unit)		
11	Compliance of Siting Criteria	KIADB Industrial Area		
12	Cost Assessment of PNG based Brick Kilns			
i	Cost of the Plant	Rs. 2,297,276,234 (Project cost)		
ii	Cost of the raw materials including fuels			
		Mines clay Yeragatti	1,480 /ton	INR/MT
		Grog	49 /ton	INR/MT
		Mines Clay Jayaram	1,136 /ton	INR/MT
		Granite dust slurry	661 /ton	INR/MT
		Tanks Clay	262 /ton	INR/MT
		Rice Husk	4,216 /ton	INR/MT
		Natural GAS	27 SCM	INR/\$CM
		HSD	65 /litre	INR/LITRE

		LPG	39,026 /ton	INR/MT
		Coal Ash	864 /ton	INR/MT
		Carton Sheets	20 /piece	INR/P IECE
		Stone Slurry	422 /ton	INR/MT
		Pet Strap-13X0.56H	1.30 /meter	INR/MTR
		Pet Strap-16x0.79V Signode	1.95 /m	INR/MTR
		Pet Strap-16x0.79V Plastiblend	1.80 /m	INR/MTR
		Cashew Nut Shell	5,760 /ton	INR/MT
iii	Cost of the fuel/unit of product	Rs. 27.19/SCM (PNG) [7500 SCM/450 MT per day = Rs. 203925 per day]		
iv	Feasibility of the conversion or retrofitting of conventional brick kilns using coal to this technology	The feasibility of the technology used in tunnel kiln in terms of fuel i.e coal and PNG, the fuel (PNG) shift is cleaner as the petcoke/coal pulverisation and handling causes huge fugitive and stack emissions (in terms of PM).		
v	Comparative cost for the retrofitting of conventional brick kilns using coal as fuel	Rs. 38684201 (initial cost for conversion to PNG project). In terms of economics of using PNG in place of Coal, as the former requires huge investment and recurring cost with no payback period. The cost of PNG accounts to 19 % of the total production cost.		
12	Observations made during monitoring along with photograph			
i	Fugitive dust emission sources	CPCB monitored fugitive emissions in the following four locations using High Volume Sampler; i. Raw Material Storage and Feeding Area; ii. Clay Preparation and Milling Area; iii. Extruder and Setting Area; iv. Unloading and Packing Area.		
ii	Fuel feeding Processes	Automatic PNG		
iii	Fuel handling	PNG		
iv	Loading, unloading point of bricks	Stickyard/loading bay		
v	Any other, if any	i. Raw Material handling through box feeders (07 Nos.) and clay preparation using Roller		



		<p>(02)/Pan Milling (01) (with capacity of 45 tons/hr) emits fugitives.</p> <p>ii. The Extruder section has got screen feeder (with circular mixer) emits fugitives due to open conveyors followed by activities such as mixing and Green brick/defecting pieces (Gregs) handling.</p> <p>iii. The unit generates used oil from the machineries equipped in the plant, however has not obtained authorization for generation and handling of HW (as the unit claims that most of the used oils is REUSED for chain lubrication). Further, some quantity of accumulated waste oil (attributed to the effect of COVID-19 and lower production) were disposed to scrap vendor (which is KSPCB authorized unit).</p> <p>iv. The effluent (generated from the domestic usage) treated in STP is being reused for vegetation and toilet flushing as per Consent, however no accountability of water consumption and wastewater generation/treatment are maintained using flow meters.</p> <p>(Photographs enclosed below as Annexure III)</p>
Name and Signature of the official		

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Annexure II

List of Plant & Machineries (M/s Wienerberger Building Solutions Private Limited, Kunigal, Karnataka)

S. No	Name of the Machinery / Unit Process	Nos.	HP
CLAY PREPARATION			
1.	BOX FEEDER	06	681
2.	SAW DUST GRINDER	01	
3.	PAN MILL	01	
4.	ROLLER MILL	02	
5.	DEDUSTING MACHINE	01	
6.	SET OF CONVEYORS	01	
FORMING MILL			
7.	ROLLER MILL	01	601.9
8.	SCREEN FEEDER	01	
9.	EXTRUDER	01	
10.	FERYMATIC CUTTER	01	
11.	TECAUMA	01	
12.	CONVEYOR	01	
13.	BOX FEEDER	01	
DRYER TRAYS			
14.	BRICK LIFTS		87
15.	ROBOTS		
16.	TRANSFER CARS		
17.	CERIC AUTO TECAUMA		
DRYER SETS			
18.	TRANSFER SETS		1917.5
19.	CHIMNEY		
20.	SUCTION BLOWER		
21.	INLET BLOWER		
22.	DRYER CHAMBERS		
23.	DRYER CHAMBERS		
24.	GRINDING MACHINE		
25.	CONVEYOR		
PACKING LINE			
26.	ROBOT		787
27.	DEHACKING MACHINE		
28.	STRAPPING MACHINE		
29.	WRAPPING MACHINE		
30.	SET OF CONVEYOR		
TUNNEL KILN			
31.	BLOWERS		561
32.	PET COKE BURNERS		
33.	LPG BURNER		
34.	ROBOT		

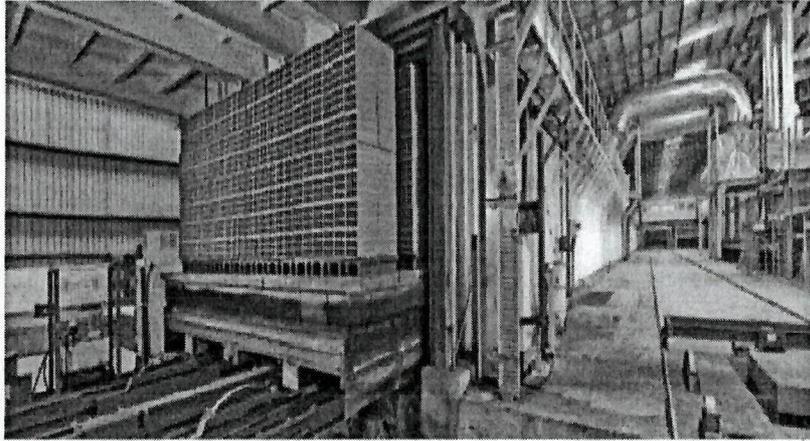


35.	TRANSFER CAR (KILN)		
36.	CHIMNEY		
37.	PRE HEATER-1		
38.	PRE HEATER-1		
PET COKE			
39.	SILO**	01	180
40.	PET COKE/COAL TRANSFER UNIT**	01	
41.	PET COKE BOX FEEDER**	01	
UTILITY			
42.	AIR COMPRESSOR**	03	512
43.	STEAM GENERATOR**	01	
44.	LATHE & MILLING	01	
45.	GRINDING MACHINE	01	
46.	DRILLING MACHINE	01	
47.	POWER HACK SAW	01	
48.	EOT CRANE	01	
KDG UNIT			
49.	DG SET (3375 KW/KVA)	03	-
50.	BELT CONVEYOR	01	-
51.	BIO-MASS HOT AIR GENERATOR	01	-
52.	EXHAUST RECOVERY DUCT	01	5
53.	ASH EXTRACT SYSTEM**	01	106
54.	FLUE GAS DESULPHURISATION (FGD)**	01	160
55.	GAS FIRING SYSTEM	01	32
56.	DUCT BURNER	01	3
** The list of machineries in blue font have been eliminated due to change of process and fuel			



Annexure III

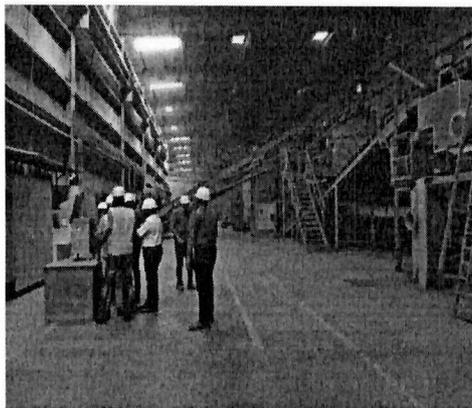
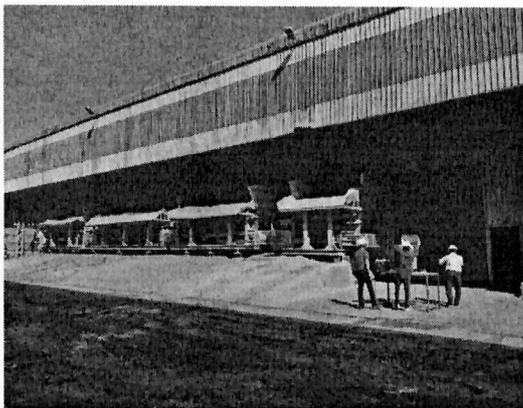
Photographs of the Unit Operations:



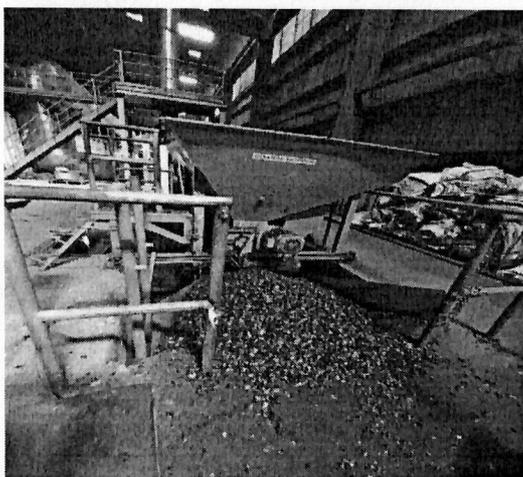
1. Tunnel Kiln showing unloading of the fired bricks



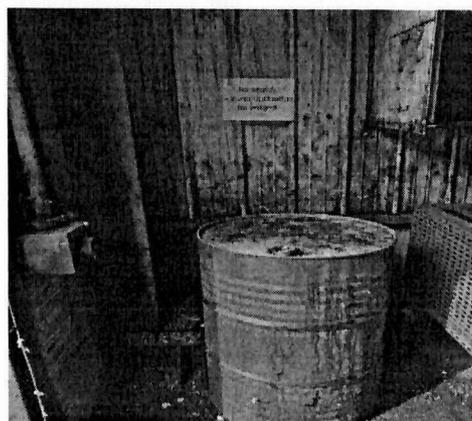
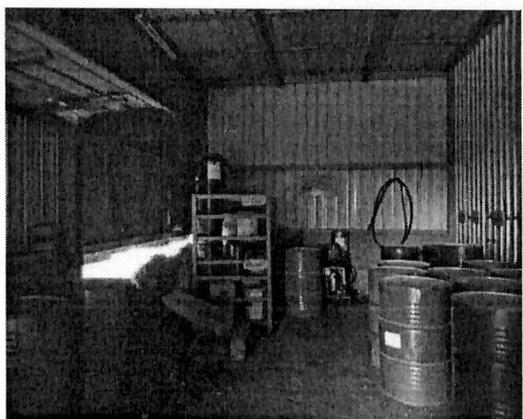
2. Robotics used for aligning the Bricks before Packing



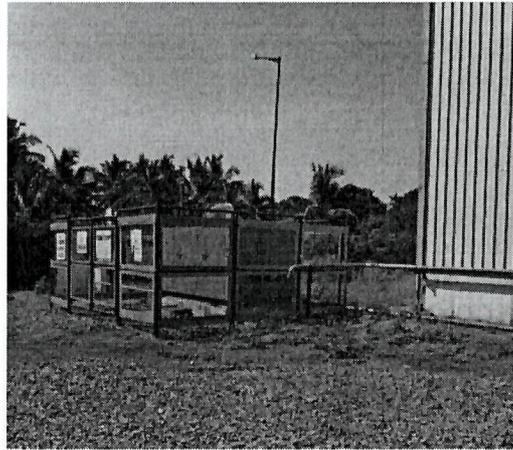
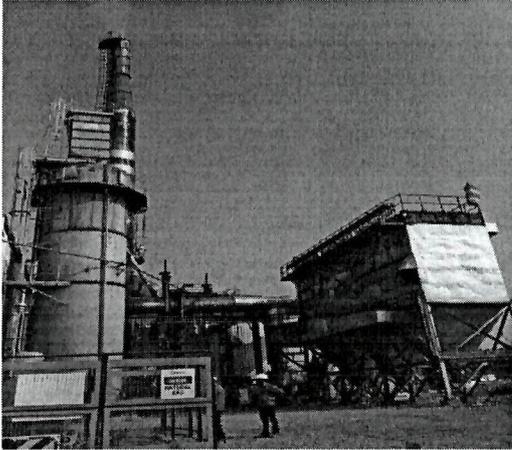
3. Fugitive Emission Monitoring in a) Raw Material Storage and Feeding Area;
b) Clay Preparation and Milling Area



4. Biomass burning for heat exchangers to supply excess heat to drying section and stack emission



5. Used Oil Storage in the area where lubricants are stored (no dedicated HW storage area and no stacking arrangements)



- 6. a) Flue gas emission using Stack attached to Tunnel Kiln into atmosphere (Bag filters and FGD are already disconnected and discontinued);
- b) Piped PNG supply meter



- 7. Stack attached to DG Sets and stack attached to Tunnel Kiln

Annexure-7 Air Pollution Control Devices (End-of-the Pipe Technologies)

The technology selection for an air pollution control device depends on characteristics of the pollutant(s) i.e. particle size, particle loading, required pollutant(s) removal efficiencies and flue gas properties like pressure, temperature, humidity, composition, reactivity etc. The various types of Air Pollution Control Devices (APCD) and their application are tabulated as below:

Classification of various types of APCD

S.No.	Type of APCD	Application
1.	Gravity Settling Chambers	<ul style="list-style-type: none"> ○ Particles settle under gravitational force ○ Only particles of >10μ size can be collected ○ Require large space, comparatively low collection efficiency ○ Low installation cost ○ No power required to operate the system ○ Used widely in draft furnace and kilns
2.	Cyclone separators	<ul style="list-style-type: none"> ○ Particles settle under centrifugal force ○ Can remove particle of > 5μ size ○ Can handle large flue gas volume, low initial cost, requires less area, less maintenance ○ Pressure drop across the system : 3"-4"wc ○ Power required for operation of APCD ○ Used mostly in industries for removal of large size particles from flue gas.
3.	Wet scrubbers	<ul style="list-style-type: none"> ○ Particulate matter diffuse in liquid droplet ○ 70% - 99% particle & gas pollutant removal efficiency ○ Simultaneously remove particulate and gaseous pollutants ○ High temp. gas can be cooled down, corrosive gases can be neutralized ○ High pressure drop across the system (5" to 15" wc) ○ Higher power required. ○ High capital cost ○ Wide range of scrubbing technology like spray, venturi, cyclonic, packed bed, impingement etc. scrubbers are available
4.	Fabric Filters	<ul style="list-style-type: none"> ○ Particles removed with fabric filtration ○ Remove particles upto 1μ ○ 99% particle removal efficiency ○ Pressure drop across the system : 3"-4"wc ○ Medium power required for operation of APCD ○ Not recommended for flue gases with high temp. (>290°C) & moisture content and fibre liable to chemical attack ○ High capital cost ○ Used in Metallurgical, foundry, cement, ceramic industry, flour mill & lime industry.
5.	Electrostatic Precipitators	<ul style="list-style-type: none"> ○ Particle settle under electrical charging ○ Can remove 0.1μ - 1μ particle size ○ Best technology for removal of PM with efficiency close to 99.9% ○ Require high voltage and high initial cost ○ Used in cement, steel, pulp & paper, petroleum & chemical industry. ○ Not recommended for flue gases containing combustible gases

Annexure-8

Suggestions for applied research/pilot testing for improvement in brick manufacturing process

1. **Field study during 2021 brick making season to optimize combustion and minimize air leakages in zig-zag kilns:** A short-term study/trials can be undertaken in 3-4 zig-zag kilns for optimizing combustion & minimizing air leakages. The study will focus on reducing air leakages and heat loss. As has been explained earlier, the leakage of cold air into the kiln between the combustion zone and the chimney not only impacts the combustion and energy efficiency but also the settling of particulate matter in flue ducts. The trials will lead to a set of recommendations to further improve the operation of zig-zag kilns by June 2021. The field study may be funded by CPCB and executed under the guidance of the Expert Committee.
2. Undertake research projects to further reduce emissions from zig-zag kilns to bring them at par with other industries and improve their resource efficiency, by the national level environmental research institutes in collaboration with the brick industry:
 - a) **Research project on use of internal fuel in zig-zag kilns in NCR:** This study will involve:
 - Techno-economic and emission performance assessment of the internal fuel mixing technology package being used by the Surya Bhatta Co.
 - Pilot testing, emission performance assessment and demonstration of internal fuel mixing in 4-5 zig zag kilns having different clay composition and mapping of availability of internal fuels in NCR.
 - b) **Research project on use of biomass briquettes/pellets in zig-zag kilns in NCR:** This study will involve:
 - Techno-economic feasibility of production of biomass briquettes/pellets in zig-zag kilns in NCR and neighboring region
 - Pilot testing, emission performance assessment and demonstration in 3-4 zig zag kilns in NCR.
 - c) **Research project on mechanized fuel feeding system:** This study will involve:
 - Assessment of various commercially available mechanized fuel feeding systems
 - Pilot testing, emission performance assessment and demonstration of mechanized fuel feeding systems in 2-3 zig-zag kilns.
 - d) **Research project on suitable APCD for zig-zag kiln:** This study will involve:
 - Developing the specifications of the system
 - Design of the system
 - Pilot testing, emission performance assessment and demonstration of APCD in 2-3 zig-zag kilns.
 - e) **Research project on Natural Gas**
 - Design and testing of appropriate technology (brick setting patterns, burner system) to utilize PNG/CNG in 1-2 zig-zag kilns
 - Study on the existing and future pipeline network in NCR, mapping of brick kilns (unlike planned industrial estates, brick kilns are located individually in agricultural fields) to estimate the investments required in the natural gas infrastructure
 - Techno-economic feasibility of using natural gas for brick firing in the NCR region.

Annexure-9

OUTLINE OF THE TRAINING PROGRAMME FOR BRICK KILN OPERATORS

Benefits from adoption of induced draft brick kiln with zigzag firing technology can only be achieved if optimum kiln operation & feeding practices are adopted. In the ongoing the Pandemic situation on-site training is not feasible, so it is recommended to conduct online training programmes for brick kilns owners & operators.

The following topics can be covered:

- **Brick setting:**
 - Setting of chamber (row-row distance, column-column distance, perforation in closing walls, position of wedges)
 - Height of brick setting and placement of wedges
- **Fuel feeding practices:**
 - Fuel preparation & sizing
 - Spoon size
 - Single-man fuel feeding practices
 - Temperature measurement in firing chambers
- **Best practices**
 - Maintaining log book for temperature measurement & shrinkage
 - Management of air flow & leakages
 - Optimum operation of fan through use of VFDs & regular maintenance
- **Troubleshooting:**
 - Major issues/ problems during operation of kiln and its remedies
- **Challenges:**
 - Availability of permanent trained labour
 - Labour Installation of APCD wherein fans are installed on miana (central island)



Amerux-10 - (374)

केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE GOVT. OF INDIA

SPEED POST

CPCB/IPCI-VI/PNG/ 2862-2870

November 27, 2020

To

**The Chairman
SPCBs/DPCC
(as per the list)**

SUB: DIRECTIONS UNDER SECTION 18(1)(b) OF THE AIR (PREVENTION & CONTROL OF POLLUTION) ACT, 1981 IN THE MATTER OF UPCOMING INDUSTRIAL UNITS IN NCR-DELHI.

WHEREAS, under Section 17 of the Air (Prevention & Control of Pollution) Act, 1981, one of the function of the State Pollution Control Boards (SPCBs)/Pollution Control Committees (PCCs) is to plan a comprehensive programme for the prevention, control or abatement of air pollution in the State/Union Territory and to secure the execution thereof; and

WHEREAS, under Section 16 of the Air (Prevention & Control of Pollution) Act, 1981, one of the functions of the Central Pollution Control Board (CPCB) is to coordinate activities of the State Pollution Control Boards and Pollution Control Committees and to provide technical assistance and guidance to SPCBs/PCCs; and

WHEREAS, the SPCBs and PCCs are empowered to stipulate even more stringent standards for discharge of environmental pollutants for various categories of industries than those notified by the Central Government, under the Environmental (Protection) Act, 1986 and rules framed there under; and

WHEREAS, industries located in 24 Districts of Uttar Pradesh, Haryana, Rajasthan and Delhi have been discharging environmental pollutants directly or indirectly into the ambient air, which pose constant threat to and cause adverse effect on the air quality in Delhi and National Capital Region; and

WHEREAS, Hon'ble National Green Tribunal vide its order dated December 18, 2017 in the matter of O.A. No.21/2014, Vardhaman Kaushik Vs. Union of India, noted that "This statistics clearly shows that all the time, the ambient air quality of NCT of Delhi is polluted and for most of the period of the month it is severe and above. This is the quality of air that we are providing to the people living in NCR-Delhi and NCT of Delhi. It is clear violation of their fundamental rights". The Hon'ble Court also noted that Industrial and Thermal Power House emissions including fly ash is one of the seven major contributors of air pollution; and

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दूरभाष/Tel : 43102030, 22305792, वेबसाइट/Website : www.cpcb.nic.in

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WHEREAS, the matter has also come up for discussion in a meeting of the High Level Task Force to review air quality of NCR-Delhi and to suggest action points, wherein, it was felt that effective measures to check air pollution including control of air emissions from industries and their regular monitoring through online systems (for red category-air polluting units) in NCR-Delhi should be ensured; and

WHEREAS, during the meeting of the High Level Task Force held on 18.12.2018, it was decided that all industries in NCR-Delhi, wherever gas supply is available must shift to PNG by 31st March, 2019. However, the target date was further extended to 30.04.2019 in the meeting held on 04.04.2019;

WHEREAS, CPCB conducted review meetings with DPCC and SPCBs of NCR-Delhi on 07.01.2019 and 15.05.2019 to review the status of conversion of industries into PNG as fuel in NCR-Delhi (wherever gas supply is available); and

WHEREAS, it was observed that in spite of availability of PNG supply in the area, large number of industries did not switch their operations to PNG. CPCB vide letter dated 02.07.2019 directed DPCC and SPCBs of NCR-Delhi to close-down all such industrial units in NCR-Delhi, where PNG supply is available and industry has not shifted to PNG. Subsequently, CPCB received a number of representations from industry associations of NCR-Delhi, expressing concerns particularly on cost viability, time period needed for such conversion etc. CPCB on 28.08.2019 communicated to SPCBs of Rajasthan, Haryana and Uttar Pradesh that "while these representations are being examined, it is felt appropriate that at this stage coercive action may not be initiated against the industrial units in NCR, which otherwise are complying with the prescribed environmental norms"; and

WHEREAS, considering the deteriorating air quality in NCR-Delhi and also considering the fact that already directions have been issued to all the existing industries in NCR-Delhi to switch over to cleaner fuels, it is decided that only those new industrial units shall be allowed to set-up in NCR-Delhi, which use cleaner fuels namely, natural gas (PNG/CNG), liquefied petroleum gas, bio gas, propane, butane etc. and

NOW THEREFORE, in view of the above and exercising the powers conferred under section 18(1)(b) of Air (Prevention and Control of Pollution) Act, 1981, you are hereby directed to allow only those new industrial units in NCR-Delhi, which are using cleaner fuels, namely, natural gas (PNG/CNG), liquefied petroleum gas, bio-gas, propane, butane etc.

Actions taken report shall be submitted to CPCB within 30 days from the receipt of these directions.

✓
(Shiv Das Meena)
Chairman

To:

1. The Chairman
Haryana State Pollution Control Board
C-11, Sector 6, Panchkula,
Haryana 134109

2. The Chairman
Rajasthan State Pollution Control Board
A-4 Institutional Area, JhalaneDungri
Jaipur - 302004.
Rajasthan

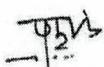
3. The Chairman
Uttar Pradesh State Pollution Control Board
Building.No. TC-12V
VibhutiKhand, Gomti Nagar,
Lucknow-226010.
Uttar Pradesh

4. The Chairman
Delhi Pollution Control Committee
4th floor, ISBT Building,
Kashmeri Gate,
Delhi - 110006.
Delhi

Copy to:

1. The Chairperson, CAQM-NCR
3rd Floor, Indian Oil Bhawan
1, Aurobindo Marg, Yusuf sarai,
New Delhi-110016
 2. The Joint Secretary (CP Division)
Ministry of Environment, Forests
And Climate Change
Indira Paryavaran Bhawan
Aliganj, Jor Bagh Road,
New Delhi – 110 003
 3. The Regional Director (Lucknow)
Central Pollution Control Board
PICUP Bhawan, Vibhuti Khand
Gomti Nagar, Lucknow
Uttar Pradesh
 4. The Regional Director (Bhopal)
Central Pollution Control Board
3rd Floor, Sahkar Bhawan,
North TT Nagar, Bhopal-462003
Madhya Pradesh
 5. The Regional Director (Chandigarh)
Central Pollution Control Board
East Arjun Nagar, Delhi-110032
 6. DH, AQM, CPCB, Delhi
- ✓ DH, IT, CPCB, Delhi

With the request to upload the directions
on CPCB web site


(Prashant Gargava)
Member Secretary