

# More than just Smoke from the Oven

NEED FOR  
STRICTER  
REGULATION FOR  
THE COKING COAL  
INDUSTRY

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As the air pollution crisis deepens in India, it is important to focus on the sources of pollution. Though, the focus is on the major sources of pollution, there is always a need to identify some of the specific sources of pollution which cumulatively add to the pollution load, either locally or at a regional basis. The focus is important given the fact that unless industry specific action plan is developed, it may not be possible to deal with the pollution problem holistically. The coke oven plants are one such activity, which today one of the major causes of air pollution in the regions where they are located. The clandestine operation of the industry, together with lax enforcement had led to mushrooming of coke oven plants in specific regions in the country. Areas where coking coal units operate are today characterized by high levels of pollution. High levels of air pollution were unknown in high rainfall area such as in Assam and Meghalaya, however, specific areas figure in the list of critically polluted areas which correlate to coke oven units. Both governmental and civil society efforts have failed to focus on the need for stricter control over the operation of coke oven plants. There is a clear need to ensure that the emissions standards for coke oven comply with internationally acceptable standards. The lack of finances and technical constraints should not be a reason for the lack of effective regulation. Environmental groups as well as larger civil society have focussed on coal mining and its environmental and social impact, in comparison, the focus on where the coal is utilised has not received the desired attention. This paper focuses on the coke oven industry and the need for stricter regulation and enforcement so as to reduce its pollution footprint.

## Coke oven plant and air pollution

Coke oven plant is used for conversion of coal into coke by the pyrolysis<sup>1</sup> of suitable graded coal, mainly Bituminous coals of high grade (low ash content and high caking index). There are primarily two types of coke oven plants, viz., recovery type<sup>2</sup> and non-recovery<sup>3</sup> type. Non-recovery type plants are also known as bee-hive coke oven plants owing to the bee-hive structure of the ovens in a coke battery.

The demand for coke mainly comes from various metal casting industries and power plants. The primary market for coke includes steel manufacturing industries, ferro alloy, graphite and carbon black industries. Coke acts both as reducing agent as well as a source of fuel to melt the iron ores.

The coking process emits various air pollutants like Particulate Matter (PM), Volatile Organic Compounds (VOCs), Polynuclear Aromatic Hydrocarbons (PAHs); methane at approximately 100 grams per metric ton of coke, ammonia, Carbon Monoxide (CO), hydrogen sulphide (50–80 g/t of coke from pushing operations), hydrogen cyanide and SO<sub>x</sub> (releasing 30% of sulfur in the feed). For every ton of coke produced, approximately 0.7 to 7.4 kg of PM, 2.9 kg of SO<sub>x</sub>, 1.4 kg of NO<sub>x</sub>, 0.1 kg of ammonia and 3 kg of VOCs (including 2 kg of benzene) may be released into the atmosphere from non-recovery type coke oven plants (Anon, 2011).

Besides stack emissions, fugitive emissions from various processes involved in coke manufacturing contribute significantly towards environmental pollution. Coal handling operations like coal crushing, coal charging and coke handling operations like coke pushing, quenching and crushing are the major sources of fugitive emissions in coke oven plants. High level of fugitive emission are also released from the 'secondary holes' provided in both sides at the bottom of the main flue tunnel in the coke oven plants during the initial hours of charging of coal.

According to an assessment by low volume sampler monitoring at two industries, the level of suspended particulate matter (SPM) is observed in the range of 666 – 14666 µg/m<sup>3</sup> near the coke ovens and coke crushing areas and the levels of SO<sub>x</sub> and NO<sub>x</sub> are observed in the range of 0.25-216.88 µg/m<sup>3</sup> and 22.65-36.88 µg/m<sup>3</sup> respectively. These concentrations of particulate matter are alarmingly high as compared to the National Ambient Air Quality Standards of 2009 (Anon, 2011).

Coke oven plant emissions or rejects (gaseous, solid & hazardous as well as liquid effluents) can cause damage to human health, aquatic and terrestrial ecology as well as material due to various exposure routes (pathways). For example adverse effects of coke oven plants on human health can derive from the direct impact of noxious gases on the organism and/or their indirect impact via food chain and changes in the environment. The manual had also described the typical composition of raw coke oven gas as given below (Anon 2010)

Raw Gas Yield [m <sup>3</sup> /h/t coal]	H <sub>2</sub> [vol.%]	CH <sub>4</sub> [vol.%]	C <sub>x</sub> H <sub>y</sub> [vol.%]	CO [vol.%]	H <sub>2</sub> S [vol.%]	BTX [g/Nm <sup>3</sup> ]	PAH [mg/Nm <sup>3</sup> ]	NH <sub>3</sub> [g/Nm <sup>3</sup> ]	CO <sub>2</sub> [vol. %]
12-25	39-65	32-42	3.0-8.5	4.0-6.5	3-4	23-30	n/a	6-8	2-3

## Legal regulation on coke oven plants

In India, coke oven plants are bounded by the various regulatory frameworks. According to the Section 7 of the Environment (Protection) Act, 1986, no person carrying on any industry, operation or process shall discharge or emit or permit to be discharged or emitted any environmental pollutant in excess of such standards as may be prescribed. Under the Environment (Protection) Rules, 1986 emission standard for bee hive hard coke plant has also been set<sup>a</sup> which came into effect from 1996. According to this, emission standard for new unit for particulate matter and hydrocarbon and emission standard for particulate matter for existing unit has been set up. General standard for discharge of effluent was also set up under the Environment (Protection) Rules, 1986; however the same has been substituted

<sup>a</sup> Inserted in E(P) Rules, 1986 vide G.S.R. 176(E), dated 2nd April, 1996 (w.e.f. 3-4-1996)

by G.S.R. 277(E) dated 31st March, 2012 and effluent discharge standard for coke oven plants within integrated iron and steel plant was set up.

The coke oven plants are also covered under the ambit of the Air (Prevention and Control of Pollution) Act, 1981. According to Section 22, no person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollutant in excess of the standards laid down by the State Board under clause (g) of sub-section (1) of section 17. As described in the previous section under air pollution, coke oven plants are also responsible for fugitive dust emission from the various individual processes. Therefore, it is also important to maintain the ambient air quality standard by these plants. The National Ambient Air Quality Standards of India (NAAQS) was formulated under the Air (Prevention and Control of Pollution) Act, 1981<sup>a</sup>.



Boundary of coke oven unit premises, Margherita, Assam

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In India, new coke oven plants including expansion and modernisation, whether recovery, non-recovery or bee hive types require prior Environmental Clearance as it is covered under the EIA Notification 2006. These projects are classified into Category A and Category B.



The coke oven plants are also regulated by the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. According to Section 4 of Sub-Section 2, the occupier shall be responsible for safe and environmentally sound management of hazardous and other wastes.

## Deficient standards

The Environment (Protection) Rules, 1986 (as amended till date) had laid down emission standards for bee-hive hard coke oven plants and soft coke industry in the year 1996. According to this, the standard for coke oven plants only talks about emission of PM and HC for new units and only PM for existing units.

It is important to mention here that the formulated standard for PM emission from the new as well as existing plants allow for higher levels of emissions. According to the standard, PM emission from new and existing units is set at 150mg/Nm<sup>3</sup> and 350mg/Nm<sup>3</sup> respectively. The findings from monitoring of coke oven plants had already showed PM emission can be as low as 89 mg/Nm<sup>3</sup> (Anon, 2011), which means that, if intended, a unit can achieve PM emission as low as this level.

<sup>a</sup> Vide No.B-29016/20/90/PCL-L dated 18th November 2009

Indian standards are quite relaxed as compared with international figure of European Union (Hein & Kaiser, 2012)

India has however not formulated any standards for these pollutants, in spite of its recognition of emission of other pollutants like  $\text{SO}_2$  and  $\text{NO}_x$ , Volatile Organic Compounds (VOC), Carbon Monoxide (CO) and Poly-nuclear Aromatic Hydrocarbons PAH from coking process.

Installation of wet scrubbing system entails reduction in gaseous emissions like  $\text{SO}_2$ ,  $\text{NO}_x$ , VOC, CO etc in the flue gas. This has however not seen in the emission pattern of the 16 bee hive coke oven plants operating in north-east region which were studied (Anon 2011).

Therefore immediate formulation of standard for these parameters is call of the hour.

Parameter	European Union
$\text{SO}_2$	<200 to 500 mg/Nm <sup>3</sup>
$\text{NO}_2$ for new plants	<350 to 500 mg/Nm <sup>3</sup>
$\text{NO}_2$ for existing plants	500 to 650 mg/Nm <sup>3</sup>
$\text{H}_2\text{S}$ (applying absorption process)	< 300 to 1000 mg/Nm <sup>3</sup>
$\text{H}_2\text{S}$ (applying wet oxidation process)	<10 mg/Nm <sup>3</sup>
Benzene	5 $\mu\text{g}/\text{m}^3$
$\text{PM}_{10}$	40 $\mu\text{g}/\text{m}^3$
$\text{PM}_{2.5}$	25 $\mu\text{g}/\text{m}^3$
Benzo-pyrene	1 ng/m <sup>3</sup>

#### Pollutant Concentration Range in 16 Plants of N-E Region, Examined by CPCB

PM: 89 - 523 mg/Nm<sup>3</sup>

CO: 1.75 - 397.80 mg/Nm<sup>3</sup>

$\text{SO}_2$ : 87 - 942 mg/Nm<sup>3</sup>

$\text{NO}_x$ : 3.80 - 20.58 mg/Nm<sup>3</sup>

Plant boundary in dilapidated condition, Margherita, Assam



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## Status of compliance with emission standards

The Environment (Protection) Rules, 1986 (as amended till date) had laid down emission standards for bee-hive hard coke oven plants and soft coke industry in the year 1996. According to this, the standard for PM and HC has been set for new coke oven plants where as the standards for PM has been set for existing units.

#### Bee Hive Hard Coke Oven Emission Standard

- (i) New unit - Particulate matter 150 mg/Nm<sup>3</sup> (corrected to 6%  $\text{CO}_2$ )  
Hydrocarbons 25 ppm
- (ii) Existing units - Particulate matter 350 mg/Nm<sup>3</sup> (corrected to 6%  $\text{CO}_2$ )

According to the Note of the 1996 emission standard for bee hive hard coke oven, units set up after the publication of this Notification shall be treated as new units. The Note further states that, after four years from the date of this notification, all the existing units shall comply with the standards prescribed for the new units. Therefore this infers that, from the year 2000 onwards all the coke oven plants (irrespective of their age) shall have to comply with the standards. The Note had also mentioned that wet scrubbing system or waste heat utilization for power generation or by-product recovery systems should be installed preferably to achieve the prescribed standards

The status of compliance level can be seen here (Anon, 2011).

#### Findings of CPCB Monitored 16 Plants

- 4 out of 7 plants (PM value for rest of the 9 plants could not be analysed by CPCB due to very high flue gas temperature) had PM emission above the standard, i.e 150 mg/Nm<sup>3</sup>
- Out of the 16 coke oven plants (out of total 42 as quoted in CPCB report) monitored by CPCB, only 3 plants had installed wet scrubber and none other had installed any air pollution control devices to control stack emission.
- Plants, which have installed either the scrubber system or the fugitive emission control system or both, do not run the air pollution control devices regularly as those are power consuming equipment and as the plants can run the plant bypassing the APC devices

In spite of this non-compliance, no legal action has been initiated against these coke oven plant operators. Rather the responsibility has been imposed on the SPCBs to ensure installation of air pollution control devices.

The situation has however remains same or have been deteriorated over the time. The non-compliance with the Emission Standard of 1996 is also evident from a recent RTI reply received from Assam PCB Regional Office (RO) of Dibrugarh and Guwahati on 29th June 2018 and 25th June 2018 respectively.

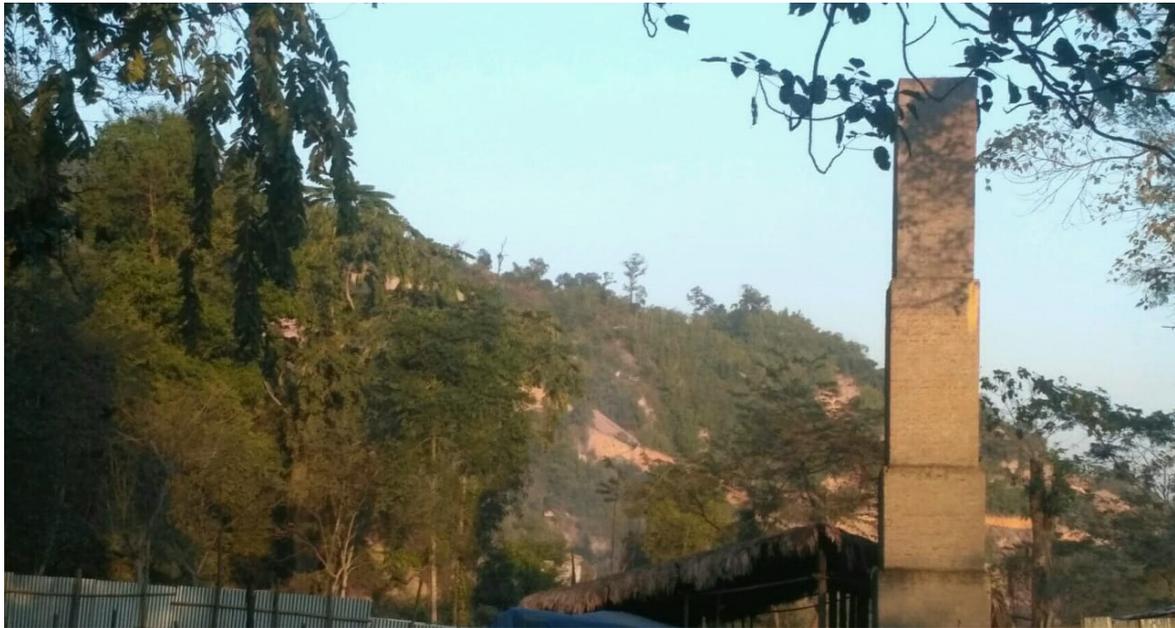
### Summary of Reply by Dibrugarh Regional Office

- **A total of 55 plants are under their purview, out of which**
  - 6 Plants have obtained CTE and CTO
  - No status is known for 30 plants
  - 10 plants not applied for CTE & CTO
  - Application of CTO for 8 plants is under process
  - 1 plant was issued closure notice
- **Stack Emission Report is given for 33 plants, out of which**
  - 24 plants have not installed any Air Pollution Control Devices (APCD)
  - No information is given about the rest of the 9 plants
  - PM Concentration for all the units is almost touching the standard value of 150 mg/Nm<sup>3</sup> with average concentration being at 140 mg/Nm<sup>3</sup>
  - HC Concentration is more than the standard value of 25ppm for 25 plants

### Summary of Reply by Guwahati Regional Office

- **A total of 21 plants are under their purview**
  - 8 Plants have obtained CTE and CTO
  - Application for 13 plants is under process
  - No information was provided on the stack emission testing report

Stack of one coke oven unit, Margherita, Assam



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## Monitoring of real time air quality

A brief analysis of the current operating stations under National Air Quality Monitoring Programme (NAMP) revealed that, there is not even a single monitoring station in Tirap district of Arunachal Pradesh where environmental violations in the form of coal mining is going on to supply coal to the coke oven plants of Assam and Meghalaya. On the other hand, Margherita and Tinsukhia of Assam currently has 1 and 3 operational air quality monitoring stations respectively, which no way can suffice the need of regular ambient air quality data generation.

To add to it, none of the States of Arunachal Pradesh and Meghalaya has a single station for Continuous Ambient Air Quality Monitoring (CAAQM) to give real time data on air quality, where as Assam recently has bagged one such station in their ambit.

## Recommendations

Some immediate steps are recommended for these coke oven plants in India

- Formulation of emission standard for SO<sub>2</sub>, NO<sub>x</sub> and VOC
- Closure of all Coke Oven Plants / units which are operating in violation of the Environment (Protection) Rules, 1986 as amended from time to time, Air (Prevention and Control of Pollution) Act, 1981 and Water (Prevention and Control of Pollution) Act, 1974 and Environment Impact Assessment Notification, 2006
- CPCB and SPCBs should review the functioning of all coke oven units in the country in order to ensure that they comply with the existing norms within a time bound manner
- Status report on operative coke oven plants in India and its coal sourcing region
- Cumulative Impact Assessment study taking into account the coke oven plants and their coal sourcing region and overall impacts of transportation and operation of coke oven plants as a whole in the environment
- Coke oven plants shall be brought under the ambit of pollution monitoring mechanism which was mandated by CPCB for 17 highly polluting industries and must be mandated to install continuous emission monitoring system as part of it.
- Immediate installation of Continuous Ambient Air Quality Monitoring stations to get a detailed and real time picture of air pollution in the region

- Formulation of a guideline to deal with the usage, handling and storage of both coal and coke within and outside the plant premises. Use of sprinklers shall be made mandatory to mitigate fugitive dust.
- Mandatory installation of air pollution control devices like Scrubbers, Baghouse and ESPs having 99% removal efficiencies for controlling particulate matter emissions from loading and pushing operations
- Maintain transparency in the operation of the coke oven plants by making information available in public domain, because in absence of information about the unit, it is impossible to gather information with respect to the plant and also to check whether these plants are operating in accordance with law or not

## Way Forward

The Indian coke oven plants are more inclined towards non-recovery type (bee-hive) coke oven plant structure, which ultimately renders the air pollution problem unmanageable. As an immediate step, a study should be executed to come out with a status report on operational conditions of these plants and compliance status report and accordingly closure action for non complying units shall be initiated immediately. CPCB in 2011 had recommended a detailed study on the status of ambient air quality in the Byrnihat, Meghalaya where cluster of coke oven plants are in operation, focusing on heavy metals (HM), Poly-nuclear Aromatic Hydrocarbons (PAH) in ambient air of Jorabat and Byrnihat, located in the Assam–Meghalaya Border; however no such study has been initiated by them till date. An immediate commissioning of this study and installation of continuous ambient air quality monitoring station is call of the hour. CPCB had only conduct an inspection of north-eastern coke oven plants, where as it is evident that the Dhanbad cluster of Jharkhand is also having large number of coke oven plants. Therefore it is essential to come out with a status report of currently operative coke oven plants across India. It must be also emphasised that coke oven plants leads to illegal coal mining in various states. There is thus strong nexus of illegal mining, deforestation, illegal transport and manufacturing of coke oven plants. The sector needs strict regulation and oversight. The role of the State Pollution Control Boards as well as Regional Offices of the Ministry of Environment, Forest and Climate Change needs to change from one as a passive spectator to an active enforcer of law. It is clear that the CPCB did a



Coke Oven unit premises, Margherita, Assam

study way back in 2011, and identified some of the key problems due to the operation of the coke oven units. However, the entire study was only an academic exercise with no effort by the CPCB as well as State Pollution Control Boards to initiate an action at the ground level. Coke oven plants thus continue to operate with the most archaic technology, causing not only serious ecological damage but also causing irreparable damage to the health of the people.

An open accessible part of coke oven unit with no boundary, Margherita, Assam



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## NOTES

1. Pyrolysis is the process of heating in the absence of air
2. In recovery type, low ash metallurgical coke (LAMC) and coke oven gas is produced, beside Coke breeze, which is produced as a by-product. Coke oven gases contain various volatile compounds which can further be processed to recover combustible gases and other bye-products like tar, ammonium sulphate, phenol, naphthalene, light oil, sulphur etc, and the gas is subsequently reused as fuel for heating the ovens.
3. In non-recovery type, there is no provision for recovery of various valuable products from the coke oven gases. All the coke oven gases are emitted as flue gas. Low ash metallurgical coke (LAMC) is the main target product. Coke breeze is the only bye-product in non-recovery type plant.

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