



COMPREHENSIVE INDUSTRY DOCUMENT
SERIES : COINDS/18/1984-85

EMISSION REGULATIONS

PART - TWO



CENTRAL POLLUTION CONTROL BOARD
February, 1998

COMPREHENSIVE INDUSTRY DOCUMENT
SERIES : COINDS/18/1984-85

EMISSION REGULATIONS

PART - TWO



CENTRAL POLLUTION CONTROL BOARD

(Ministry of Environment & Forests, Government of India)

Parivesh Bhawan, East Arjun Nagar

Delhi - 110 032

CPCB, 1985 (First Edition)

CPCB, 200 Copies, 1995 (First Reprint)

CPCB, 500 Copies, 1998 (Second Reprint)

ISBN : 81 - 86396 - 21 - 7

PREFACE

This document contains emission regulations for six specific industrial operations selected from the Schedule of Industries listed in the Air (Prevention and Control of Pollution) Act, 1981. The first set of emission regulations for six specific industrial operations selected from the Schedule was published in July, 1984. The other industrial operations listed in the Schedule are under active consideration for the national evolution of emission standards.


(NILAY CHAUDHURI)
CHAIRMAN

CONTENTS

<u>Subject</u>	<u>Page</u>
Emission Standards	1
Calcium Carbide	5
Copper, Lead and Zinc Smelting	6
Carbon Black	8
Fertilizer (Phosphatic)	10
Oil Refineries	12
Aluminium	16
Guidelines for Minimum Stack Height	18

EMISSION STANDARDS

The emission standard for Calcium Carbide, Copper, Lead and Zinc Smelting, Carbon Black, Fertilizer (Phosphatic), Oil Refineries and Aluminium Extraction are given below in abstract.

As prescribed in the Air (Prevention and Control of Pollution) Act, 1981 Section 17(1)(g), the emission standards for the air polluting industrial operations, as mentioned above, are evolved to be laid down by the State Pollution Control Boards. The emission standards for other industrial operations covered in the Schedule will be evolved subsequently. The rationale for evolving these standards are given in the report.

These standards are applicable till December, 1987 and will be reviewed again in January, 1988 based on experience and input from the monitoring data obtained during this period. The stack monitoring shall be done as prescribed by the Central Pollution Control Board.

The State Boards may adopt standards that are more stringent than those given below depending on the location of the industries and specially if it is in a protected area. They shall not, however, relax the standards.

A protected area is one that is already polluted being in a metropolitan/ industrial location. A protected area also includes a sensitive area because of its proximity to national parks, forests, historical monuments and health resorts.

How to Express the Emission

While measuring the emission in a stack, the temperature, pressure, and humidity are to be recorded. The emission limits prescribed are expressed as concentration of pollutants per unit volume of air under standard or normal conditions, written as Nm³. The standard conditions for air in India, hereinafter termed as Standard Air, are 25°C temperature, 760 mm Hg pressure, and zero percent moisture. Emissions measured at other conditions of air are to be computed for Standard Air for reporting compliance to the prescribed limits.

For example, if the volume of the gas drawn through the sampling train, as measured by the dry gas meter, is V_m cubic metres under a negative pressure of P_m mm Hg and a temperature of $T_m^\circ\text{C}$; then the standard volume, V_{std} is given by

$$V_{std} = V_m Y \left(\frac{298}{273 + T_m} \right) \left(\frac{P_{bar} - P_m}{760} \right)$$

where P_{bar} is the barometric pressure, at the sampling site, in mm Hg and Y is the calibration factor of the dry gas metre. Thus, if the total particulates collected is M_n , mg, then the emission concentration is $\frac{M_n}{V_{std}}$ mg/Nm³

1. CALCIUM CARBIDE

Standard for particulate matter emission

Source	Emission Limit
Kiln	250 mg/Nm ³
Arc Furnace	150 mg/Nm ³

2. COPPER, LEAD AND ZINC SMELTING

Standard for particulate matter and oxides of sulphur

Concentrator	150 mg/Nm ³ for particulate matter
Smelter and Converter	Off-gases must go for H ₂ SO ₄ manufacture : No release of SO ₂ /SO ₃ shall be permitted from the smelter or converter.

3. CARBON BLACK

Standard for particulate matter emission

Year of Commissioning	Emission limit
New Plants (Built and Commissioned after January 1, 1985)	150 mg/Nm ³

Existing Plants	250 mg/Nm ³
(Built and Commissioned before December 31, 1984)	(till December 31, 1986)
	150 mg/Nm ³
	(from January 1, 1987)

4. FERTILIZER (Phosphatic)

Standard for fluoride and particulate matter

Process	Emission limit
Acidification of rock phosphate	25 mg/Nm ³ as total fluoride(F ⁻)
Granulation, Mixing, Rock Grinding	150 mg/Nm ³ of particulate matter from each process

5. OIL REFINERIES

Standard for sulphur dioxide

Process	Emission limit
Distillation (Atmospheric plus Vacuum)	0.25 kg/Te of feed*
Catalytic Cracker	2.5 kg/Te of feed
Sulphur Recovery Unit	120 kg/Te of Sulphur in the feed

*Feed indicates the feed for that part of the process under consideration only.

6. ALUMINIUM

Standard for fluoride and particulate matter

Process	Standard
Calcination	250 mg/Nm ³ of particulate
Aluminium Smelting	1 kg (F ⁻)/Te of aluminium produced and 150 mg/Nm ³ of particulate matter

Schedule	Status in respect of evolving Emission Regulations
1. Asbestos and asbestos products industries	Under preparation (UP)
2. Cement and cement products industries	Prepared for cement industry*
3. Ceramic and ceramic products industries	UP
4. Chemical and allied industries	Prepared for Sulphuric acid*
	Prepared for Nitric Acid*
	Prepared for Calcium Carbide**
5. Coal and lignite based chemical industries	UP
6. Engineering industries	UP
7. Ferrous metallurgical industries	Prepared for Integrated Iron and Steel*
8. Fertilizer industries	Prepared for Urea*
	Prepared for Phosphatic Fertilizer**
9. Foundries	UP
10. Food and agricultural products industries	UP
11. Mining industries	UP
12. Non-ferrous metallurgical industries	Prepared for Aluminium**
	Prepared for Copper**
	Prepared for Lead**
	Prepared for Zinc**
13. Ores/mineral processing industries including beneficiation, pelletization, etc.	UP
14. Power (coal, petroleum and their products) generating plants and boiler plants	Prepared for Thermal Power*
15. Paper and pulp (including paper products) industries	UP
16. Textile processing industries	UP
17. Petroleum refineries	Prepared for Oil Refineries**
18. Petroleum products and petro-chemical industries	Prepared for Carbon Black**
19. Plants for recovery from and disposal of wastes	UP
20. Incinerators	UP

*Printed in Emission Regulations - Part I

**Printed in Emission Regulations - Part II

CALCIUM CARBIDE

1. Background

Calcium carbide is the basic material required for producing acetylene. There are, at present, eight major manufacturers of calcium carbide in the country with a total production of over 1,00,000 tonnes per annum.

Calcium oxide is obtained from limestone in kilns. This is made to react with carbon in arc furnaces with SODERBERG type graphite electrodes.

2. Emissions

During the decomposition of calcium carbonate to calcium oxide and carbon dioxide, fine powder is generated by attrition and decomposition of the lump limestone. This could be carried out of the kiln by the carbon dioxide formed. These kilns are usually vertical shaft type in which the emissions can be maintained at levels less than 250 mg/Nm^3 , by proper operation and feed control. Enormous quantities of particulate matter is generated in arc furnaces. It is required that this is collected in a suitable pollution control equipment. High efficiency scrubbers or bag filters with spark arresting devices can easily control this to less than 150 mg/Nm^3 .

3. Standards

The following standards are adopted:

<u>Source</u>	<u>Standard</u>
Kiln	250 mg/Nm^3
Arc furnace	150 mg/Nm^3

COPPER, LEAD AND ZINC SMELTING INDUSTRY

1. Source of Emissions

The source of pollutant emissions are:

- i) Concentrator
- ii) Smelter and Converter

There will also be emissions from mining and ore handling, which are not considered for the present. Emission regulations from sulphuric acid, fertilizer and power plant are separately dealt in "Emission Regulations (July 1984) Part-I", Comprehensive Industry Document Series: COINDS/17/1983-84.

2. Concentrator

The ore is ground in rod and ball mills and then sent for froth floatation. The final concentrate after thickening is filtered. During the crushing operation in ball mills, considerable amount of dust is generated.

In the absence of any monitoring data it is considered rational to go by the achievability of bag filter, wet scrubber or ESP. Therefore, an emission limit of 150 mg/Nm^3 is adopted for the concentrator stack.

3. Smelter and Converter

The wet concentrate is first dried and then conveyed to the smelter.

Three products are formed in the smelter, namely, slag, metal and SO_2 bearing gases. Further refining is done in a converter. The off-gases from the converter travel through cyclones and join the main stream of off-gases from the smelter at the crossing tower where built-in ESP is assumed. These gases from crossing tower finally enter the sulphuric acid plant.

4. Basis

Under normal operating conditions no sulphurdioxide should be emitted prior to the sulphuric acid plant. It is claimed that off-gases containing less than 4.7 percent SO_2 is not suitable for production of H_2SO_4 and hence needs venting. This is considered extremely undesirable for the

protection of vegetative cover and human health. Also for this reason, the plant should be maintained so that there are no fugitive emissions.

5. Emission Limits

No SO_2/SO_3 emission is permitted from the duct/stack of smelter which is generally attached to the crossing tower. All SO_2/SO_3 must go to the sulphuric acid plant in closed circuit even if the concentration of SO_2 is less than 4.7% in the off-gas.

SULPHURIC ACID PLANT SHOULD BE MADE OPERATIVE ALL THE TIME, IF NECESSARY BY OXIDIZING SULPHUR TO MAKE UP THE SO_2 CONTENT IN THE OFF-GASES.

6. Standards

The following standards are adopted:

Source	Standard
Concentrator	150 mg/Nm ³ for particulate matter
Smelter and Converter	Off-gases must go for H_2SO_4 manufacture. No release of SO_2/SO_3 shall be permitted from the smelter or converter

CARBON BLACK

1. Background

The process consists in burning aromatic hydrocarbons in reactors under reducing conditions. The normal product is carbon black. Owing to the process conditions, there is a large amount of carbon monoxide produced.

2. Basis

2.1 Particulate Matter

Carbon black, as particulate matter, is attempted to be saved by control devices from getting lost into the atmosphere. The gases from the reaction vessel pass through bag filters before being vented to the atmosphere. Properly maintained bag filters with reverse pulse-jet cleaning mechanism can control the emissions to within 150 mg/Nm^3 . However, some of the older plants have bag filters of the shaker type, where the emissions can go upto 250 mg/Nm^3 . Guided by the control efficiency of bag filters installed in the existing plants the standard for stack emission is adopted as 250 mg/Nm^3 of particulate matter for existing plants.

2.2 Carbon Monoxide

The vent gas is usually very rich in carbon monoxide and under adverse meteorological conditions could cause excessive build-up in concentration in the ambient air which may cause harm to the people living in the neighbourhood. To minimize this, it is required that gases are either recycled or oxidized in an after-combustor prior to venting. The height of the stack shall be atleast 30 metres.

3. Standards

The following standards are adopted:

Year of Commissioning	Emission Limit
New Plants (Built and Commissioned after January 1, 1985)	150 mg/Nm^3
Existing Plants (Built and Commissioned before December 31, 1984)	250 mg/Nm^3 (till December 31, 1986) 150 mg/Nm^3

Year of Commissioning	Emission limit
Existing as well as new plants	To install after-burners for reactor off-gas, by December 1987.

FERTILIZER (PHOSPHATIC)

1. Background

In this group of fertilizers, there are fifty one companies manufacturing single super phosphate (SSP). There are only ten companies manufacturing complex phosphatic fertilizers. The annual production of SSP in India is 1.2 million tonnes compared to 2.2 million tonnes of the total production of phosphatic fertilizers, (Source : Fertilizer Statistics, Fertilizer Association of India, New Delhi, 1983-84).

Complex fertilizer include Diammonium phosphate (DAP), Nitro-phosphate, Ammonium Phosphate Sulphate (APS) and Urea ammonium phosphate (UAP). Productionwise DAP tops the complex group. Captive production of phosphoric acid from rock phosphate and sulphuric acid also exists; some units directly purchase. Many complex fertilizers involve only granulation and mixing of different basic fertilizers.

2. Source of Emissions

The rock phosphate generally has about 4 percent fluoride (as F^-). Fluoride is liberated during acidification of the rock phosphate in digestors and in the concentration of phosphoric acid. Depending on the type of fertilizer desired, sulphuric, phosphoric or nitric acid becomes the digesting acid.

Fluoride is emitted from the rock phosphate during digestion, either as dust or as vapour (Fluorine, Hydrofluoric acid or Silicon Tetrafluoride) Grinding of rock phosphate would create dust emissions.

3. Basis

Forty kilogramme (kg) of Fluoride (as F^-) is the most that can be emitted per tonne of rock phosphate processed. Scrubbing with mildly alkaline medium is demonstrated to perform at an efficiency level above 99.9 percent in arresting fluoride in plants in India (Data provided below). The controlled emission can be less than 0.04 kg of F^- /Te of rock phosphate processed.

3.1 : Performance Data of a Unit in India.

Fluoride emission	:	3.6 mg/Nm ³
Total gas quantity	:	164,000 Nm ³ /hr
Phosphoric acid production	:	165 Te/day
Rock phosphate processed	:	520 Te/day

$$\text{Fluoride emission} = \frac{3.6 \times 164000 \times 24}{1000 \times 1000 \times 520}$$

$$= .03 \text{ kg/Te of rock phosphate processed}$$

$$\text{Efficiency of control} = (40 - 0.03) \times 100/40 : 99.925 \text{ percent}$$

4. Standards

Taking 99.5 percent as the stable efficiency, the total fluoride emission is 0.2 kg/Te rock phosphate processed. Consequently, the measured emission for total fluoride should be less than 25 mg/Nm³.

In the case of mixed fertilizers, care shall be taken so that the product is not lost during granulation and mixing. As such, good control techniques would be used in these cases whereby an emission limit of 150 mg/Nm³ can be easily achieved. Similarly, in the case of grinding of rock phosphate a limit of 150 mg/Nm³ shall also be achieved. The following limits are adopted:

Process	Emission Limit
Acidification of rock phosphate	25 mg/Nm ³ as total F ⁻
Granulation, mixing and grinding of rock phosphate	150 mg/Nm ³ of particular matter

OIL REFINERIES

1. Background

The spectrum of operations of refineries in India ranges between basic distillation units to plants having facilities for polymerization, reforming and blending. The sulphur in the feedstock varies widely depending on the source of the crude oil. This has an effect on the emissions. India needs to import almost 30 percent of crude for processing. The sulphur content of imported crude ranges between 1.8 and 2.0 percent while that in the Bombay High crude is about 0.2 percent.

The source of the crude controls the type of products that can be obtained. Some of the less valuable products, such as heavy naptha, are converted to products with a greater sale value, such as diesel or kerosene because of their special demand in India. This conversion is accomplished by cracking, polymerization and reforming.

2. Source of Emissions

The basic pollutant in oil refineries is sulphur dioxide. This can be liberated either from the fuel or from the process. The crude oil is distilled and the heavy fraction obtained is used as a fuel in the refining process.

The emissions of sulphur dioxide because of sulphur in the fuel is from the following processes:

- i) Atmospheric Distillation
- ii) Vacuum Distillation
- iii) Viscosity Breaker Unit (Vis Breaker)
- iv) Coking unit
- v) Cat Cracker feed heater
- vi) Reformer Heater

The process-controlled emissions and related to feed quality are from:

- i) Fluid catalytic cracker (FCC)
- ii) Sulphur recovery unit (SRU)
- iii) Bitumen unit

3. Basis

3.1 Distillation

In cases where the process consists of having a common stack from atmospheric and vacuum distillation, the normal uncontrolled emission is 198 kg/hr or 0.25 kg/Te of feed (Mathura Refinery). The standard for distillation units (atmospheric plus vacuum) is, therefore, adopted as 0.25 kg/Te of feed. In those cases where the fuel contains high sulphur, it is required that the sulphur content is reduced.

3.2 FCC and CO Boiler

The emissions from the CO boiler are sulphur dioxide, carbon monoxide and particulate matter. The particulate matter, chiefly containing spent catalyst, shall be controlled by installing high efficiency cyclones. The particulate carbon monoxide shall be controlled by having an after combustor. The sulphur dioxide emission was found to be 350 kg/hr or 0.25 kg/Te of feed at the FCC Mathura Refinery. Adopting this as the standard, the recommended procedure for sulphur dioxide control shall be reduction of sulphur content in the fuel.

3.3 Sulphur Recovery

Amine scrubbing shall be required for cleaning of hydrogen sulphide in the off gas. The scrubbed hydrogen sulphide shall then pass through the SRU. The conversion efficiency of the sulphur recovery unit shall be kept above 98 percent. As revealed from the data maintained by the Mathura Refinery, the outlet sulphur dioxide concentration is 90 kg/hr or 17.5 Te/day of sulphur feed. This works out to a conversion efficiency of 94 percent or an emission of 120 kg/Te of sulphur in the feed. Using this as the basis, the SO_2 emission from the sulphur recovery unit is adopted as 120 kg/Te of sulphur in the feed.

3.4 Ambient Air Quality vis-a-vis implementation of Emission Standards

There are twelve refineries in India. Three of these are located in sensitive areas. One of these is in Mathura and two in Bombay. This standard is, therefore, applicable to these three refineries.

The ambient air quality should be studied for the next three years to determine the type of standards applicable in the other refineries. This data should be made available to the Central and the relevant State Pollution Control Boards by the refineries for one year, beginning April 1986. If more than one year's data is available, this shall also be sent, by June 1987 in the format published by the Central Pollution Control Board, in its document on Monitoring Regulations. This is relevant considering the industrialisation of Baroda, Cochin, Haldia, Madras and Visakhapatnam. Applicable emission standards for these refineries will be evolved after the monitoring data has been studied.

4. General

- a) Emissions from power plants have already been dealt with the Emission Regulations (Part-I), Comprehensive Industry Document Series, COINDS/ 17/1983-84. The stack heights should be calculated as per the formula given in the above regulation.
- b) The flare in the refinery should be smokeless.

5. Standards

On the basis of the above rationale the following standards are adopted:

Process	SO ₂ Emission Limits
1. Distillation (Atmospheric plus Vacuum)	0.25 kg/Te of feed
2. Catalytic Cracker	2.5 kg/Te of feed
3. Sulphur Recovery Unit	120 kg/Te of Sulphur in the feed.

Note: The feed indicates the feed for that part of the process only.

Emission Data of Mathura Refinery

Plant	Feed Rate, Te/day	Sulphur Dioxide Emission	
		ppm	kg/hr
Distillation	9,000 - 22,000	90-	42-
		250	198
Vis Breaker	1,000 - 3,000	175-	35-
Unit		200	40
FCC	2,500 - 3,500	30-	2-
Charge Heater		60	3
FCC	2,500 - 3,500	650-	194-
CO		1250	355
Boiler			
Sulphur	17.5	7500-	30-
Recovery		20000	90
Unit			

ALUMINIUM

1. Background

The raw material for aluminium manufacture is bauxite. This is aluminium oxide which has to be purified in several distinct steps before aluminium can be extracted through electrolysis by the classical Hall-Heroult process.

There are six existing primary aluminium manufacturers in the country. Two of these use the VERTICAL SODERBERG method while the others use PREBAKED ANODES. In all cases, it is possible to put the electrolytic cell into an enclosure and draw the exhaust gases, through a pollution control device prior to releasing it through the stack.

2. Source of Emission and Basis

The sources of pollutant emissions are:

2.1 Calcination Kiln

The purified aluminium hydroxide that is precipitated is calcined in a rotary kiln. The kiln emissions are collected by electrostatic precipitators as in cement plants. Similar to cement industries producing 200 tonnes per day cement or more the emission limits for particulate for kiln emissions is retained at 250 mg/Nm³ (Reference, Emission Regulations (July 1984) Part One, COINDS/17/1983-84).

2.2 Boilers

Aluminium plants generally have captive boilers for their steam requirement or for power generation. Stack height and emission standards are given in 'Emission Regulations (July 1984) Part One,' Comprehensive Industry Document Series: COIDS/17/1983-84'.

2.3 Baking Furnace

Pre-baked anodes generally utilize a fuel for baking the green anodes in order to improve their dry strength. The emission from the baking process is usually sulphur dioxide, generated from the sulphur in the fuel. The control of sulphur dioxide shall be through controlling the stack height (Reference 'Emission Regulations (July 1984) Part One: COINDS/17/1983-84').

2.4 Aluminium Production

In the manufacture of aluminium by electrolysis of alumina; cryolite, fluorspar and aluminium fluoride are added. The fluoride emission (as F^-) is about 0.2 Te per Te of Aluminium produced. A negligible amount of this may be absorbed in the carbon liner. The standard methods of control of fluoride emissions is either by a venturi scrubber with a mildly alkaline medium or a dry scrubber with a fluidized-bed reactor followed by a bag filter to control carry-over of particulates, prior to release from the stack. In both these methods it is possible to get a collection efficiency of atleast 99.5 percent. Consequently, an emission of 1.0 kg (of F^-) per Te of aluminium is kept as the standard.

Simultaneously, the efficiency of the control device would be adequate to keep the emission of particulates to less than 150 mg/Nm^3 .

3. Standards

The following standards are adopted:

Process	Standard
Calcination	250 mg/Nm^3 of particulates
Aluminium Smelting	1 kg (F^-)/Te of aluminium produced 150 mg/Nm^3 of particulate matter

GUIDELINES FOR MINIMUM STACK HEIGHT

Plant Type	Stack Height
For all plants except Thermal Power Plant	30 m

2. For plants where the sulphur dioxide emission is estimated as $Q(\text{kg/hr})$ the stack height, H in metres is given by

$$H = 14 (Q)^{0.3}$$

3. For plants where the particulate matter emission is estimated as $Q(\text{tonnes/hr})$ the stack height, H in metres is given by

$$H = 74 (Q)^{0.27}$$

4. If by using the formula given in 2 or 3 above, the stack height arrived at, is more than 30 m then this higher stack should be used.

In no case should the height of the stack be less than 30 m, for plants given in the Schedule of the Air (Prevention and Control of Pollution) Act, 1981, and located in industrial areas of cities.

