Confederation of Indian Industry

# REVIEW OF
# AIR EMISSION STANDARDS
# CEMENT INDUSTRY

Cement Manufacturers' Association

## OBJECTIVE

Sector specific emission standard bulletin for Indian Cement industry is developed with an objective to create awareness among various stakeholders and to provide clear & concise information on following areas:

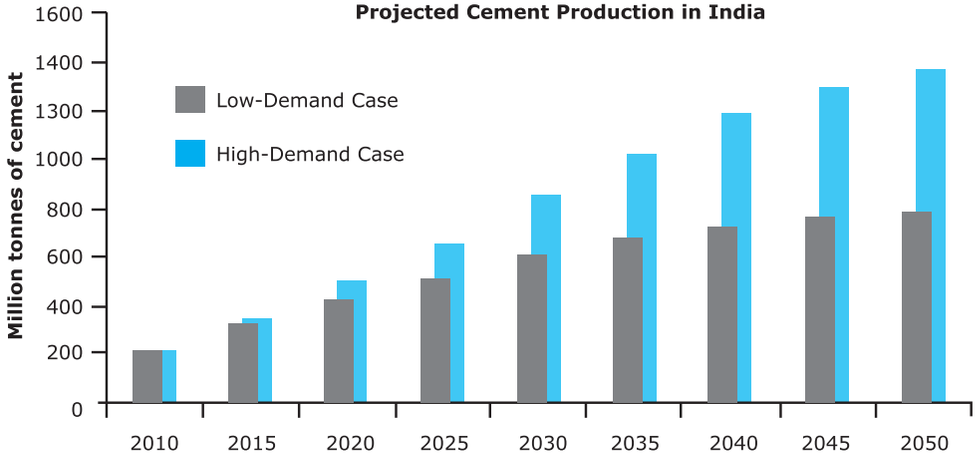
- Capacity utilization - Current level & anticipated projection
- Indian Environmental Acts/Regulations pertaining to Air pollution related to cement sector
- Current Emission Norms for cement industry
- Global Cement Industry Emission Norms
- Best Available Technology to achieve the standards along with their installation & operating cost.
- Emission unit conversion.

## INDIAN CEMENT INDUSTRY[1]

Cement is one of the most technologically advanced industries in the country. The modern Indian cement units are state-of-the-art plants and are comparable to the best in the world. The Indian cement industry has managed to keep pace with the global technological advancement. The induction of advanced technology has helped the industry immensely to improve its efficiency by conserving energy, fuel & addressing the environmental concerns.

The Indian cement industry is the 2nd largest market after China accounting for about 7% of the total global production. It comprises of 185 large and 365 mini cement plants with an installed capacity of 350 million tones.

The production & dispatch figures of cement for the year 2013-14 are 256.04 millions tones (MT) & 248.7 million tones (MT) respectively. The production and dispatch figures for the year 2014-15 (upto December 2014) are 200.8 MT & 192.46 MT respectively.




## INDIAN ENVIRONMENTAL ACTS/REGULATIONS PERTAINING TO AIR POLLUTION[2]

The Indian cement industry must comply with the various environmental acts and regulations notified by the Ministry of Environment and Forests (MoEF), etc., which covers different spheres of the environment, encompassing emissions of air pollutants, environmental impact assessment, consumption of water, generation and discharge of trade effluents, utilisation and storage of hazardous waste, noise generation, utilisation of forest land and wildlife areas.

The Air (Prevention and Control of Pollution) Act was enacted in 1981 and amended in 1987 to provide for the prevention, control and abatement of air pollution in India. The Act deals with the particular type of pollution and presents an integrated approach to tackle the problem of pollution. The Act provides for the imposition of restriction on the use of certain industrial plant in any pollution control area without the previous permission and consent of the State Board. The Act provides that the State Government, in consultation with the State Board, is empowered to declare any area or areas within the jurisdiction of the concerned State an "Air Pollution Control Area".

The Environment (Protection) Act was enacted in 1986 with the objective of providing for the protection and improvement of the environment. It empowers the Central Government to establish authorities charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991. Under this act MoEF has released notification dated on 25th August, 2014 to make the rules further to amend the environment (Protection) Rules, 1986 also it is called Environment (Protection) (Fifth Amendment) Rules, 2014 .

The Ministry of Environment & Forests (MoEF) introduced the Environmental Impact Assessment (EIA) Notification 2006 on 14th September 2006, which not only reengineered the entire environment clearance (EC) process specified under the EIA Notification 1994, but also introduced a number of new developmental sectors which would require prior environmental clearance. The EIA Notification 2006 has further introduced a system of screening, scoping and appraisal and for the setting up of Environment Impact Assessment Authority (EIAA) at the Central level and State Level Environment Impact Assessment Authorities (SEIAAs) to grant environmental clearances at the Central and State level respectively.

1 DIPP- Department of Industrial Policy & Promotion
Low Carbon Roadmap study for Cement Industry

2 Technical EIA Guidance Manual for Cement Industry by MoEF
Air (Prevention and Control of Pollution) Act, 1981

## INDIAN CEMENT INDUSTRY STACK EMISSION STANDARDS[3]

| Parameter | Standards | | |
|---|---|---|---|
| | Rotary Kiln- without co-processing | | |
| | Date of Commissioning | Location | Concentration not to exceed, in mg/Nm³ |
| Sulphur Dioxide ($SO_2$) | Irrespective of commissioning | Anywhere in the country | 100 |
| Nitrogen Dioxide ($NO_2$) | On or after the date of notification | Anywhere in the country | 600 (with effect from 01.06.2015) |
| | Before the date of notification | Anywhere in the country | 800 (with effect from 01.01.2016) |
| Particulate Matter | On or after the date of notification | Anywhere in the country | 30 (with effect from 01.01.2016) |
| | Before the date of notification | Critically polluted area or urban centers with population above 1.0 lakhs or within its periphery of 5.0 kilometers radius | 50 (with effect from 01.01.2015) |
| | | | 30 (with effect from 01.06.2016) |
| | | Other than critically polluted area or urban centers | 100 (with effect from 01.01.2015) |
| | | | 30 (with effect from 01.06.2016) |

## GLOBAL CEMENT INDUSTRY STACK EMISSION STANDARDS[4]

| No. | Countries | Annual Cement Proudction | Sulphur Dioxide ($SO_2$) | Nitrogen Dioxide ($NO_x$) | Particulate Matter (PM) |
|---|---|---|---|---|---|
| | | Million Tones | (mg/Nm³) | (mg/Nm³) | (mg/Nm³) |
| 1 | China | 2300 | 200 | 400 | 50 |
| 2 | India | 251.9 | 100 | 600-800 | 30-100 |
| 3 | United States | 77.8 | 120 | 450 | 20 |
| 4 | Brazil | 70 | No Limit | No Limit | 70 |
| 5 | Turkey | 70 | 300 | 400 | 100 |
| 6 | Saudi Arabia | 50 | 365 | 600 | 340 |
| 7 | South Korea | 49 | 120 | 660 | 30-40 |
| 8 | Egypt | 46 | 400 | 600 | 50 |
| 9 | Indonesia | 35 | 800 | 1000 | 80 |
| 10 | Germany | 34 | 400 | 400 | 50 |
| 11 | Pakistan | 32 | 1700 | 400-1200 | 300 |

All monitored values for $SO_2$ & $NO_2$ shall be corrected to 10% $O_2$, dry basis

3 Environment (Protection) (Fifth Amendment) Rule, Notification dated on 25th August, 2014 by MoEF
4 Environment department of country, Published Journal & Standards or Plant

## BAT-BEST AVAILABLE TECHNOLOGY FOR EMISSION CONTROL[5]

| Pollutant | Source | Control Method | | |
|---|---|---|---|---|
| | | Preventive measures | Primary Measure | Secondary Measure |
| $SO_2$ | 1. Sulphur containing fuel<br>2. Sulphur containing raw material | 1. Reduction of S in fuel<br>2. Reduction of S in Raw material | 1. Utilization of exhaust gases in pre heater & raw mill<br>2. Process Control Optimization | 1. Injection of absorbent such as slaked lime, quicklime<br>2. Wet scrubber Installed in Retznei plant (Lafarge,Austria) |
| $NO_x$ | 1. Nitrogen in fuel (Fuel $NO_x$)<br>2. Nitrogen in combustion air (Thermal $NO_x$) | 1. Reduction of $N_2$ in fuel<br>2. Optimization of Primary Air | 1. Flame Cooling<br>2. Low $No_x$ Burner<br>3. Low $No_x$Calciner<br>4. Use of Mineralizers<br>5. Process Optimization | 1. Selective Non-catalytic Reduction (SNCR) Installed in Swedish plants<br>2. Selective Catalytic Reduction (SCR) Installed in Solnhofer portland Zementwerke (Germany) |
| **Particulate Matter** | 1. Raw material dust- Quarrying, crushing & handling of raw material<br>2. Feed material- dust feeding, milling stacking, blending, reclaiming, conveying & transferring of feed material<br>3. Cement kiln dust- Feeding & processing of material involving countercurrent circulation of hot gases<br>4. Clinker dust- Cooling involving air circulation & open storage of clinker<br>5. Cement dust- Feeding, milling, conveying, bagging & loading of cement | **1. Techniques for dusty operations**<br>• Enclose/encapsulate dusty operations<br>• Covered conveyors and elevators<br>• Mobile and stationary vacuum cleaning for proper and complete maintenance of the installation<br>• Ventilation and collection in fabric filters<br>• Use closed storage with an automatic handling system<br>**2. Techniques for bulk storage areas and stockpiles**<br>• Open pile wind protection<br>• Water spray and chemical dust suppressors<br>• Paving, road wetting and housekeeping<br>• Humidification of stockpiles<br>**3. Reduction of channeled dust emissions**<br>• Electrostatic precipitators<br>• Fabric filters | | | |

| Pollutant | Techniques | Kiln System Applicability | Reduction efficiency (%) | Reported Emissions ($mg/Nm^3$) | Reported Cost | |
|---|---|---|---|---|---|---|
| | | | | | Investment (INR ₹ in Million) | Operating (INR ₹ /MT of Clinker) |
| $SO_2$ | Absorbent Addition | All | 60-80 | 200-400 | 25-35 | 7-30 |
| | Wet Scrubber | All | >90 | 10-300 | 700-2500 | 35-150 |
| $NO_x$ | SNCR | Preheater & Precalciner | 30-50 | 200-500 | 160-380 | 7-120 |
| | SCR | Possibly all Preheater & Precalciner | 43-97 | 300-500 | 600-1000 | 20-220 |
| | Flame Cooling | All | 10-30 | 500-1000 | Upto 20 | Upto 35 |
| | Low Nox Burner | All | 0-35 | 500-1000 | Upto 50 | 5 |
| | Low Nox Calciner | Precalciner/Pre heater | 10-50 | 450-1000 | 120-470 | - |
| PM | Electrostatic Precipitator | All Kiln System | - | <10-<20 | 240-720 | 7-15 |
| | | Clinker Cooler | - | <10-<20 | 90-150 | 6.5-15 |
| | | Cement Mills | - | <10 | 90-150 | 6.5-15 |
| | Fabric Filters | All Kiln System | - | <5 | 240-720 | 10-25 |
| | | Clinker Cooler | - | <5 | 120-170 | 7-12 |
| | | Mills (Raw, Cement, Coal) | - | <10 | 35-60 | 2-3 |

Basis: Normally refers to daily averages, dry gas, 273 K, 101.3 kPa and 10% $O_2$
Normally refers to a kiln capacity of 5000 tone of clinker/day
Considered year 2008

5 Best Available Techniques (BAT) Reference Document for the production of Cement by European Commission Environment Protection Agency BAT Guidance Note on BAT for the production of Cement (1st Edition)

**QUICK CHECK!!!**

**EMISSION UNIT CONVERSION**

**Exhausts $O_2$% level to reference $O_2$% level**

$$E_R = \frac{21 - O_R}{21 - O_M} \times E_M$$

Where:
$E_R$ (ppm): emissions concentration related to the reference oxygen level $O_R$
$O_R$ (Vol. %): reference oxygen level
$E_M$ (ppm): emissions concentration related to the measured oxygen level $O_M$
$O_M$ (Vol. %): measured oxygen level

**Example:**
An exhaust constituent value of 325 ppm with 3% $O_2$ can be converted to 10% $O_2$.

$$E_R = \frac{21 - O_R}{21 - O_M} \times E_M$$

$$\text{ppm @ 10\%} = \frac{21 - 10}{21 - 3} \times 325$$

ppm @ 10% = 198.6 ppm

**Parts per Million to mg/Nm$^3$**

$$mg/Nm^3 = \frac{ppm \times P \times MW}{R \times T}$$

Where:
P: Pressure in kPa, for normal conditions, this is 101.3 kPa
MW: Molecular weight of the exhaust constituent
R: Universal gas constant, 8.3144 kNm/kmole K
T: Temperature in degrees Kelvin, this is 273.15°K (0°C) for normal conditions.

Substituting these constants and the molecular weight of the various exhaust constituents into the equation, the formula can be sorted to the following.
mg/Nm$^3$ = ppm x mg/Nm$^3$ per ppm conversion

Where the conversion factor is:
1 ppm $NO_x$ = 2.052 mg/Nm$^3$
1 ppm $CO_2$ = 1.963 mg/Nm$^3$
1 ppm CO = 1.249 mg/Nm$^3$

**Example:**
The following example converts 325 ppm NOx from parts per million to milligrams per normal meter cubed.
325 ppm $NO_x$ x 2.052 mg/$Nm_3$ = 667 mg/Nm$^3$ $NO_x$ mg/Nm$^3$ units require a %$O_2$ reference point; this is the same requirement as ppm. The same above equations apply to convert from one $O_2$ level to another $O_2$ level.



**CII Sohrajbi Godrej Green Business Centre (CII - Godrej GBC)**

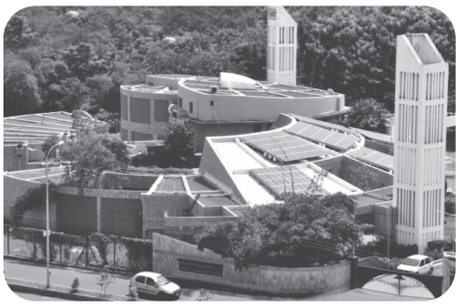
CII – Sohrabji Godrej Green Business Centre (CII - Godrej GBC), a division of Confederation of Indian Industry (CII) is India's premier developmental institution, offering advisory services to the industry on environmental aspects and works in the areas of Green Buildings, Energy Efficiency, Water Management, Renewable Energy, Green Business Incubation and Climate Change activities.

**Cement Manufacturers' Association (CMA)**

Cement Manufacturers' Association (CMA), the apex representative body of large cement manufacturers in India was established in 1961. It is a unique body in as much as it has both the private and public sector cement companies as its members.

CMA acts as a bridge between Indian cement Industry and the Government. It creates a conducive environment to promote growth of cement industry, through advice and consultation. It closely works with government, various Regulators on policy issues, enhancing efficiency, competitiveness, growth and development opportunities for Indian cement industry.

As a representative organization of cement industry, CMA articulates the genuine, legitimate needs and interests of the cement industry. Its mission is to impact the policy and legislative environment so as to foster balanced economic, industrial and social development in the cement industry.



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