

**INDIAN NETWORK FOR CLIMATE
CHANGE ASSESSMENT (INCCA) GHG
EMISSIONS PROFILE 2007 NEW DELHI, 11th
MAY 2010**

**CEMENT: PROCESS AND FUEL
COMBUSTION IN CEMENT
MANUFACTURE**

Dr. S.P. Ghosh

Advisor (Technical)

Cement Manufacturers' Association



IMPORTANT ROLE OF CEMENT INDUSTRY IN GHG EMISSION REDUCTION

- Globally, cement industry generate 5 to 6% of total GHG Emission*
- Cement Manufacturing Releases mainly CO₂ the Major GHG. Small amounts NO_x are reported in rare cases.
- 1 tonne cement production generates 0.6 to 1 tonne CO₂: Calcination 45 – 50%, Fuel Combustion 40 – 45%, Power Generation and Use 10 – 20%.
- In India Manufacturing and Construction contributes to 15% of GHG Emission and 24% of CO₂ emission.**
- Indian cement industry contributes annually 30% of GHG emission by Industry Sector and 18% of total GHG emission by Energy Use Sector**

* World Resources Institute, Washington.

** MOEF Project for UNFCCC 2004 NATCOM-I.



TOP 5 CEMENT PRODUCING COUNTRIES & THEIR GHG EMISSION PROFILE

Production (Million Tonnes)

Country	Production 2007	Percent of World Production	GHG Emission Estimate (T/T Cement)*
China	1354	48.35	1.14*
India	171	6.10	0.868**
USA	95.5	3.43	NA
Japan	71.4	2.55	0.736*
Russia	59.9	2.14	NA
S. Korea	54.4	1.94	0.74*
Others	993.8	35.49	NA
World Total	2800	100	2725 Mln T.*

* Estimates based on data from WBCSD, Cement Industry Associations of China, Japan, S. Korea & Cembureau (EU) on Large Cement Plants.

** Estimate based on Large Cement Plants Only.



INDIAN CEMENT INDUSTRY – STATUS DECEMBER 2007

International Ranking	2nd
Installed Capacity	184.18 Million Tonnes
Production	171 Million Tonnes
No. of Plants	Large: 136
	Mini** 206 – Rotary: 13
	–
	VSK: 193

* Projected, 2007-2008

** AIMCMA – 2006

(All India Mini Cement Manufacturers' Association)



SIGNIFICANT GHG EMISSION REDUCTION

(Million Tonnes)

Year	Cement Production	GHG Emission	Ratio GHG: Cement
1995	67.08	76.65	1.14
1996	74.96	84.74	1.13
2000	102.21	98.89	0.96
2003	120.42	115.74	0.96
2005	142.70	130.82	0.91
2006	158.99	141.66	0.89
2007	170.93	152.44	0.88*

* Including Large, Mini & White Cement Plants.



GHG EMISSION PLANT/TYPE-WISE AND CATEGORY-WISE: INDIAN CEMENT INDUSTRY - 2007 (Million Tonnes)

Category	Production	GHG EMISSION		GHG Total
		Process	Fuel (Including Fuel for CPP)	
Large Plants	164.445	69.494	64.546	134.040
Mini Plants	5.868	2.972	3.515	6.487
White Cement Plant	0.629	0.331	0.317	0.648
Total	170.934	72.797	68.378	141.175
GHG Tonnes/Tonne Cement: Whole Cement Industry				0.825

METHODOLOGY OF ESTIMATION CEMENT MANUFACTURING - PROCESS

- a) **Based on Actual Consumption of Raw Meal/Kiln Feed and Tallying with Clinker Production for each Plant.**
- b) **Actual Kiln Feed Quantity (t) X CaO Content of Kiln Feed for each Plant for each year.**
- c) **CaO Content of Kiln Feed derived on the basis of Weighted Average of each Plant for each Year – Quantity of Kiln Feed (t) vs CaO%.**
- d) **Value b X 0.785 = CO₂ from Ca CO₃ in Process for any Plant.**
- e) **Actual Kiln Feed Quantity (t) X MgO Content of Kiln Feed for each Plant for each year.**
- f) **MgO Content of Kiln Feed derived on the basis of Weighted Average of each Plant for each Year – Quantity of Kiln Feed (t) vs MgO.**
- g) **Value of f X 1.1 tonnes = CO₂ from Mg – Carbonate in Process for any Plant.**
- h) **Σ (d + g) = Total CO₂ Emission from Process.**

METHODOLOGY OF ESTIMATION CEMENT MANUFACTURING - FUEL FOR KILN

- **Based on Actual Consumption of different types of Fuel (Coal – Indigenous, Imported, Petcoke, Lignite, Bio Fuel use by Cement Plants).**
- **Sum of Quantity of each type of Fuel X C% X 3.66 Year-wise for each plant for each year.**
- **C% of each type of Fuel for each year calculated for plant clusters from Weighted Average of Consumption vs C%.**
- **Total CO₂ from Fuel Use in Kiln for all plants for each year:**
 Σ Quantity of each type of Fuel used (t) X C% of Respective Fuel type X 3.66.

METHODOLOGY OF ESTIMATION CEMENT MANUFACTURING - FUEL FOR CAPTIVE POWER

- **Fuel for Captive Power used – Indigenous Coal, Petcoke.**
- **Total Fuel type Consumed for each year for each plant (t) X C% X 3.66 determined.**
- **C% of each type of Fuel for each year calculated for plant clusters from Weighted Average of Consumption vs C%.**

CHARACTERISTICS OF GHG EMISSION ESTIMATION METHOD

- **Actual Data on Consumption and Quality of each Component taken for Calculation.**
- **No default Factor has been taken.**
- **The Data provided by Plants verified with CMA Database before use.**
- **Plant Data collected through wide circulation of 8 page Data Sheet.**
- **In case of discrepancy between plant data and CMA data, variations are discussed and sorted out.**
- **More than 87% of Plants Data Collected till date, expected to reach 90% by end of May 2010.**
- **GHG Emission estimates by Computer-based Software. Would be completed with + 90% data receipt.**

COPY OF A PAGE FROM DEDICATED SOFTWARE PACKAGE ON YEAR-WISE GHG EMISSION FROM 1 CEMENT PLANT

Year	CO ₂ from Clinker (Tonne)			CO ₂ from Power (Tonne)			Grand Total CO ₂ (T)	Clinker Produced (T)	CO ₂ (T) Per (T) Clinker	Cement Produced (T)	CO ₂ (T) Per (T) Cement	Total Mitigation Due to Fly Ash
	Process	Fuel	Total	Grid Power	Captive Power	Total						
1995	1194726	773435	1968161	171195	65402	236597	2204759	2270347	0.97	2297274	0.96	-
1996	1138957	735780	1874738	157662	70156	227818	2102556	2167671	0.97	2151645	0.98	-
1997	1088762	678816	1767578	127066	92359	219425	1987004	2077357	0.96	2111955	0.94	-
1998	1041462	550304	1591766	104508	86750	191258	1783024	1990092	0.90	2244827	0.79	813
1999	1308513	639499	1948012	88286	124259	212546	2160559	2504226	0.86	2517795	0.86	17743
2000	1179553	518574	1698128	86348	113153	199502	1897630	2260823	0.84	2637480	0.72	28477
2001	1260777	518064	1778842	87426	129028	216455	1995298	2419710	0.82	2525974	0.79	76888
2002	1479165	586577	2065742	90358	144344	234702	2300445	2842615	0.81	2499018	0.92	165581
2003	1507890	582616	2090506	98258	147713	245971	2336477	2900972	0.81	2714252	0.86	229976
2004	1691451	614076	2233527	126376	142502	268879	2502406	3120411	0.80	3060531	0.82	269805
2005	1710286	652629	2362916	188070	106760	294830	2657746	3293143	0.81	3149401	0.84	296600
2006	1771141	708346	2479487	239331	83788	323120	2802607	3413002	0.82	3310415	0.85	394867
2007	1862613	784066	2646679	250091	88489	338581	2985260	3594058	0.83	3557398	0.84	494614

PROBLEMS IN ESTIMATION : GHG EMISSION INVENTORY

- **Out of 136 Plants nearly 39% Plants follow CSI Method of Data Compilation.**
- **Data from these Plants had been re-arranged and reconciled for Data Entry and Calculations.**
- **Merger and Acquisition of Plants in a larger scale in this Millennium posed problems in Data Collection for pre-2000 years for more than 20 Plants.**
- **20 Plants had been shut down in the 2nd half of 90's. Data collection from these plants had been difficult.**

GHG MITIGATION: ISSUES TO ADDRESS (SWOT)

S 1) Fast paced Growth of Industry assured for decades because of Escalating Infrastructure Growth Plan.

2) Large Scale Expansion With New Generation Jumbo Capacity Plants – Highly Energy Efficient and Environment Friendly.

W 1) New Fly Ash Notification 2009: Fly ash is priced Commodity: Availability and costing create bottlenecks.

2) Hazardous Materials (Management, Handling & Trans Boundary Movement) Notification, 2007 is turning out more an obstacle then facilitator in recycling Hazardous Combustibles in Cement Plants.



GHG MITIGATION: ISSUES TO ADDRESS (SWOT)

O 1) **Low Per Capita Cement Consumption: (140 Kg)**
– **Lower Capacity than Sub-Saharan Africa-will be boosting Enhancement.**

2) Focus of World Leader Companies in Cement Manufacturing and Machinery Supply on India for Collaborative Venture.

T1) Dwindling Fuel (Coal) Availability from Linkages may stall Growth of New Ventures.

2) Advent of Multi-Nationals in Large Scale may affect the National Outlook and priorities of the industry.