

# CONCRETE TROUBLES

**A report on the emissions from Cement Plants in India and a critique of the ongoing co-incineration of Hazardous Wastes in the Cement Industries**



**Global Anti Incineration Alliance (GAIA) – India  
&  
Community Environmental Monitoring, The Other Media**

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**For more details please visit:**

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## Introductions to the report:

In 2010, Indian Central Pollution Control Board (CPCB) released the “*Guidelines on Co-processing in Cement/Power/Steel Industry*”<sup>1</sup> which gave an official sanction for co-incineration of industrial and municipal wastes in cement plants. This directive will effectively allow cement plants across India to incinerate a range of hazardous, post-production waste from manufacturing and a variety of post consumer municipal waste.

We attribute this initiative of the CPCB to a global trend in cement kiln co-incineration. The primary proponents of cement kiln co-incineration globally are the cement industry led by Holcim, La-Farge and Cemex in association with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Germany. This consortium makes two key arguments on waste co-incineration:

- a) Using alternate fuel or waste would reduce climate footprint of the rapidly growing cement industry
- b) By diverting waste to cement manufacturing it provides a short-term fix to the growing menace of municipal and manufacturing waste being faced by the cities and industry.

The CPCB’s proposal for co-incineration has been endorsed by GIZ across India. It is based on the certain assumptions about manufacturing and waste disposal methods in India:

- The existing operations of the cement plants are non-polluting.
- Toxic by-products resulting from burning of waste will be destroyed under high temperatures of the kiln.
- The current technologies for monitoring/incinerating are sufficiently advanced to allow hazardous waste burning with no additional pollution load; and that these technologies will be deployed wherever co-incineration is permitted.
- The existing monitoring/enforcement infrastructures are robust enough to detect and tackle violations.

The most important assumption is that CPCB had carried out due diligence to assess the state of existing plants for their ability to burn hazardous waste.

Indian cement plants have been known to pollute even without co-incineration of waste. A series of ambient dust samples taken prior to the commencement of this project in Himachal Pradesh and Tamil Nadu between 2008 and 2010 found high levels of fine particulate pollution and toxic heavy metal contamination around plants using conventional fuel like coal<sup>2</sup>. These findings not only proved that emissions from cement plants using coal were excessive but also the highlighted the poor regulatory mechanism, which allowed such a situation to persist for years. This exposes the poor state of affairs as far as regular monitoring of cement plants is concerned and also raised several questions about the capacity of the regulatory agencies especially the CPCB to ensure strict emission monitoring that was assured while sanctioning waste co-

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<sup>1</sup>Guidelines on Co-Processing in Cement/Power/Steel Industry, February 2010

<sup>2</sup> Disease stalks villages around cement plants, March 6 2011.  
<http://www.tribuneindia.com/2011/20110307/himachal.htm#2>

incineration (refer CPCB guidelines document). It also raises several doubts on the due diligence carried out by the GIZ before collaborating and recommending co-incineration of waste in Indian cement kilns.

Further, a preliminary investigation into the due diligence followed by CPCB before sanctioning the practice revealed that it to be based on a few trial runs conducted with poor scientific rigour. The process was non-transparent and non-inclusive as it failed to seek comments from the public or conduct any consultation with communities living around cement plants. Trial runs with the most toxic and explosive chemicals were conducted without public and in some cases the without workers knowledge and in the absence of accident management plans.

The study is primarily targeted to verify the 3 main claims made by CPCB before granting approval to co-incineration in Cement plants.

1. Assess the nature of pollution from the cement plants using conventional fuel;
2. Assess the effectiveness of the monitoring mechanisms employed by the state pollution control agencies where these plants are located.
3. Assess the capabilities of the CPCB in monitoring and regulating the co-incineration of hazardous waste in the cement units in the long run.

The findings of earlier samples taken in Himachal Pradesh and Tamil Nadu between 2008 and 2010 had already provided an inkling of the state of affairs as far as regulation and monitoring was concerned but it was necessary to widen the study area to few more regions in order to establish a trend. Given that co-incineration of hazardous waste had begun on trial basis in some of the plants, efforts were also made to reach out to workers and communities in those localities to understand the nature of operations and impacts of pollution from those units.

#### **Methodology of data collection:**

Air samples and other information related to the operations of the cement plants were collected in two phases.

In the **phase 1**, samples of dust present in the ambient air were taken from the vicinity of the plant. The equipment used is a low volume air-sampling device called the MiniVol<sup>3</sup>. Most of the samples were taken continuously over a period of 24-hour while some were taken over 12 hour due to logistical constraints. The samples were sent for analysis to the Chester LabNet<sup>4</sup>, a laboratory based in Oregon, USA. The laboratory tested the samplers for Particulate Matter (PM<sub>2.5</sub>) using the Gravimetry technique<sup>5</sup> and used the X-ray Fluorescence (XRF) technique (See Annexure 2) to detect the presence of heavy metals.

In **phase 2**, information specific to the plants and about co-incineration practices in general was collected from the State and the Central Pollution Control Boards/Committees using the Right to Information Act, 2005.

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<sup>3</sup> <http://www.airmetrics.com/index.html>

<sup>4</sup> <http://www.chesterlab.net/index.php>

<sup>5</sup> <http://www.chesterlab.net/service.php#gra>

### **Rationale for the samples:**

Most of the state PCBs lack basic equipment to monitor dust emissions, almost never test for the heavy metals in the cement dust, even though it is scientifically well documented that cement dust contains heavy metals<sup>6</sup> such as antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium, and vanadium.

Due to resource constraints, the region of sampling could be extended to include only two more states (in addition to Tamil Nadu and Himachal Pradesh) where a total of 10 samples were taken around different cements plants.

Gujarat (Kutch region) – Sanghi Cement and JayPee Cements  
Chhattisgarh (Jamul and Aresmetta) – ACC Holcim and LaFarge India  
Tamil Nadu (Trichy) – Dalmia Cements  
Himachal Pradesh (Bagheri and Bir Palasi) – JayPee Cements and Asian Cements

### **Selecting the sites in the various states and existing levels of pollution:**

An important criterion for the selection of sampling locations was the presence of a community resistance against the pollution caused by the cement plants. All the 4 selected locations have an ongoing community struggle against pollution or worker struggle for better conditions at the plant. Some of the plants are also facing litigation on issues of causing pollution<sup>7</sup>.

It was evident during interactions with community members and workers in all the selected locations that the cement plants and the allied mines were a major source of pollution. Testimonies from these communities during the sampling revealed the pattern of the dust emissions from the plants and mines, associated health problems (especially respiratory ailments) and the social implications of resulting environmental degradation.

### **Summary of Sample Results collected through a low volume air sampler:**

Overall 10 air samples were collected and tested for parameters like PM<sub>2.5</sub> and heavy metals. The results revealed that:

**PM<sub>2.5</sub> Results:** All ten samples were in violation of Indian short-term 24-hour standard for PM<sub>2.5</sub>. In some cases the levels exceed the Indian standards by 6 to 7 times.

Particles less than 2.5 micrometers in diameter (PM<sub>2.5</sub>) are referred to as "fine" particles and are believed to pose the largest health risks. Because of their small size (less than one-seventh the average width of a human hair), fine particles can lodge deep into the lungs.

“Health studies have shown a significant association between exposure to fine particles

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<sup>6</sup> <http://www.epa.gov/osw/nonhaz/industrial/special/ckd/rtc/chap-3.pdf>

<sup>7</sup>JAL thermal plant: The dust refuses to settle, June 2012  
<http://infochangeindia.org/environment/features/jal-thermal-plant-the-dust-refuses-to-settle.html>

and premature mortality. Other important effects include aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days), lung disease, decreased lung function, asthma attacks, and certain cardiovascular problems such as heart attacks and cardiac arrhythmia. Individuals particularly sensitive to fine particle exposure include older adults, people with heart and lung disease, and children.”<sup>8</sup>

The Indian Ministry of Environment and Forests (MoEF), the U.S. EPA and the World Health Organization have all adopted health-based air quality standards for exposure to fine particulate matter. They have also adopted short-term (24-hour) and long-term (annual average) standards for exposure to fine particulate matter in order to prevent both acute and chronic effects of exposure to particulates.

**Manganese Results:** Levels of manganese in 9 out of 10 samples exceed the U.S. EPA Reference Concentration for exposure to manganese (0.05 µg/m<sup>3</sup>). However, these standards for manganese are for long-term exposures of one year (or longer). These results indicate unhealthy levels of manganese only if they reflect ambient levels of manganese that generally prevail at these locations.

Manganese is a neurotoxin with regards to its health impacts the U.S. EPA has observes:

“Chronic (long-term) exposure to high levels of manganese by inhalation in humans may result in central nervous system (CNS) effects. Visual reaction time, hand steadiness, and eye-hand coordination were affected in chronically-exposed workers. A syndrome named *manganism* may result from chronic exposure to higher levels; *manganism* is characterized by feelings of weakness and lethargy, tremors, a mask-like face, and psychological disturbances. .... The Reference Concentration (RfC) for manganese is 0.00005 mg/m<sup>3</sup> based on impairment of neurobehavioral function in humans.”<sup>9</sup>

**Silicon Results:** Levels of silicon in 7 out of 10 samples ranged from 8.9 to 53.4 µg/m<sup>3</sup>. The most prevalent environmental form of silicon is silicon dioxide (SiO<sub>2</sub>), or silica. In the natural environment, crystalline forms of silica predominate over non-crystalline forms.

According to the California Office of Environmental Health Hazard Assessment (OEHHA), inhalation of crystalline silica initially causes respiratory irritation and an inflammatory reaction in the lungs and acute exposures to high concentrations cause cough, shortness of breath, and acute silicosis. It also refers to scientific reports that state that “chronic levels of silica dust that do not cause disabling silicosis may cause the development of chronic bronchitis, emphysema, and/or small airways disease that can lead to airflow obstruction, even in the absence of radiological silicosis.”<sup>10</sup> The California OEHHA has established a health-based standard for crystalline silica of 3 µg/m<sup>3</sup> on an annual basis.

Levels of crystalline silica in the samples were not determined. However, because levels of silicon in 7 out of 10 samples ranged from 8.9 to 53.4 µg/m<sup>3</sup>, levels of silica

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<sup>8</sup> [http://www.epa.gov/ttn/naaqs/pm/pm25\\_index.html](http://www.epa.gov/ttn/naaqs/pm/pm25_index.html)

<sup>9</sup> <http://www.epa.gov/ttn/atw/hlthef/manganes.html>

<sup>10</sup> [http://www.oehha.org/air/chronic\\_rels/pdf/silicacrel\\_final.pdf](http://www.oehha.org/air/chronic_rels/pdf/silicacrel_final.pdf)

ranged from 19 to 114 µg/m<sup>3</sup>. It is reasonably certain that levels of crystalline silica in these seven samples exceeded the California OEHHA annual standard for crystalline silica of 3 µg/m<sup>3</sup>.

**Lead Results:** Levels of lead in 5 out of 10 samples exceed the U.S. EPA 3-month health-based standard for lead of 0.15 µg/m<sup>3</sup>. However, these standards for lead are for long-term exposures (of three-months and one year, respectively). These results indicate unhealthy levels of lead only if these results reflect ambient levels of lead that generally prevail at these locations. According to the experts additional testing (over several months) would be necessary to determine long-term average ambient levels at these locations.

Lead is a neurotoxin with regards to its health impacts the U.S. EPA observes:

- EPA has revised the level of the primary (health-based) standard from 1.5 micrograms per cubic meter (µg/m<sup>3</sup>), to 0.15 µg /m<sup>3</sup>, measured as total suspended particles (TSP). EPA has revised the secondary (welfare-based) standard to be identical in all respects to the primary standard.
- Scientific evidence about lead and health has expanded dramatically since EPA issued the initial standard of 1.5 µg/m<sup>3</sup> in 1978. More than 6,000 new studies on lead health effects, environmental effects and lead in the air have been published since 1990. Evidence from health studies shows that adverse effects occur at much lower levels of lead in blood than previously thought.
- Children are particularly vulnerable to the effects of lead. Exposures to low levels of lead early in life have been linked to effects on IQ, learning, memory, and behavior. There is no known safe level of lead in the body.”<sup>11</sup>

**Mercury Results:** Levels of mercury in 2 out of 10 samples exceed the California OEHHA annual standard for Mercury of 0.03 µg/m<sup>3</sup>.

*We would like to point out here that the levels of mercury found in all 10 of the samples are likely to substantially underestimate actual mercury levels. This is because filtered air sampling is a method that is inherently incapable of accurately estimating levels of mercury in ambient air because, in air, mercury is predominantly in a gaseous form that will not be retained by the filter.*

Mercury is a neurotoxin. With regard to mercury, according to the U.S. EPA:

“Mercury in the air eventually settles into water or onto land where it can be washed into water. Once deposited, certain microorganisms can change it into methylmercury, a highly toxic form that builds up in fish, shellfish and animals that eat fish. Fish and shellfish are the main sources of methylmercury exposure to humans. Methylmercury builds up more in some types of fish and shellfish than others. The levels of methylmercury in fish and shellfish depend on what they eat, how long they live and how high they are in the food chain. **Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages.** Research shows

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<sup>11</sup> <http://www.epa.gov/air/lead/pdfs/20081015pbfactsheet.pdf>

that most people's fish consumption does not cause a health concern. However, it has been demonstrated that high levels of methylmercury in the bloodstream of unborn babies and young children may harm the developing nervous system, making the child less able to think and learn."<sup>12</sup>

**Nickel Results:** Levels of Nickel in 2 out of 10 samples exceed the California Annual Standard for Nickel of 0.014 µg/m<sup>3</sup>.

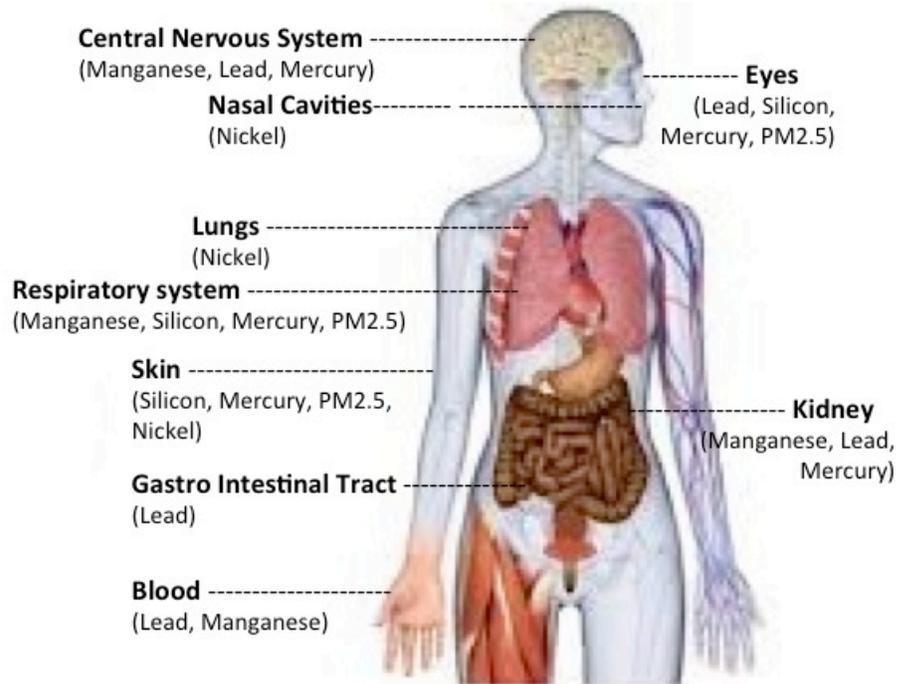
Nickel is a human carcinogen. Based on human epidemiological studies, the World Health Organization has estimated that long-term exposure to 0.025 micrograms of nickel per cubic meter is associated with an excess 1:100,000 risk of cancer, and that the risk is linearly proportional to the dose.<sup>13</sup>

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<sup>12</sup> <http://www.epa.gov/hg/about.htm>

<sup>13</sup> [http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0014/123080/AQG2ndEd\\_6\\_10Nickel.pdf](http://www.euro.who.int/__data/assets/pdf_file/0014/123080/AQG2ndEd_6_10Nickel.pdf)

## TARGET ORGANS IN THE HUMAN BODY FOR THE CHEMICALS FOUND IN THE SAMPLE RESULTS



## Region wise sample results analysis:

### Himachal Pradesh:

- The sample collected downwind of ACC Limited, approx 250 m west of the cement grinding and blending unit contained a PM<sub>2.5</sub> level of 311.7 µg/m<sup>3</sup>, which is more than **five** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- The sample collected at the top of the house approximately 250 m west of JayPee cement grinding and blending unit contained 346.1 µg/m<sup>3</sup> of PM<sub>2.5</sub>, which is more than **five** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- The findings also revealed unsafe levels of manganese, lead and nickel.

### Chhattisgarh:

- Levels of PM<sub>2.5</sub> were **430.7 micrograms per cubic meter (µg/m<sup>3</sup>)** in an air sample collected from the terrace of a resident of Ghasidas Nagar at a distance approximately 300 meters from the ACC Jamul/Holcim Cement Plant. This level is more than **seven** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- Levels of PM<sub>2.5</sub> were **381.4 µg/m<sup>3</sup>** in an air sample collected from the terrace of another resident of Ghasidas Nagar at a distance of approximately 400 meters west of the ACC Jamul/Holcim Cement Plant. This level is more than **six** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- Levels of PM<sub>2.5</sub> were **158.2 µg/m<sup>3</sup>** in an air sample collected from the terrace of a house located in the southern side of Lafarge Cement plants and southwestern side of the limestone mines in Arasmetta Village. This level is more than **two and half** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- Levels of PM<sub>2.5</sub> were **131.0 µg/m<sup>3</sup>** in an air sample collected from the terrace of a house at a distance of approximately 100 meters west of the Lafarge Cement Plant in Arasmetta. This level is more than **two** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- These air samples also contained unsafe levels of silica, manganese, nickel, lead and mercury.
- It should also be noted that there were at least 8 hours of intermittent rains on the day the two samples in Arasmetta, downwind of Lafarge, were collected. Hence the final readings are a conservative estimate of pollution in the ambient air.

### Gujarat:

- Levels of PM<sub>2.5</sub> were **210.1 µg/m<sup>3</sup>** in an air sample collected from the terrace of Village Sarpanch (Village Head) located about a kilometer east from Sanghi Cement plants and about 300 meters south of the limestone mines in Jadhua Village. This level is more than **three and half** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.

- Levels of **PM<sub>2.5</sub>** were **291.8 µg/m<sup>3</sup>** in an air sample collected from the house of a resident in Jadhua village located about a 500 meters east from Sanghi Cement plants and about 400 meters south of the limestone mines. This level is more than **four and half** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- Levels of **PM<sub>2.5</sub>** were **89.7 µg/m<sup>3</sup>** in an air sample collected from the top of the temple in Kharia village downwind of the mines of JayPee Cements. This level is more than **one and half** times the Indian short-term 24-hour standard for PM<sub>2.5</sub>.
- These air samples also contained unsafe levels of silica, manganese, nickel and lead.

#### Tamil Nadu:

- Levels of **PM<sub>2.5</sub>** were **66.1 µg/m<sup>3</sup>** in an air sample collected from the house of a resident in Vadugarpettai village located about a 200 meters west from Dalmia Cement plants. This level is more than the Indian short-term 24-hour standard for PM<sub>2.5</sub>. The plant was not operational on the day the sample was collected.

**Detailed interpretation of all the results are provided in Annexure 1.**

#### **Relevance of high levels of PM<sub>2.5</sub> in results – Comparison with US EPA Air Quality Index (AQI):**

The United States Environmental Protection Agency (U.S. EPA) categorizes air quality using an index based on 24-hour average levels of PM<sub>2.5</sub>. This index was revised as recently as December 14<sup>th</sup>, 2012, and the PM<sub>2.5</sub> levels associated with air quality categories is presented below:<sup>14</sup>

AQI Category	Index Values	Previous Breakpoints (1999 AQI) (µg/m <sup>3</sup> , 24-hour average)	Revised Breakpoints (µg/m <sup>3</sup> , 24-hour average)
Good	0 - 50	0.0 - 15.0	0.0 – 12.0
Moderate	51 - 100	>15.0 - 40	12.1 – 35.4
Unhealthy for Sensitive Groups	101 – 150	>40 – 65	35.5 – 55.4
Unhealthy	151 – 200	> 65 – 150	55.5 – 150.4
Very Unhealthy	201 – 300	> 150 – 250	150.5 – 250.4
Hazardous	301 – 400	> 250 – 350	250.5 – 350.4
	401 – 500	> 350 – 500	350.5 – 500

Comparing the sample results with the Air Quality Index (AQI), the levels of PM<sub>2.5</sub> in samples collected in the vicinity of the ACC Jamul/Holcim Cement Plant, Chhattisgarh

<sup>14</sup> EPA Revises the National Ambient Air Quality Standards for Particle Pollution (December 14<sup>th</sup>, 2012). <http://www.epa.gov/pm/2012/decfsstandards.pdf>

and ACC Cement and JayPee Cement plant in Himachal Pradesh, should be considered as “hazardous triggering health warnings of emergency conditions. The entire population is more likely to be affected”.<sup>15</sup>

The levels of PM<sub>2.5</sub> in samples collected in the vicinity of the Lafarge Cement Plant, Arasmetta, Chhattisgarh should be considered as unhealthy - sample collected from the terrace of a house located in the southern side of Lafarge Cement plants where “everyone may begin to experience some adverse health effects, and members of the sensitive groups<sup>16</sup> may experience more serious effects”<sup>17</sup> and unhealthy for sensitive groups - sample from the house at a distance of approximately 100 meters west of the Lafarge Cement Plant in Arasmetta, where “although general public is not likely to be affected at this AQI range, people with lung disease, older adults and children are at a greater risk from exposure to ozone, whereas persons with heart and lung disease, older adults and children are at greater risk from the presence of particles in the air”.<sup>18</sup>

The levels of PM<sub>2.5</sub> in samples collected in the vicinity of the Sanghi Cement Plant, in Jadhua village, Gujarat should be considered as very unhealthy and “this would trigger a health alert signifying that everyone may experience more serious health effects”.<sup>19</sup> While the levels of PM<sub>2.5</sub> in samples collected in Kharia village, Gujarat and in the vicinity of Dalmia Cements, Tamil Nadu should be considered as moderate where “air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms”.<sup>20</sup>

#### **Data obtained by Regional Pollution Control Boards of Himachal Pradesh, Gujarat and Chhattisgarh of the emissions from cement units located in their region:**

The findings of this study sufficiently establish that the emissions from the plants are in violation of the national and international standards. It was important to correlate our findings with that of the state pollution control boards. Right to Information requests were filed with the Himachal Pradesh, Gujarat, Tamil Nadu and Chhattisgarh State Pollution Control Boards to obtain their data on emissions from the cement plants within their jurisdiction where we carried out our samplings.

These are the findings of the data gathered from such agencies:

1. Levels of PM 2.5 in most of these results were above the permissible limits as per the Indian National Ambient Air Quality (NAAQ) Standards.
2. There were no analyses conducted for any of the heavy metals known to be usually present in the cement dust emissions.
3. The protocol of collecting the samples were not described and neither were the vital details like location of the samplers, wind direction, weather conditions etc., were mentioned in any of the results analysed, thus making the findings scientifically unreliable.

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<sup>15</sup> <http://www.airnow.gov/?action=aqibasics.aqi>

<sup>16</sup> Elderly, women and children comprise of sensitive groups

<sup>17</sup> <http://www.airnow.gov/?action=aqibasics.aqi>

<sup>18</sup> <http://www.airnow.gov/?action=aqibasics.aqi>

<sup>19</sup> <http://www.airnow.gov/?action=aqibasics.aqi>

<sup>20</sup> <http://www.airnow.gov/?action=aqibasics.aqi>

4. The labs belonging to the State Pollution Control Boards of Gujarat, Himachal Pradesh, Tamil Nadu and Chhattisgarh have no valid recognition by the CPCB as mandated under the Environment (Protection) Act of 1986<sup>21</sup>, hence severely compromising the scientific validity of all work carried out in these laboratories.

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<sup>21</sup> [http://cpcb.nic.in/14\\_StatewiseStatusRecognizedLabs.pdf](http://cpcb.nic.in/14_StatewiseStatusRecognizedLabs.pdf)

### **RTI Questions/ Response from CPCB and State PCBs on Co-incineration:**

In the months of May 2012 Right to Information (RTI) requests were filed with the CPCB and the State PCBs to understand the nature and extent of the waste co-incineration exercise across the country. Table 1 is a summary of all the responses received to the following questions:

- a) List of all cement plants authorized to co-incinerate various forms of waste in their process.
- b) Copies of all emission and compliance monitoring data of these plants from the month they started co-incineration up to May 2012.
- c) List of all the materials/ waste that has been approved by the board for co-incineration including the names of the companies where the waste originates.

### **Key observations of the responses received:**

1. There are at least 11 states in the country that have permitted co-incineration of waste in cement kilns either on a trial or regular basis. These states are Rajasthan, Himachal Pradesh, Tamil Nadu, Andhra Pradesh, Karnataka, Odisha, Madhya Pradesh, Chhattisgarh, Jharkhand, Gujarat and Maharashtra.
2. At least 39 plants in the country (in these 11 states) are burning a combination of hazardous and other wastes in their kilns either on trial or on regular basis.
3. The nature of waste which is currently being co-incinerated belongs to automobile industries, rail coach factories, refineries, chemical plants, hazardous and municipal waste processing facilities, pesticide plants, Fast Moving Consumer Goods industries etc.
4. None of the 11 states permitting co-incineration had any systematic method of emission monitoring, recording and documentation.
  - a) 7 states failed to provide records of any emission/environmental monitoring.
  - b) 4 states provided some data on emissions testing conducted during the trial run but the regular monitoring records were not available.
5. In some cases, the emission data recorded from the trial runs revealed elevated levels of heavy metals like lead, manganese and copper. These metals were found to be above levels prescribed US EPA. It is not known as to what action has been taken by these authorities on the units. Legal action on such violations also becomes difficult especially when there are no national emission standards for these chemicals.
6. While CPCB is the nodal authority in monitoring and maintaining the records pertaining to co-incineration around the country, in at least 15 out of 39 plants where co-incineration is taking place, CPCB has admitted to have no knowledge or records of the quantum of wastes being incinerated or the way in which co-incineration was being carried out.

## **State and Central Infrastructure for Monitoring Cement Industries**

When co-incineration was given an approval by the CPCB several concerns were raised about its ecological impacts on local communities living around cement facilities. These concerns were allayed by the CPCB and the GIZ who claimed that cement co-incineration was the safest method of waste disposal and that the CPCB and State PCBs are capable of monitoring the activities.

Nothing could be farther from truth than these claims. It is evident from our results and from the state PCB's own, albeit sparse emission data that there are unregulated emissions ongoing from the cement plants. Such a scenario raises a doubt that when the agencies cannot regulate emissions from a regular cement plant, would they be able to do so when the same plant is incinerating hazardous waste.

On the matter of CPCB's claim of the capability of the regulatory agencies to monitor emissions – cement dust or co-incineration – is again something that lacks credibility.

A RTI response revealed that there are only 10 Environmental laboratories (Govt. / Public Sector Undertakings / Educational Institutes / State or Central Pollution Control Board) recognized by the CPCB under Section 12 (1) b of the Environment (Protection) Act, 1986<sup>22</sup>.

Out of these 10 recognized laboratories, 2 are Central Laboratories of CPCB located in Delhi and Kolkata, 4 are Regional Laboratories of Maharashtra Pollution Control Board located in Pune, Nashik, Aurngabad and Nagpur and one is a Central Laboratory of Punjab Pollution Control Board. Other 3 recognized laboratories are of Educational and Research Institutions.

This implies that barring Maharashtra, 10 out of the 11 states engaged in trial or full-time co-incineration of hazardous waste in cement plants do not even have a recognized laboratory in their Pollution Control Board. This state of affairs raises a serious doubt about the credibility of the monitoring data generated by these labs in case they were monitoring the emissions from the cement plants.

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<sup>22</sup> [http://cpcb.nic.in/13\\_ListRecognizedEnvironmentalLaboratories.pdf](http://cpcb.nic.in/13_ListRecognizedEnvironmentalLaboratories.pdf)

## **Comparison of Co-incineration in Indian Cement Plants with Holcim-GIZ Guidelines:**

In its guidelines on co-processing released under the Holcim-GIZ Public Private Partnership several principles are listed in its guide on co-incineration of wastes<sup>23</sup>. These “guidelines include specific principles and requirements for co-processing of waste in cement kilns including the observation of the compliance with all applicable laws and regulations, environmental aspects of cement production and AFR pre-processing, operational issues, occupational health and safety as well as communication and corporate social responsibility”.

When compared to the situation on ground the co-incineration experiment in India fails several of these principles:

**Principle 2** of the guidelines states that, “**baselines for traditional fuels and raw materials shall be defined**”. Indian standards on emissions are very poor and barely address the environmental challenges posed by the cement sector let alone defining the baselines. For example there are no legally prescribed standards for heavy metal emissions in air from cement plants in India, and in absence of such standards it is difficult to ensure compliance by the industries.

**Principle 3** of the guidelines recommends, “**installing of community advisory panels**”. None of the cement plants carrying out trials of co-incineration had informed local communities. Regular co-incineration of waste continues without any community oversight or engagement. Fire accidents caused due to improper storage of waste reported at cement kilns also remain uninvestigated<sup>24</sup>.

**Principle 5** of the guidelines states that, “**emissions monitoring is obligatory**”. Information gathered under the RTI for this investigation has revealed that barely any state agencies have continued monitoring after regular co-incineration was sanctioned by the CPCB. Even if there was monitoring on one or two occasions this was conducted in an irregular manner and excluded heavy metal testing. Even CPCB, the nodal agency, does not have complete information of the quantum or the type of waste being co-incinerated in at least 15 cement plants in the country.

**Principle 13** of the guidelines on site suitability **requires properly trained management and employees for handling and processing of AFRs**. It is a well known and documented fact that Indian cement plants primarily recruit contract labours for majority of their processing works. In Chhattisgarh the employees of the ACC plant informed the team that the company has employed more contract workers than permanent workers and it is they who carry out all the risky and hazardous tasks, they also informed us that though the company was burning waste regularly, the workers had no knowledge or training on handling such materials.

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<sup>23</sup> [http://www.holcim.com/holcimcms/uploads/CORP/SummaryGuidelines2\\_COPROCEM.pdf](http://www.holcim.com/holcimcms/uploads/CORP/SummaryGuidelines2_COPROCEM.pdf)

<sup>24</sup> Fire at cement factory, 200 tonnes of waste material gutted

[http://articles.timesofindia.indiatimes.com/2012-10-04/coimbatore/34258951\\_1\\_fire-cement-factory-structure](http://articles.timesofindia.indiatimes.com/2012-10-04/coimbatore/34258951_1_fire-cement-factory-structure)

## **Implications of Storage of Hazardous Waste inside Cement Plants, Interstate transport and Safety of Workers:**

**Licences and Permissions:** A very concerning aspect of the co-incineration is with regards to the legality of storage of hazardous waste on plant site. Facilities set up for storage and handling of hazardous wastes require an Environmental Clearance (EC) under the Environmental Impact Assessment (EIA) Notification 2006. In order to obtain the EC, the facility has to conduct an EIA study, public consultation and be subjected to the scrutiny of the experts at the Ministry of Environment and Forests. All these steps are required and important for the facility given the toxic and dangerous nature of the wastes it handles. None of this scrutiny or procedure has been applied to the cement units prior to sanctioning co-processing.

CPCB's report titled "Report On Co-incineration of Hazardous Waste in Cement Kilns in Central Zone<sup>25</sup>" observes "most of the units are instructed to co-incinerate the hazardous waste but they are not given permission by SPCBs in spite of repeated meetings/clarifications and even after obtaining the trial run permission by CPCB". Such permissions from SPCB might also not be legally viable keeping in mind the provisions of EIA Notification 2006 and Hazardous Wastes (Management, Handling and Transboundary Movement) Rules 2008.

**Transportation and Storage:** Another major area of concern is the safe transportation and storage of the hazardous waste itself. Once again these aspects of the hazardous wastes are governed by the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules 2008 and the EIA Notification 2006. It is not clear how these provisions are being applied in the current scenario. The CPCB report makes very critical and concerning observations regarding the status of transportation and storage of hazardous wastes in the cement plants studied. It states:

- Most of the hazardous wastes are being transported by road only which is highly risky.
- The hazardous wastes are being transported by unauthorized vehicles due to non-availability of authorized transporters. Moreover the transporters will not agree for transporting small quantity of waste.
- Taking interstate transportation permission from SPCBs for transporting the hazardous waste from one state to other state is a big challenge for the industry, because there is lack of co-ordination between different SPCBs as a result the industry is suffering and finally permission delayed.
- Storage, handling and feeding systems for using the hazardous waste in cement kiln need improvement. Manual handling of hazardous waste was observed in almost all the plants which may cause health problems to workers in future.

**Safety of the Workers:** Though the CPCB guidelines require the cement plant operators to train their workers to handle waste, there is absolutely no obligation by the operator or the regulators to share any information with the public. During our interactions with community members and workers in Jamul, Chhattisgarh, where ACC-Holcim facility has been co-incinerating waste, we were informed that no information was

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<sup>25</sup> <http://cpcb.nic.in/Co-incinHW.pdf>

shared with the public. Workers reported storage of date expired cosmetics and beauty products, plastic wastes etc., in the factory premises but did not realize it was for co-incineration. They also reported incidents of pilferage of these products by workers on several instances and of resale of some of these materials in the second-hand markets. This raises critical questions about security of the premises where the waste is stored and implications on public health and safety in an event that the waste leaves the cement facility in an unauthorized manner.

CPCB has made similar observations too. In its report the board states, "It was observed that in most of the industries awareness about the safe handling & disposal of hazardous waste to the operator was not founded and found less in most of the industry and some places helpers were not wearing proper protective gadgets during the handling of the waste."

**Monitoring:** There is no environmental monitoring information available to explain the manner in which hazardous waste is being stored or burned inside the cement plants. No water, air or leachate monitoring data has been made available so far and hence there is a lot of ambiguity in the procedure of monitoring of emissions from storage and burning of hazardous waste. It is not certain if the cement plants even have the capacity to monitor emissions from co-incineration of hazardous waste.

While the CPCB has allowed co-incineration its Regional Office's observation clearly show the hasty manner in which co-incineration was approved. On the issue of the monitoring of emissions, the report notes, "The industries are not equipped for regular monitoring of environmental parameters as per the protocol given by CPCB, especially for micro pollutants in most of the cement units who were using hazardous waste on regular basis."

### **Co-incineration of hazardous waste in cement plants will cause harm to public health and the environment**

Any claims of the benefits of co-incineration of hazardous waste in cement plants rests on several assumptions that require further inspection. For instance co-incineration of hazardous waste in cement plants is promoted by the cement industry on the basis that the raw materials for the manufacture of cement have a high affinity for toxic substances, such as dioxins/furans, resulting in the low concentrations of toxic substances in stack emissions.

First, compared to other industrial facilities, cement kilns emit very large volumes of exhaust (from 25,000 to 200,000 cubic meters per hour, depending on kiln size)<sup>26</sup>. What matters is the **total amount** of dioxins/furans and other toxic substances that cement plants emit. **For cement kilns, lower concentrations of toxic substances in stack emissions are offset by larger volumes of emissions.** Approval of individual projects involving co-incineration of hazardous waste in cement plants need to take into account the total quantities of emissions of dioxins/furans and other toxic substances over time,

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<sup>26</sup> Department of the Environment, Water, Heritage and the Arts (April 2008) "Emission estimation technique manual for Cement manufacturing Version 2.1" <http://www.npi.gov.au/publications/emission-estimation-technique/pubs/cement.pdf>

not simply their concentration in stack emissions.

Second, unlike many other toxic substances, incorporation into the food chain, not inhalation, is the prevailing pathway for human intake of dioxin.

Many recent studies including the 'Draft Health Reassessment of Dioxin-Like Compounds, Mercury Study Report to Congress, and Risk Assessment Support to the Development of Technical Standards for Emissions from Combustion Units Burning Hazardous Wastes: Background Information Document' indicate that there can be significant risks from indirect exposure pathways (e.g., pathways other than direct inhalation). The food chain pathway appears to be particularly important for bio-accumulative pollutants which may be emitted from hazardous waste combustion units. In many cases, risks from indirect exposure may constitute the majority of the risk from a hazardous waste combustor."<sup>27</sup>

Therefore, locations surrounded by agricultural lands, particularly those for the raising of livestock, should be "NO-GO" sites for the co-incineration of hazardous waste in cement plants.

## **Conclusion**

It is quite evident that the cement plants in India are poorly regulated and highly polluting even with the use of conventional fuel like coal. Their impacts on local environment and public health are severe but in the absence of strict standards or regulatory oversight the industry has been able to get away with impunity.

It is also clear that the regulatory agencies are themselves do not have adequate capacity to monitor and control the emissions from the cement plant. Our regulatory guidelines for air emissions from cement plants does not even mandate tests for heavy metals. In such circumstances decision to co-incinerate hazardous waste in cement plants is a hasty one. This decision has led the authorities to undermine scientific due diligence necessary for an exercise of this nature.

Waste from industrial and municipal sources is a big issue which needs to be addressed but end of pipeline options like co-incineration can never resolve it. An inquiry into the role of the agencies like CPCB and GIZ needs to be conducted on the due-diligence that was undertaken before recommending co-incineration. Ultimately, considering the environmental and safety track record of the cement industry in India coupled with a poor monitoring infrastructure, co-incineration of waste can never be safe.

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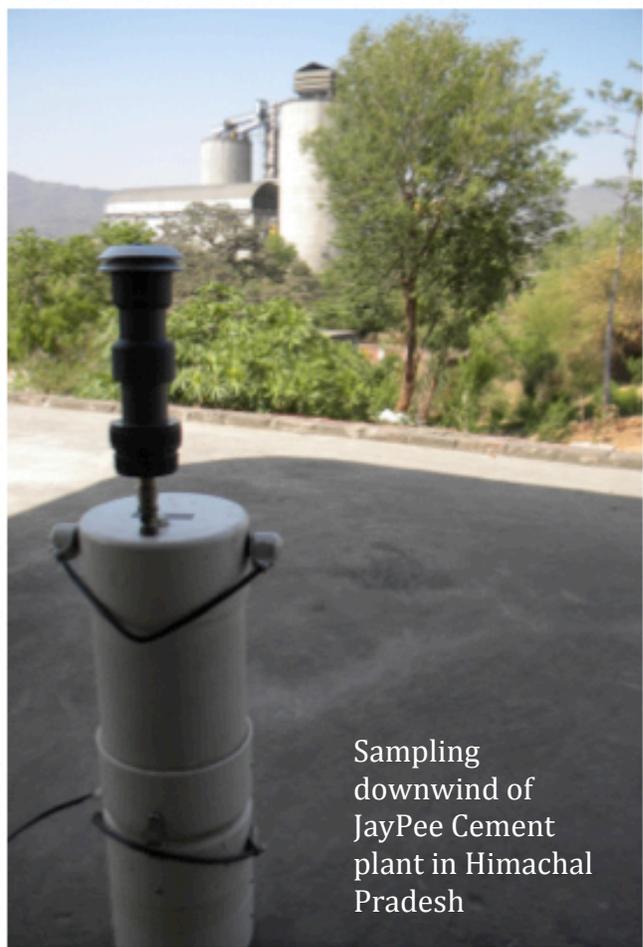
<sup>27</sup> U.S. EPA (July 1998) "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities." [http://www.epa.gov/earth1r6/6pd/rcra\\_c/protocol/volume\\_1/chpt1-hh.pdf](http://www.epa.gov/earth1r6/6pd/rcra_c/protocol/volume_1/chpt1-hh.pdf)



View of Sanghi Cement plant from the road



JayPee Cement Plant, Himachal Pradesh 15.11.2



Sampling downwind of JayPee Cement plant in Himachal Pradesh



Left: Dust pollution from JayPee, Himachal Pradesh



Up: Sampling downwind of Cement Plants  
Down: Community meeting in progress



## **Annexure 1 – Interpretation of Sample Results from Various States**

### **Interpretation of Dust Sample results from Gujarat:**

#### **SAMPLE A:**

**Date of Sampling:** 2 February 2013

**Time of Sampling:** 24 hour sample from 12.35 pm

**Location:** On top of the house of Jadhua village head; about 1 km east of the Sanghi Cement plant and about 300 mtrs south of the Sanghi limestone mines.

**Conditions:** The weather conditions were normal, with gentle shifty breeze mostly from North East to South West. The minivol sampler was set up and removed in the presence of the sarpanch and other community members.

#### **SAMPLE B:**

**Date of Sampling:** 2 February 2013

**Time of Sampling:** 24 hour sample from 1.50 pm

**Location:** On the window of the house of a resident of Jadhua village; about 500 mtrs east of the Sanghi Cement plant and about 400 mtrs south of the Sanghi limestone mines.

**Conditions:** The weather conditions were normal, with gentle shifty breeze mostly from North East to South West. The minivol sampler was set up and removed in the presence of the family members of the house and other community members.

#### **SAMPLE C:**

**Date of Sampling:** 3 February 2013

**Time of Sampling:** 12 hour sample from 4.05 pm

**Location:** On top of the temple of Kharia village; downwind of the limestone mines of JayPee Cements.

**Conditions:** The weather conditions were normal, with gentle shifty breeze. The minivol sampler was set up and removed in the presence of the temple caretaker and some of the prominent members of the community.

## RESULTS (Gujarat):

1. PM 2.5, Silica and Manganese levels were found above limits in all the 3 results.
2. Lead was found high in two out of three samples.

Location	Date	PM2.5	Si	Fe	Mn	Ni	Hg**	Pb
Jadhua Village house head, Sample A	2/2/13	210.1	21.2	7.3	0.11	0.013	0.024	0.178
Jadhua Village close to factory, Sample B	2/2/13	291.8	20.1	6.6	0.11	0.0055	0.013	0.174
Temple of Kharia village, Sample C	2/3/13	89.7	8.9	4.3	0.057	0	0	0.117
<b>Health-based standards</b>	EPA Air Quality Index, 24-hour	>250.5	Hazardous - This would trigger a health warnings of emergency conditions. The entire population is more likely to be affected.					
	EPA Air Quality Index, 24-hour	150.5–250.4	Very Unhealthy - People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.					
	EPA Air Quality Index, 24-hour	55.5-150.4	Unhealthy - People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion					
	EPA Air Quality Index, 24-hour	35-5-55.4	Unhealthy for Sensitive Groups - People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.					
	WHO 24-hour	25	None	None	None	None	None	None
	WHO annual	10	None	None	0.15	0.0025	1.00	0.50
	EPA 24-hour	35	None	None	None	None	None	None
	EPA 3-month	None	None	None	None	None	None	0.15
	EPA annual	12	None	None	None	None	None	None
	<b>India NAAQS 24-hour</b>	<b>60</b>	<b>None</b>	<b>None</b>	<b>None</b>	<b>None</b>	<b>None</b>	<b>1.00</b>
	India NAAQS Annual	40	None	None	None	0.02	None	0.50
	California OEHHA 24-hour	None	None	None	None	0.2	0.60	None
	California OEHHA annual*	None	3	None	0.09	0.014	0.03	None
	EPA RfC	None	None	None	0.05	None	0.30	None
* Standard for								

crystalline silica								
<i>Italic = conc &lt; 3 times uncertainty</i>								
<u>underline = conc &lt; 2 times uncertainty</u>								
0.0 = conc < uncertainty = non-detect								
<a href="http://oehha.ca.gov/air/allrels.html">http://oehha.ca.gov/air/allrels.html</a>								
	Sample level exceeds 24-hour standard (directly comparable)							
	Sample level exceeds annual standard (of significance if reflects generally prevailing air quality)							

## **Interpretation of Dust Sample results from Chhattisgarh:**

### **SAMPLE 1:**

**Date of Sampling:** 5 February 2013

**Time of Sampling:** 24 hour sample from 08.05 pm

**Location:** On top of the house of Mr. Mohanlal Sahu at Gharidas Nagar, at about 500 mts on the western side of ACC Holcim Cements, Jamul

**Conditions:** The weather conditions were normal, with gentle shifty breeze. The minivol sampler was set up and removed in the presence of the members of the household, trade union and other community members.

### **SAMPLE 2:**

**Date of Sampling:** 5 February 2013

**Time of Sampling:** 24 hour sample from 08.40 pm

**Location:** On top of the house of Mr. Bhagibali Nishad at Masoria Talao, at about 500 mts on the north of ACC Holcim Cements, Jamul

**Conditions:** The weather conditions were normal, with gentle shifty breeze. The minivol sampler was set up and removed in the presence of the members of the household and trade union.

### **SAMPLE 3:**

**Date of Sampling:** 7 February 2013

**Time of Sampling:** 24 hour sample from 01.25 pm

**Location:** On top of the house of Mr. Ganpat in Aresmetta village, south of Lafarge Cement plant and south west of limestone mines.

**Conditions:** The weather conditions were erratic, with gentle breeze and there were about 8 hours of intermittent rains during the sampling period. The minivol sampler was set up and removed in the presence of the members of the household and trade union.

### **SAMPLE 4:**

**Date of Sampling:** 7 February 2013

**Time of Sampling:** 24 hour sample from 01.40 pm

**Location:** On top of the house of Mr. Pyarelal of Amora Colony on the western side of the Lafarge plant in Aresmetta village. The house is located about 100mts from the plant boundary.

**Conditions:** The weather conditions were erratic, with gentle breeze and there were about 8 hours of intermittent rains during the sampling period. The minivol sampler was set up and removed in the presence of the members of the household and trade union.

**RESULTS (Chhattisgarh):**

1. PM 2.5, Silica and Manganese levels were found above limits in all the 4 results.
2. Mercury and Lead was found high in two out of four samples.

Location	Date	PM2.5	Si	Fe	Mn	Ni	Hg**	Pb
Mohanlal Sahu At Ghasidas Nagar, Sample 1	2/5/13	430.7	51.1	42.4	1.945	0	0.053	0.649
Terrace Of Bhagibali Nishad, Sample 2	2/5/13	381.4	53.4	50.6	2.043	0	0.063	0.412
Terrace Of Mr. Ganpat, Sample 3	2/7/13	158.2	21.8	9.8	0.182	0.0025	0.016	0.032
Terrace Of Pyarelal, Sample 4	2/7/13	131.0	21.2	5.8	0.151	0.0019	0	0.034
<b>Health-based standards</b>	EPA Air Quality Index, 24-hour	>250.5	Hazardous - This would trigger a health warnings of emergency conditions. The entire population is more likely to be affected.					
	EPA Air Quality Index, 24-hour	150.5–250.4	Very Unhealthy - People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.					
	EPA Air Quality Index, 24-hour	55.5-150.4	Unhealthy - People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion					
	EPA Air Quality Index, 24-hour	35-5-55.4	Unhealthy for Sensitive Groups - People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.					
	WHO 24-hour	25	None	None	None	None	None	None
	WHO annual	10	None	None	0.15	0.0025	1.00	0.50
	EPA 24-hour	35	None	None	None	None	None	None
	EPA 3-month	None	None	None	None	None	None	0.15
	EPA annual	12	None	None	None	None	None	None
	India NAAQS 24-hour	60	None	None	None	None	None	1.00
	India NAAQS Annual	40	None	None	None	0.02	None	0.50
	California OEHHA 24-hour	None	None	None	None	0.2	0.60	None

	California OEHHA annual*	None	3	None	0.09	0.014	0.03	None
	EPA RfC	None	None	None	0.05	None	0.30	None
* Standard for crystalline silica								
<i>Italic = conc &lt; 3 times uncertainty</i>								
<u>underline = conc &lt; 2 times uncertainty</u>								
0.0 = conc < uncertainty = non-detect								
<a href="http://oehha.ca.gov/air/allrels.html">http://oehha.c a.gov/air/allrel s.html</a>								
	Sample level exceeds 24-hour standard (directly comparable)							
	Sample level exceeds annual standard (of significance if reflects generally prevailing air quality)							

## Interpretation of Results form Tamil Nadu

**Date of Sampling:** 17 April 2012

**Time of Sampling:** 9.30 am

**Location:** Terrace of Benjamin's house, about 200 mts west of Dalmia Cements at Vadugarpetai, Keeltheru

**Conditions:** The weather conditions were normal, the monitors were informed that the factory was not in operation and they could not notice any visible smoke or dust from the unit. The minivol sampler was set up and removed in the presence of the members of the household and community.

### RESULTS (Tamil Nadu):

1. PM 2.5 was above standards in the result.

Site	Sample Date		PM-2.5	Lead	Manganese	Nickel
Tamil Nadu - Dalmia Cement	4/17/12		66.1	0.007	0.039	0.004
<b>Health-based standard</b>	India NAAQS, 24-hr		60	1.0	none	none
	India NAAQS, annual		40	0.5	none	20
	WHO Guideline Value, 24-hr		25	none	none	none
	WHO Guideline Value, annual		10	0.5	0.15	0.025
	California standard, 24-hour		none	none	none	0.2
	California standard, annual		12	1.5	0.09	0.014
	U.S. EPA, 24-hour		35	none	none	none
	U.S. EPA, long-term		15	0.15	0.05	none

## Interpretation of Results form Himachal Pradesh

**Sample: Downwind of ACC Cement**

**Date of Sampling:** 14 May 2012

**Time of Sampling:** 24 hour sample from 08.40 pm

**Location:** The terrace of

**Conditions:** The weather conditions were. The minivol sampler was set up and removed in the presence of the members of the household and community representatives.

**Sample: Downwind of JayPee Cement**

**Date of Sampling:** 15 May 2012

**Time of Sampling:** 12:15 pm

**Location:** On the top of the house of Mr. Pawan Kumar.

**Conditions:** The weather conditions were normal, with gentle breeze and visible dust from the unit. We were also informed that the unit had used water sprinklers intermittently as they had foreknowledge of our sampling exercise. The minivol sampler was set up and removed in the presence of the members of the household and trade union.

### RESULTS (Himachal Pradesh):

1. PM 2.5, Nickel and Manganese levels were found above limits in all the 2 results.
2. Lead was found high in one of the samples.

Site	Sample Date	PM-2.5	Lead	Manganese	Nickel
Himachal Pradesh - ACC Cement	5/14/12	311.7	0.167	0.329	0.052
Himachal Pradesh - JayPee Cement	5/15/12	346.1	0.054	0.534	0.038
<b>Health-based standard</b>	India NAAQS, 24-hr	60	1.0	none	none
	India NAAQS, annual	40	0.5	none	20
	WHO Guideline Value, 24-hr	25	none	none	none
	WHO Guideline Value, annual	10	0.5	0.15	0.025
	California standard, 24-hour	none	none	none	0.2
	California standard, annual	12	1.5	0.09	0.014
	U.S. EPA, 24-hour	35	none	none	none
	U.S. EPA, long-term	15	0.15	0.05	none

## **Annexure 2 – Methodology for Analysing the Filters for PM2.5 and Heavy Metals**

### **Gravimetry**

Filters are purchased from commercial vendors are acceptance tested by visual inspection. Filters passing inspection are equilibrated in a temperature and humidity controlled environment, tare weighed, and either stored or shipped immediately to the client. Filters returned from the field are equilibrated in a temperature and humidity controlled environment for 24 hours prior to gross weighing.

*CHESTER LabNet* operates microbalances capable of measuring mass to one microgram used for smaller filters, as well as a balance that measures mass to a tenth of a milligram which is used for the larger filters. The balances are under computer control, and all weighing operations follow a strict QC program. All filters are weighed and data is recorded using a proprietary custom software program. This software automatically records analytical results. The software uses the information in the data file to calculate the net mass, as well as the difference in QA reweights. Tare and gross weights are electronically transferred to the laboratory information management system (LIMS).

**CHESTER LabNet** uses these gravimetric techniques for a wide variety of methods, including but not limited to NIOSH 0500, NIOSH 0600, CFR 50, Appendix B (TSP), J (PM10) and L (PM2.5) and IO 3.1.

### **X-ray Fluorescence (XRF)**

XRF offers rapid analysis of over 35 elements (Na through Pb). XRF is an EPA approved (IO-3.3), non-destructive analytical method wherein a filter or section of filter ("punch") is loaded into the instrument, then bombarded with X-ray beams. The subsequent excitement of electrons can be measured when the electrons fall back to their valence state, releasing energy in the process. Each element has a "fingerprint" of electrical discharges which can then be measured to determine the quantity of each element being measured.

Since XRF is non-destructive, filter samples can then be used for subsequent analysis, or reanalyzed by XRF. Detection limits for XRF are dependent on the "count time" of each sample and the area of the X-ray beam, and are determined in units of  $\mu\text{g}/\text{cm}^2$ . Due to the unadulterated nature of the sample, CLP data packages cannot be generated as a true spike is not possible, and duplicates are not truly duplicates, rather replicates of the same sample. Most of the elements measured by XRF can also be measured by conventional metals analysis or Ion Chromatography.

### ANNEXURE 3: Responses from State Pollution Control Boards to RTI

States	List of all cement plants authorized to co-incinerate various forms of waste in their process.	Copies of all emission and compliance monitoring data of these plants from the month they started co-incineration up to May 2012	Provide a list of all the materials/ waste that has been approved by the board for co-incineration including the names of the companies where the waste originates.
Rajasthan	<ul style="list-style-type: none"> <li>- ACC Ltd, Lekhri, Dist Bundi</li> <li>- Aditya Cement Ltd, Sambhupura, Chittorgarh</li> <li>- Ultra Tech Cement Ltd, Kotputli, Dist Jaipur</li> <li>- Shree Cement Ltd (Ambuja Cements), Ras, Jaitaran Dist Pali</li> <li>- Shree Cement Ltd, Andheri Deori, Masuda Dist Ajmer</li> <li>- Trinetra Cement Ltd, Banswara</li> </ul>	No monitoring data other than results of Particulate Matter provided by the PCB. It is also not clear from the reports if the Particulate Matter tested were PM 10 or PM 2.5	<p>No data provided from State PCB</p> <p><b>RTI from CPCB reveals:</b></p> <ul style="list-style-type: none"> <li>- ETP Sludge from CETP Pali</li> <li>- ETP bio solids, spent carbon and WTP sludge from soft drink industry</li> <li>- Oily rags, phosphate sludge and chemical ETP sludge from Automobile Industry</li> <li>- Grinding dust from Rolling, Bearing and Seal industry</li> <li>- Paint Sludge from Rail Coach Factory Kapurthala, M/s Sigma Vibracoustics India Pvt Ltd and Punjab Tractors Ltd, Mohali.</li> <li>- Waste mix solid and liquid from Gujarat Eniro Protection &amp; Infrastructure Ltd Surat</li> </ul>
Himachal Pradesh	<ul style="list-style-type: none"> <li>- ACC Ltd Gagaj Cement Works</li> <li>- Ambuja Cements Ltd, Village Suli, Solan Dist</li> </ul>	Some monitoring data for 2009 and 2010 provided by the State PCB. High quantities of toxic metals like lead and manganese were detected in the samples. Action taken on these units for these emissions is not known. It should also be noted that India does not have standards for many toxic metals such as lead, manganese, mercury etc in air.	<ul style="list-style-type: none"> <li>- Non-hazardous damaged/ expired/ non moving consumer products from Hindustan Unilever Ltd.</li> <li>- Vicks Vaporub process waste from Sarvottam Remedies Ltd.</li> <li>- ETP Sludge and Cream waste from Colgate Palmolive India Ltd</li> <li>- Gelatin Waste from Unichem Laboratories</li> <li>- Paint Sludge from TVS Motors Company Ltd</li> <li>- Solid waste mix from Shivalik Solid Waste Management Ltd</li> </ul>
Tamil Nadu	<ul style="list-style-type: none"> <li>- ACC Madukarai Cement Works, Coimbatore</li> </ul> <p>(Tamil Nadu PCB has still not provided complete list of</p>	No data provided	<ul style="list-style-type: none"> <li>- Tarry residues</li> <li>- Oily sludge and emulsion (refinery sludge)</li> <li>- Waste and residues – paint</li> </ul>

	<p>industries where cement co-incineration in Tamil Nadu is taking place. The current information provided is a response to specific RTI on ACC Madukarai)</p> <ul style="list-style-type: none"> <li>- Ultra Tech Cement, Reddipalayam, Ariyalur</li> </ul>		<p>sludge</p> <ul style="list-style-type: none"> <li>- Chemical sludge, activated sludge from waste water treatment</li> <li>- Tyre chips</li> <li>- Used/ Spent oil</li> <li>- Chemical sludge from waste water treatment – TANFAC Industries Cuddalore</li> <li>- ETP Chemical sludge, Phosphate sludge and Oily rags from Ford India Ltd. Chengalpettu</li> <li>- Poly residue from SRF India Ltd, Bhind, MP</li> <li>- FRP waste (green mesh with resin) from Suzlon Energy Ltd, Pondy cherry</li> <li>- ETP sludge from BASF India Ltd Managalore</li> <li>- Tyre chips and paint sludge from anywhere available</li> <li>- Plastic waste from nearby areas</li> <li>- Refinery sludge from CPCL, Chennai</li> </ul>
Andhra Pradesh	<ul style="list-style-type: none"> <li>- Ultra Tech Cement Ltd Bhogasamudram, Anthapur Dist</li> <li>- India Cements, Wadapally, Nalgonda Dist</li> <li>- NCL Industries Ltd, Mattampally, Nalgonda Dist</li> <li>- Kesoram Cements, Basant Nagar, Karimnagar Dist</li> <li>- Bharati Cement Corporation Ltd, Kadappa Dist</li> <li>- My Home Industries Ltd. Srinagar, Nalgonda Dist</li> <li>- Sagar Cements Ltd, Mattampally, Nalgonda Dist</li> <li>- Zuari Cements Ltd, Krishna Nagar, Kadappa Dist</li> <li>- M/s Madras Cements Ltd. KSR Nagar, Krishna Dist</li> <li>- Penna Cements Industries Ltd, Belkatur, Rangareddy Dist</li> </ul>	<p>Data for Ultra Tech Cement Ltd for the period January to March 2013 provided.</p> <p>No data from any other units provided</p>	<p>These cement industries have co-processed about 41,155 tons of:</p> <ul style="list-style-type: none"> <li>- Spent Solvents</li> <li>- Spent Carbon</li> <li>- Organic residues etc</li> </ul>
Karnataka	<ul style="list-style-type: none"> <li>- M/s Ultra Tech Cement, Gulbera</li> <li>- ACC Ltd. Wadi Cement Works</li> <li>- M/s Vasavadatta Cement, Gulberga</li> <li>- Heidelberg Cement (Mysore</li> </ul>	Not Available	<ul style="list-style-type: none"> <li>- Ink Sludge and paint sludge from Reserve Bank of India, Mysore</li> <li>- Cured resin &amp; green mesh from M/s SE Composites, Udupi</li> </ul>

	Cement Ltd) Tumkur		<ul style="list-style-type: none"> <li>- Spent Wash (Non – HW) from M/s Renuka Sugars, Belgaum</li> <li>- Chemical sludge from ETP M/s Syngenta India Ltd, Goa</li> <li>- Plastic waste &amp; other Non-recyclable combustible Waste Goa State</li> <li>- Benzofuran from M/s Kumar Organic Products Ltd. Bangalore &amp; Vivimed Labs Ltd Bidar</li> <li>- Spent Wash (Non HW) from M/s Ugar Sugar Works Ltd, Belgaum</li> <li>- Reinforced Plastic (FRP) Waste from M/s Suzalan Se Composites Udipi</li> <li>- Grinding Muck from Kirloskar Toyota Textile Machinery Pvt Ltd Jigani</li> <li>- ETP bio solids, spent carbon and WTP sludge from Hindustan Coca Cola Pvt Ltd</li> <li>- FRP waste (green mesh with resin) from Suzlon Energy Ltd, Pondycherry</li> <li>- SEP sludge and n-Butanol salt from Jubilant Organosis Ltd, Mysore</li> <li>-</li> </ul>
Odisha	M/s ACC Limited, Bargarh Cement Works at Cement Nagar, PO Bardol, Dist Bargarh	Not Available	<ul style="list-style-type: none"> <li>- Used Oil</li> <li>- Waste Containing Oil</li> <li>- Spent resin from DM plant</li> <li>- Chemical sludge, phosphate sludge, paint sludge, oily rags and grinding dust from automobile industry</li> <li>- Grinding muck from textile machine manufacturing industry</li> <li>- Grinding dust from rolling, bearing and steel industry</li> <li>- ETP bio solids, spent carbon, WTP sludge from soft drink industry</li> <li>- Plastic, expired consumer products and laminates from consumer goods industry</li> <li>- TDI tar and ETP sludge from Chemical industry</li> <li>- Petroleum refining sludge from petroleum refinery</li> </ul>

			<ul style="list-style-type: none"> <li>- Plastic waste from Municipality</li> <li>- Tyre chips from vendors/ tyre manufacturers</li> </ul>
Madhya Pradesh	<ul style="list-style-type: none"> <li>- Samruddhi Cement Ltd (unit Vikram Cement Works) Neemuch, MP</li> <li>- ACC Ltd Keymore Cement Works, Katni Dist</li> </ul>	Some monitoring data for 2011 and 2012 provided by the State PCB. High quantities of toxic metals like lead, cadmium, chromium and manganese were detected in the samples. Action taken on these units for these emissions is not known. It should also be noted that India does not have standards for many toxic metals such as lead, manganese, mercury etc in air.	<ul style="list-style-type: none"> <li>- Paint sludge from Mahindra Two Wheelers Ltd. Pithampur, Dhar</li> <li>- Poly residue grinding muck from SRF Ltd Malanpur</li> <li>- ETP bio solids, spent carbon and WTP sludge from soft drink industry</li> <li>- Oily rags, phosphate sludge and chemical ETP sludge from Automobile Industry</li> <li>- Grinding dust from Rolling, Bearing and Seal industry</li> </ul>
Chhattisgarh	<ul style="list-style-type: none"> <li>- ACC Ltd. Jamul Cement Works, Distt Durg</li> <li>- Lafarge India Ltd, Sonadih Cement Plant, Dist Baloda Bazar</li> <li>- Lafarge India Ltd, Arasmetta Cement Plant, Dist Janjgir Champa</li> <li>- Ambuja Cement Eastern Ltd, Dist Baloda Bazar</li> <li>- Ultratech Cement, Hirmi, Dist Baloda Bazar</li> </ul>	Trial run emission monitoring data for all the plants for the years 2009, 2010 and 2011 provided.	<ul style="list-style-type: none"> <li>- Acid tar sludge from Bhilai Steel Plant</li> <li>- Waste mix solid, waste mix liquid, plastic and resin waste and low density waste mix solid from M/s Gujarat Enviro Protection Infrastructure Pvt Ltd, TSDF in Surat, Silvassa and Faridabad.</li> <li>- Non-Hazardous FMCG date expired and damaged materials, tyre chips and plastic waste from Open Market i.e. Emami, Godrej, HLL etc</li> <li>- TDI tar from M/s Narmada Chemture Petrochemicals Ltd, Bharuch</li> <li>- SPL from Balco, Korba</li> <li>- ETP Sludge, pesticides residues, off specified pesticides, PTA, Oily rags, Process sludge and Terephthalic acid from M/s MCC PTA India Corp Pvt Ltd, Haldia, West Bengal</li> <li>- Plastic waste, tyre and tyre chips from local municipal bodies and near by open market.</li> </ul>
Jharkhand	<ul style="list-style-type: none"> <li>- ACC Ltd Chaibasa Cement Works, West Singhbhum</li> </ul>	Trial burn monitoring data for the year 2011	<ul style="list-style-type: none"> <li>- Spent Catalyst and petroleum refining sludge from</li> </ul>

	District	provided.	<p>Petroleum refinery</p> <ul style="list-style-type: none"> <li>- Phosphate sludge, paint sludge, oily rags, chemical ETP sludge, chemical sludge and grinding dust from automobile industry.</li> <li>- Plastic waste from Municipalities and Industries</li> <li>- Tyre chips from suppliers and Tyre manufacturers</li> <li>- ETP bio solid, WTP sludge and spent carbon from soft drink industry</li> <li>- Grinding muck from Textile Machine Manufacturing industry</li> <li>- Used Oil from its own generation at the Chaibasa.</li> </ul>
Gujarat (info based on RTI response from CPCB, the state PCB did not respond to the RTI request)	<ul style="list-style-type: none"> <li>- Ultra Tech Cement Ltd, Gujarat Cement Works, Amreli, Gujarat</li> <li>- Ultra Tech Cement, Narmada Cement Works, Amreli, Gujarat</li> <li>- Ambuja Cement Ltd, Junagarh, Gujarat</li> <li>- Gaj Ambuja Cement Ltd, Junagarh, Gujarat</li> </ul>	No data provided	<ul style="list-style-type: none"> <li>- Waste mix solid and liquid from Gujarat Enviro Protection &amp; Infrastructure Ltd Surat and Colortex Industries Ltd. Surat.</li> <li>- TDI tar from Narmada Chematur Petrochemicals Ltd Bharuch</li> <li>- Waste mix solid and liquid from Gujarat Enviro Protection &amp; Infrastructure Ltd Surat</li> <li>- Waste mix liquid from Bharuch Enviro Protection &amp; Infrastructure Ltd and Lupin Ltd, Ankaleshwar</li> </ul>
Maharashtra	<p>According to the response in the RTI dt September 2012:</p> <p>“The Board has not provided any permission to the cement industry for regular co-processing of waste in kilns. However M/s Ambuja Cements Ltd, Upparwahi Taluk, Chandrapur district has carried out some trial runs for co-processing of bio mass and other waste and carried emission monitoring by third party with the permission of the Board and monitoring reports are awaited.</p> <p>M/s ACC Ltd Chanda Cement Works, Ghugus, Chandrapur has not still started co-incineration of waste though permission of the same has been accorded by</p>	Trial run data provided of the period between 2006 and 2010.	No list provided

	CPCB.”		
West Bengal	There is no co-processing of waste in Cement Kiln in West Bengal	--	--
Bihar	There is no co-processing of waste in Cement Kiln in Bihar	--	--
Punjab	There is no co-processing of waste in Cement Kiln in Punjab	--	--
Haryana	There is no co-processing of waste in Cement Kiln in Haryana	--	--
Uttar Pradesh	There is no co-processing of waste in Cement Kiln in Uttar Pradesh	--	--
Assam	There is no co-processing of waste in Cement Kiln in Assam	--	--
Jammu & Kashmir	There is no co-processing of waste in Cement Kiln in J&K	--	--
Uttarakhand	There is no co-processing of waste in Cement Kiln in Uttarakhand	--	--