India: introducing co-processing

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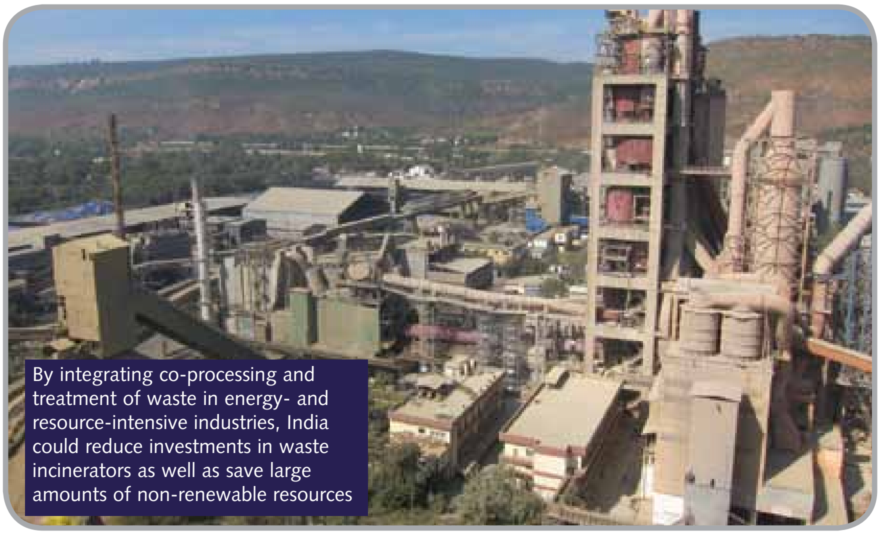
With waste generation expected to increase as India develops its economy further, the co-processing and treatment of industrial and hazardous waste in energy- and resource-intensive industries such as the cement becomes an attractive proposition. However, co-processing requires an appropriate body of regulations to be developed and implemented. In this first of a two-part article, the current status of co-processing in India and opportunities for improving this service are explored.



By integrating co-processing and treatment of waste in energy- and resource-intensive industries, India could reduce investments in waste incinerators as well as save large amounts of non-renewable resources

Almost 8Mta of hazardous wastes is generated from more than 40,000 enterprises in India, of which 3.6Mta is assumed to be recycled, 3.4Mta landfilled and about 650,000tpa contains energy that is possible to incinerate or recover (Gupta, 2012). This categorisation of hazardous wastes into three classes is based on hazard potential and the characteristics determining ultimate disposal, in accordance with the Hazardous Wastes Rules (2008).

There are currently 16 Treatment, Storage and Disposal Facilities (TSDFs) in operation/planned in nine Indian states, 14 secure landfills and six incinerators with a capacity of 34Mt and 200,000t, respectively.

It is expected that waste generation in India will increase with economic growth and thus the pressure to increase treatment capacity will rise. By integrating the co-processing and treatment of waste in energy- and resource-intensive industries it is anticipated that India can:

- reduce investments in costly waste incinerators
- save large amounts of non-renewable fossil fuels and raw materials
- reduce greenhouse gas emissions
- increase treatment capacity for hazardous chemicals.

The 2009 "Hazardous Waste Management Strategy" (HWMS) draft incorporates the essence of the "National Environmental Policy 2006", relevant multilateral agreements like the Basel Convention and national regulations. Article 10 of the HWMS deals with the possible treatment of hazardous wastes for use in cement kilns, stating that: "Subject to the implementation of suitable safeguards, incineration of high-calorific value hazardous wastes in cement kilns is one of the safe alternatives to conventional incineration." It further adds that: "The spread of the [Indian] cement industry in the country across the states makes this option particularly attractive."

In its "Ninety-Fifth Report on Performance of Cement Industry", the Parliamentary Standing Committee on Commerce encouraged the increased use of waste as alternative energy and resources in cement production. The paper was published on 24 February 2011 and delivered to the Rajya Sabha (the upper house of the Parliament of India).

Who is responsible for what?

- The Ministry of Environment and Forests (MoEF) is the responsible authority for hazardous waste management in India.
- The Central Pollution Control Board (CPCB) is an advisory body to the MoEF, and is responsible for developing policies and regulatory requirements on the co-processing and treatment of wastes in industries. It also oversees its implementation and grants permits for the treatment of hazardous waste.

Current co-processing status of the Indian cement sector

The Indian cement industry is the second largest in the world with a total installed cement capacity of about 320Mta, production of 220Mta and approximately 181 kilns. During 2006-11, the annual growth rate over the five-year period was nine per cent, according to the Cement Manufacturers' Association 2011 Annual Report. Infrastructure and housing needs have provided development opportunities and the government's plan to double infrastructure expenditure is expected to sustain industry growth at a similar pace in the coming years.

After vibrant growth and technological

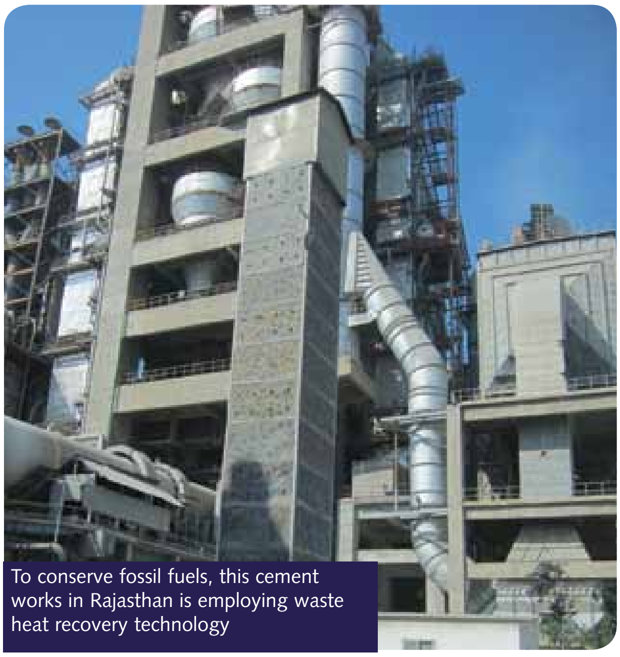
advances over the past decade, the Indian cement sector has become more efficient and is ranked after Japan in terms of energy efficiency. A substantial level of reorganisation has taken place in recent times with several instances of consolidation which have also contributed to the implementation of cutting-edge technologies.

However, Indian coal with its high ash content increases fuel consumption and coal imports. Variations in the quality of coal, together with inadequate supplies and transport bottlenecks, affect cost efficiency in terms of energy consumption.

Last year, the Indian cement industry consumed more than 356Mt of virgin raw materials, over 25Mt of coal and 18bnkWh electricity. Waste recovery and coal replacement in the cement industry has only been practiced for a relatively short time in the country. As such, the thermal substitution rate (TSR) is still below one per cent.

Local cement majors such as ACC, Ambuja, Lafarge, Shree Cement and UltraTech are involved in co-processing activities with hazardous waste. India's top two cement producers, ACC and UltraTech, reached a TSR of 0.59 per cent and 0.47 per cent, respectively as of February 2011 (Karunakaran and Ghosh, 2011).

However, many cement companies have no experience with co-processing of alternative fuels and very few have targeted Municipal Solid Waste (MSW) and the possible production of Refuse-Derived Fuel (RDF). Nevertheless, the substitution of raw materials and clinker with industrial inorganic waste materials like fly ash from coal-fired thermal power plants and blast furnace slag (BFS) from the production of pig iron is widely practiced. Indian cement standards allow up to 35 per cent clinker substitution by fly ash or 70 per cent by BFS.



To conserve fossil fuels, this cement works in Rajasthan is employing waste heat recovery technology

Figure 1: the location of TSDFs is concentrated on the west coast of India

Co-processing opportunities

About 25 cement plants have started co-processing in India and the following main categories of hazardous wastes have been tested and permitted by the CPCB:

- paint sludge from the automobile sector
- petroleum refining sludge
- tar from the production of toluene diisocyanate (TDI-tar)
- effluent treatment plant sludge (ETP).

Plastic wastes and tyre chips, which are classed as non-hazardous wastes, have also been permitted but the TSR is still less than one per cent.

A large untapped potential for fuel substitution seems to be MSW and the possible production of RDF. Due to a lack of reliable inventories, MSW generation can only be estimated and it seems fair to assume a daily per capita average of 0.25kg. With a population of 1.21bn people in 2011, this would translate to approximately 110Mta. MSW management is the responsibility of the Municipal authorities.

Co-processing of heterogeneous wastes requires relatively large investments in competence, equipment and infrastructure. However, if planned early, pre-treatment and co-processing equipment can be phased in during the construction of new plants and therefore, become more affordable. Emissions trading systems can provide additional economic incentives to expand the use of secondary fuels or biomass as substitutes for fossil fuels. The impact of switching from a fossil fuel to a secondary fuel on

Indian coal, with its high ash content, makes specific demands on cement plant operators to keep energy consumption as efficient as possible

energy efficiency of the process itself can be negative but is often compensated by energy savings in other parts of the economy.

After the EU27, India is currently the fourth-largest emitter of CO_2 with six per cent of the world's emissions, or approximately 2bnt (Olivier et al, 2012). The cement, steel and power industries are collectively consuming more than 500Mta of coal. Assuming an average heat content of 26MJ/kg or 6211kcal/kg (due to high ash content) and an emission factor of 2.42t CO_2/t of coal, this would imply an emission of more than 1.2bnt of CO_2 from fossil fuel consumption in these three sectors alone. CO_2 emissions from the use of electricity and calcination of limestone are not included (Karstensen, 2011).

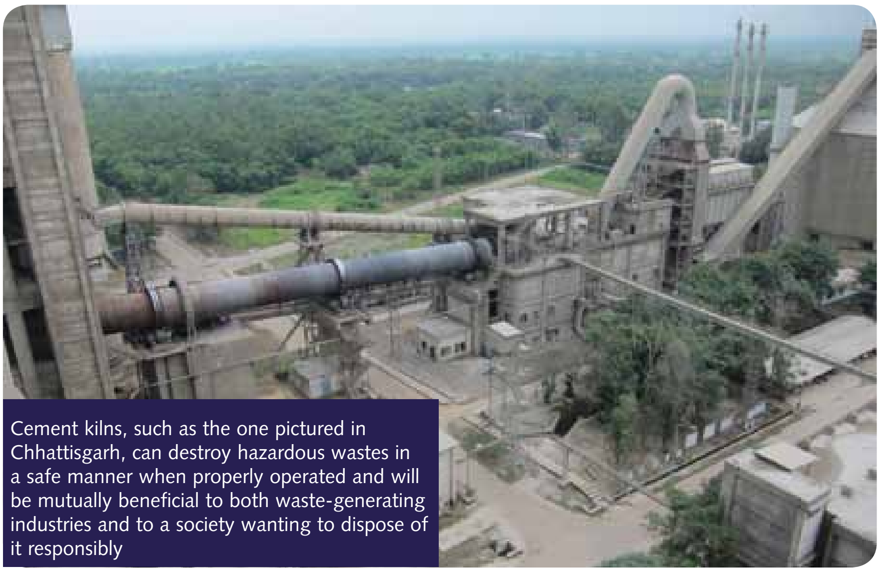
Widespread co-processing and high substitution rates ideally require:

- the availability of sufficient waste materials with adequate quality within a reasonable distance of the plant
- a robust regulatory framework and flexible permitting conditions enabling changes in the waste types without costly requalification procedures
- a level playing field with other waste treatment companies
- technical and environmental know-how
- a 'polluter-pays' principle-stimulating waste treatment
- a (future) price on carbon.

Cement kilns can destroy organic hazardous wastes in a safe manner when properly operated and will be beneficial to industries that generate such waste and a society that wants to dispose of such wastes in a safe and environmentally-acceptable manner. The added benefit of non-renewable fossil energy conservation is important, since large quantities of valuable natural fuel can be saved in the manufacture of cement.

Co-processing of industrial and hazardous wastes presents challenges for plant operators and regulators. Operators need to understand and control all the impacts that co-processing will have on the production process, final product, environment, and health and safety of workers. Regulators need to understand these issues to fulfill their roles in controlling impacts on the environment as well as on health and safety. Both operators and regulators should understand the concerns of the public over the possible negative effects of co-processing, and they should establish efficient lines of communication to explain their activities and avoid conflicts.

In 2011, CPCB entered into a four-year institutional cooperation with SINTEF which aims to assist in the implementation of safe co-processing practices in resource- and energy-intensive industries in India. The objective of this Norwegian-funded project was to build capacity, carry out training and transfer knowledge, as well as provide input to the development of a robust regulatory system reflecting international best practice. We take a closer look at regulatory requirements and co-processing experiences to date in part two of this article: "India: developing co-processing" on page 95.



Cement kilns, such as the one pictured in Chhattisgarh, can destroy hazardous wastes in a safe manner when properly operated and will be mutually beneficial to both waste-generating industries and to a society wanting to dispose of it responsibly

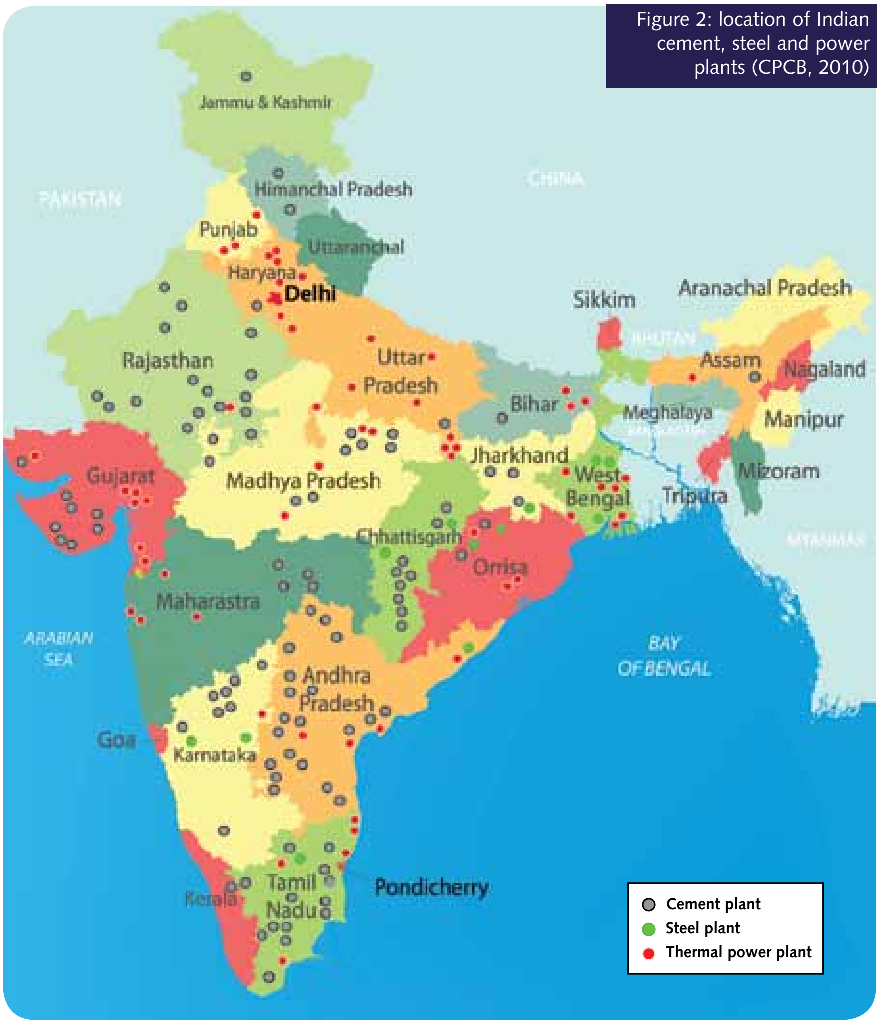


Figure 2: location of Indian cement, steel and power plants (CPCB, 2010)

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