Introducing low carbon technology among small-scale foundry units in India: barriers & opportunities

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Background

In India, small and medium enterprises (SMEs) are an important part of the economy in terms of their contribution to gross domestic production (GDP), industrial production, employment generation and exports. SMEs, or SSIs (small-scale industries), as they are commonly called in India, generate almost 40 per cent of India's manufacturing sector output and 35 per cent of total exports. As per the most recent government Census of SSIs there were about 11 million SSI units in the year 2002-03, 87% of which are unregistered [1].

There are many energy intensive sub-sectors in SMEs. Energy accounts for a major share of the operating cost in these sub-sectors, which means that to remain competitive, it is absolutely essential for them to improve their energy performance. Since 1994, TERI, with the support of SDC (Swiss Agency for Development and Cooperation), has initiated a programme aimed at achieving energy savings, with consequent reduction of carbon-dioxide emissions, in select energy intensive SSI sectors. The programme was developed as part of the response of the Swiss government to support developing countries in implementing UN conventions concerned with global environment.

Four sub-sectors have been selected by TERI-SDC for improving energy efficiency through demonstration and replication of energy efficient technology:

- Foundries (energy efficient cupola)
- Glass units (gas fired pot and muffle furnaces)
- Brick kilns (Vertical Shaft Brick Kilns)
- Biomass gasifier for thermal applications.

This case-study provides a summary of the technology demonstration in the foundry sector, barriers to replicate the demonstrated technology and results of dissemination efforts made by TERI. Large-scale uptake of the new technology by foundry units in India will significantly improve their competitiveness, reduce local pollution and mitigate carbon-dioxide emissions as well.

Energy efficient cupola demonstration

There are about 5,000 foundry units in India, most of which are in the small-scale. Most of the foundry units are spread over 20 disparate geographically clusters in different parts of the country. Some products (castings) manufactured by foundry units are manhole covers, motor bodies, pump parts, automotive parts, electric motor bodies, water pipes and a range of industrial and machinery items.

Most of the small-scale foundry units are family owned and managed. The general level of awareness among them about energy conservation and new technologies is low. Although some of the entrepreneurs are interested in energy efficiency and technological improvements they are constrained by lack of technical know-how and finances. Melting in cupola furnaces is the most energy intensive operation in a foundry unit. Majority of the cupolas being operated by the small-scale foundry units are highly energy-inefficient and hence there is a large potential, in the range of 25 to 65 percent, to save energy through adoption of improved cupola designs. After discussions with foundry industry associations, it was decided that the best way of promoting a new technology or design is through setting-up of a demonstration plant in one or two units in a cluster. Successful demonstration would help in motivating other units in the cluster to undertake similar projects within their units.

Consultations with foundry experts from British Cast Iron Research Institute (BCIRA) revealed that the DBC (divided blast cupola) was a well-proven technology for improving the energy performance of a cupola furnace at a modest investment. Hence under the project, TERI in association with a British expert from BCIRA, designed and installed a full-scale demonstration DBC melting furnace at a foundry unit in Howrah cluster, in the state of West Bengal in east India. An attractive energy saving of 35 per cent in coke consumption was achieved in the demonstrated plant [2]. The economics of operation of a DBC was found to be very attractive and the total investment in a new DBC was recovered between 1 to 2 years from the savings in coke alone. There are other benefits of DBC like reduction in oxidation losses and more consistent metal quality which makes the investment further attractive for a foundry unit.

Barriers to replication of the technology

Though the payback on investment in a new DBC was demonstrated to be very attractive, replications of the technology did not happen immediately as was envisaged. Some of the reasons for slow rate of adoption of the demonstrated technology by other foundry units could be attributed to one or more of the following factors:

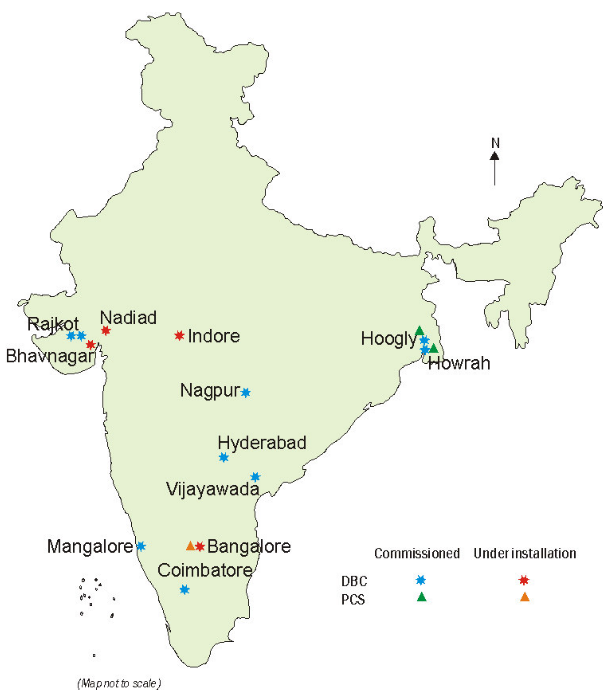
- *Technology barrier:* The DBC concept, adopted for the demonstration unit, is not perceived by the entrepreneurs as a new or novel concept/technology. Several foundry units had in the past constructed a DBC, either on their own or by through local consultants, prior to the demonstration although most of these furnaces are not optimally designed. Hence convincing them of the benefits of the improved version of the DBC is a major barrier.

- *Investment barrier:* Most foundry units have limited capacity to evaluate a new technology and often choose the least upfront investment while choosing a new technology. Design specifications of the demonstrated DBC require higher upfront investment due to stringent material specifications and standard auxiliaries like blowers and bucket charging system. Since SMEs typically want to minimise first-cost, a higher initial cost of the optimally designed DBC is a barrier to adoption of the technology.

Replications of the technology

Encouraged by the success of the demonstration at Howrah and by the early replications at Nagpur, Hoogly, and Rajkot—and assisted by the project's ongoing dissemination efforts—several more foundry units located all over India have adopted the new DBC technology. By the end of 2004, 13 DBCs were in operation. An analysis revealed that these cupolas had cumulatively saved over 4,300 tonnes of coke, which translated into a reduction in carbon dioxide emissions of nearly 11,000 tonnes.

At the end of 2005, a total of 16 DBCs were in operation; eight more DBCs are under installation [see figure]. These figures do not include a large number of 'self-replicated' DBCs —that is, cupolas whose designs are based on the project's designs, but which have been fabricated and installed without any support from the project.



In conclusion

The foundry industry is an important activity in the SME sector in India. The total coke consumption by the foundry units is estimated to be about 600,000 tonnes per year. On a conservative scale, it is possible to save about 25% of the coke by adoption of the energy-efficient technology, which translates into a reduction of 150,000 tonnes of coke or 410,000 tonnes of CO_2.

The present intervention is unique in the way that it brought together a truly multi disciplinary team, wherein the competencies and synergies among the various actors were pooled. The results show that there is a huge potential for coke saving as well as net CO_2 abatement in small scale foundries in India. At the same time, appropriate design of the cupola would help improve the ambient conditions as well as reduce the global emissions. There is a good possibility of this model being replicated not only in other clusters in India, but also in a large number of units being operated in other countries under similar conditions.

References

1. Third All India Census of Small-Scale Industries, 2004
2. Dugar S, et al, 1999. Energy efficiency improvement and pollution reduction in small scale foundry unit in India- results of a full-scale demonstration plant, Proceedings of the 6th Asian Foundry Congress, Calcutta, the Institute of Indian Foundrymen, Calcutta, 347 pp