Economics of Pollution Control Technology and Modernized Production System: A case Study on Foundry Industry in Howrah, West Bengal, India

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1. Introduction

In the present economic system the goal of sustainable development process is to maintain the inter-generational equity by ensuring quality of life for our future generation which essentially requires the stopping of further damage of the environmental quality. From this point of view the necessity of an integrated system consisting of modern production and controlling technologies is being gradually recognised. Various regulatory measures are being implemented by the regulatory authorities, mainly in the industrial sector, which is the major contributor of pollution, for adopting such technologies.

But the basic problem of environmental regulations involves the government trying to induce a polluter to take socially desirable action for pollution prevention, which may not be in the best interest of the polluter since environmental protection costs money. The type of production, input used, technology employed, space used as well as plant size and the scale of production determine the nature and extent of pollution which, in turn, influence the abatement cost. Hence, the profit maximizing private investor's decision making for implementation of pollution abatement measure is influenced by the benefit obtained as a result of additional investment on it. On the other hand, social planners/policy makers' aim is to provide better environment to the society to increase the social welfare. Hence, the adoption of modern

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production and pollution control technologies is an action which should be acceptable to the polluter, unless forced and to the sufferers.

Being declared as a "red category industry" for discharging hazardous substance in the environment regulatory measures were implemented for compulsory use of controlling device for pollution control in the iron foundry industry all over India. But the resulting effect was the closure of units, mainly small and medium sized, which contribute a major share of the foundry products. The relatively high investment at the initial stage was one of the many reasons for this. However, one significant point to be noted in this context is the lack of awareness among the foundry owners about the benefits that may be achieved by installing the control device. It helps not only to improve the quality but also to increase the quantity of output. It also helps to reduce the requirement of coke consumption, thereby, improving the environment and in the process indirectly labour productivity as well, since it is recognized that the slow and long-term adverse impact of SPM on human health causes a reduction in productivity. As the developed countries are gradually becoming importer of foundry product, rather than the producer of it, the demand for such product of the developing countries would be on the increase in the world market provided the quality and the cost effectiveness of the product are maintained. This essentially requires the installation of modern production and pollution control technologies.

But when the production decision of the owners involves cost due to adoption of controlling device and modernisation of production technology, a comparative analysis of cost and benefit arising out of such additional investment has to be made. The calculation should include financial as well as social and environmental costs and benefits.

The present study attempts a comparative analysis of costs and benefits in the context of the additional investment made or to be made on the air pollution control technology and modern production technology that may provide the owners the proper guidance in decision making.

2. Data and methodology

The study is based primarily on a sample survey that was conducted among the foundry units located in Howrah district in West Bengal, India. In the absence of well-maintained records in the units primary level information were collected by interviewing several individuals related to the job. The survey included 77 units of the different sizes having one or the other types of controlling device installed. The differences in the production technology was also considered. In addition to the collection of the primary data, different secondary sources were also used to supplement the information supplied by the units. The comparative analysis has been made here on the basis of the opportunity costs.

3. Comparative analysis

The analysis of the data show that about 90 per cent of the total sample units (77) are using the simple type of pollution controlling technologies like the dry multiple cyclone system, wet scrubber system or a combination of the two. More sophisticated and efficient controlling

Table 1 : Maximum and minimum values of the efficiency indicators of the pollution control and production technologies

Sl. No.	Type of Pollution Control Technology	Type of Production Technology*	Efficiency indicators			
			Melted output / iron ratio		Metal / Coke Ratio	
			Maximum	Minimum	Maximum	Minimum
1.	Dry System with single cyclone (N=2)	SB DB	0.70 -	0.42 -	4.1 -	4.0 -
2.	Dry System with multiple cyclones (N=18)	SB DB	0.80 0.90	0.80 0.54	3.1 9.4	3.1 2.5
3.	Wet Scrubber System (N=37)	SB DB	0.94 0.91	0.53 0.38	5.9 8.1	2.8 2.9
4.	Ventury Scrubber (N=1)	SB DB	- 0.84	- 0.84	- 8.0	- 8.0
5.	Bag House (N=1)	SB DB	- -	- -	- 10.0	- 10.0
6.	Packed bed Scrubber (N=1)	SB DB	0.81 -	0.81 -	5.1 -	5.1 -
7.	Combined dry and wet System (N=15)	SB DB	0.91 0.96	0.62 0.42	7.71 6.0	2.8 3.9
8.	Wet Scrubber with box (N=2)	SB DB	0.88 -	0.88 -	3.5 -	3.5 -

- SB = Single blast, DB = divided blast

Source : Sample survey

technologies are available now but the use of these is restricted only to a few big units (producing more than 25 MT per melting day) because of the high cost involved. About 50 per cent of the units are still using the traditional cupola, though an improved production technology (divided blast Cupola) design is available in the market,.

The results depicted in Table 1 in respect of two important indicators of the level of efficiency, viz.; melted output/iron ratio indicating the increase in productivity level and metal/coke ratio showing the extent of reduction of coke consumption for the different production technologies and controlling technologies, show that compared to the pre-modernization period (where melted output/iron ratio was about 0.70 and metal/coke ratio was 2.5:1 for small sized cupola and 4.5:1 for big sized cupola) significant achievements have been made with respect to both except in a few cases[†].

Table 2 : Percentage distribution of foundry units by the level of SPM discharged at the end of pipe

SPM level at the end of pipe (mg/nm^3)	Melting rate per hour (ton)	Percentage of units by type of controlling technology							
		I	II	III	IV	V	VI	VII	VIII
≤150	<3	0.0	5.5	13.5	0.0	0.0	0.0	6.7	0.0
	≥3	50.0	22.2	10.8	100.0	0.0	100.0	20.0	0.0
	Subtotal	50.0	27.7	24.3	100.0	0.0	100.0	26.7	0.0
>150	<3	0.0	55.7	40.6	0.0	0.0	0.0	33.3	0.0
	≥3	0.0	16.6	27.0	0.0	100.0	0.0	6.7	50.0
	Subtotal	0.0	72.3	67.6	0.0	100.0	0.0	40.0	50.0
	Non-response	0.0	0.0	8.1	0.0	0.0	0.0	33.3	50.0
	Total	100	100	100	100	100	100	100	100

With respect to the level of SPM, the present norm has been decided at the level of $<=150 mg/nm^3$ for all foundry units as against the level of ≤ 450 mg/nm^3 for the units where the melting rate is < 3 ton/hour and ≤ 150 mg/nm^3 for the rest. It is found from the result presented in Table 2 that according to the present norm none of the widely used controlling

[†] As information regarding production and consumption of materials have been taken for a single day, failure to achieve pre-modernization level in a few cases might be due to some operational fault on that particular day.

technologies (types 2,3 and 7), which are less costly, could be considered independently as efficient ones. It is viewed that it is difficult to maintain the SPM level at ≤ 150 mg/nm^3 independently either by dry system or wet system. A technology combining appropriately these two systems may tackle these problems; but it then would be relatively costly. Moreover the expected level of differences between controlling devices and production technologies could not be found, which presumably reflects perhaps the lack of awareness among the owners about the technologies suitable for their respective units and their inefficiency in operating the system. Inability in reducing the SPM level according to the prescribed norm seems to be due to the inefficiency in operating the system. This might lead the owners to take a negative attitude towards modernization. It may be necessary for the owners to go deeper into this problem of failure to comply with the requirement and adapt ways of improving it.

At the same time, it should be stated that some improvements in the technologies are required for the achievement of the prescribed norms. Besides, the awareness about the merits and demerits and the level of technical efficiency of these available technologies may help the owners to adopt one which would be appropriate for the given size for operating the units profitably after incurring this additional investment.

Based on the knowledge about the technologies and the required investment on this the owners may take their decisions regarding the level of production through a comparative analysis of costs and benefits[†]. Table 3 depicts the minimum level of output a unit has to produce to recover the additional cost it has to incur and associated results regarding the per unit annualized cost and benefit at the varying levels of investment.

The results depicted in Table 3 indicate that the minimum level of output to be produced to recover the involved cost depends on the cost of investment a unit incurs. For instance, a big unit, operating 50 days/year, may recover its additional investment of Rs. 8 lakh for complete modification by producing 10 ton per melting days if the life of the machines is assumed to be 10 years (with necessary replacement of parts, if and when required); for small units it may be 9

[†] As the detailed information on cost of production, investment etc. were not available for the whole system, per unit cost and benefit have been calculated for the additional investment

ton per melting day because of its lower cost of investment. But the big sized firms may enjoy the benefit more by producing more output relative to the small units.

Table 3 : Required minimum level of production for operating the units at various levels of investment on pollution control technology and modification of production technology

Total capital investment[1] (Rs. Lakh)	Melting rate of Cupola (ton/year)		Production of output[2] per melting day (ton)	Additional cost per ton of output[3] (Rs.)	Additional benefit per ton of output[4] (Rs.)
	Traditional	Improved			
8.0	5.0	7.0	10	590.0	655.4
9.0			10	656.0	655.4
10.0			11	657.0	670.6
15.0			15	704.0	718.4
6.5	2.5	4.5	9	545.7	723.2
8.0			9	655.7	723.2
9.0			10	658.0	736.7
10.0			10	724.0	736.7

Notes : Following assumptions have been made for the estimation

(i) Rate of annualized cost of capital, at 10 per cent rate of interest and 10 years life, is 16 per cent of the present capital investment;
(ii) Depreciation rate (including replacement cost) is 17 per cent per annum;
(iii) Annual maintenance cost is Rs. 0.25 lakh.

1. Cost of modification of Cupola is Rs. 1.00 lakh.
2. Total melting days per year is 50.
3. The H.P of motor for operating device is 25 and 20 respectively for big and small sized firms.
4. (i) increase in melted output / iron ratio = 0.70 to 0.75;
   (ii) increase in metal / coke ratio = 4 to 6;
   (iii) decrease in HP of motor for blows = 50 to 40 for big sized firms
   = 40 to 25 for small sized firms
   (iv) prices of iron, coke and electricity are Rs. 7500/- per ton of iron, Rs. 2700/- per ton of coke and Rs. 3/- per kwh. respectively.

In the context of social cost or benefit of the modernization program it would be observed that by running the small sized cupola producing 450 of melted metal per year, society could earn at least Rs. 1000/- per day only for his labour payment which would be lost if the firm is closed for not adopting the controlling device[‡]. The environmental cost, on the other hand, may be due to the long-term effect of SPM on human health causing the diseases like Cardio-vascular respiratory problems. The resulting effect of these would be the loss of wage earning due to suffering from these diseases or premature death.

4. Concluding remarks

One of the major reasons for running the foundry industry passing through a phase of stagnation with respect to production of output is the use of old and obsolate production technology along with the inappropriate controlling device. To avail themselves of the opportunity of meeting the growing international demand for foundry product each unit has to adopt modernization policies along with the appropriate controlling device meeting the quality, quantity and the cost effectiveness criteria of the products. The decision of production then, of course, could be taken by comparing the costs and benefits obtained from the additional investment. While taking this decision the private owners should take care of the social and environmental costs related to this decision, which is essential to achieve sustainable growth process for the future generation.

On the other hand, for the sake of social welfare the social planners / policy makers should take initiative to enable the firms to adopt modernization programme, along with the regulatory measures, by providing funds to them as loan, particularly to small units because of the high initial investment cost. Otherwise, the imposition of the regulatory measure alone may push the producers to adopt illegal operation. Financial incentives may also be offered to encourage them to adopt these technologies for reducing the SPM level more efficiently. A uniform method of measuring the pollution level along with regular monitoring system provided by the regulatory authority is also necessary to make the effort successful.

[‡] Minimum of 25 workers of various categories are engaged in the production per day in a small sized firm. The payment is made according to the category of workers and volume of production. It is observed that, on an average, a minimum of Rs. 40/- is paid per labour per day in a small factory. Hence total labour payment would be (40 x 25 a minimum of Rs. 40/- is paid per labour per day in a small factory. Hence total labour payment would be (40 x 25 =) Rs. 1000/- per day in a single unit.

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