Air Quality Management Strategy for Kolkata City under India Canada Environment Facility Project – A Case Study.

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Abstract

Air pollution, presently a common concern for all the major cities of the world, is increasingly contributing severe impacts on human health including significant effect on ecosystems. The sources of air pollution are stationary (industrial operations), mobile (transportation) and area (windblown dust & miscellaneous burning). The West Bengal Pollution Control Board (WBPCB) has established the monitoring network for ambient air quality that measures the principal pollutants i.e. Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x) and Lead (Pb). The city Kolkata basically experiences unhealthy air because of high SPM & RPM. While establishing the main concerns and sources, WBPCB as one of the strategies for air quality improvement had initiated its efforts to control SPM & RPM by implementing more stringent emission standards for stationary sources followed by cleaner technology programme. The air quality management strategy was taken based on scientific considerations. As a first step, coal fired boilers (up to 2 t / hr. steam generation capacity) were phased out within Kolkata Metropolitan Area (KMA) followed by installation of oil / gas fired boilers. The concept of the joint venture project of WBPCB and India Canada Environment Facility (ICEF) was to provide financial assistance to the industries for adopting the cleaner fuel technology (50% of the total cost involvement for technology transfer) and the stakeholders were taken into confidence during project formulation. The main target of the project was compliance of the new stricter emission standards and that has been established significantly under this project. Cost effectiveness of the air quality management has been done and benefits like increase in the efficiency of the combustion system, insignificant increase in the production cost, manufacturing of better quality products, better work-zone area & air quality and collectively improved air quality in Kolkata have been achieved.

Introduction

Air pollution is one of the most serious environmental concerns in developing countries around the world where India is no exception. The alarming levels of air pollution already established the adverse effects on human health and ecosystems depending upon the location and dispersion of pollution. The sources of air pollution depend upon the variety of activities including large stationary sources, medium and small-scale industries, vehicles for transportation, construction activities, waste & miscellaneous burnings and road dust. The complex operations of different industries with old technologies and ineffective control equipment with exponentially increasing number of automobiles are all responsible for high emission of air pollutants.

Health Effects Study of Urban Air Pollution in Kolkata

Kolkata is one of the most prominent metropolis in Asia. The Kolkata Metropolitan Area (KMA) is a large urban-industrial corridor covering area of 1,350 sq. km (38 municipalities and 3 municipal corporations) with a population of 13.22 million. The Kolkata Municipal Corporation (KMC) acts as a hub of the metropolis (141 wards) and covers area of 187.33 sq. km with a population 4.58 million. Industrial development in KMA has been influenced by the growth of different industries like fertilizer, paper and pulp, different organic and inorganic chemical industries, pharmaceutical units, brewery, distilleries, jute, plastic, textiles units. Apart from thermal power plants, there are cluster of industries like iron foundries, rolling mills, galvanizing units, secondary lead smelters, tanneries, rubber product manufacturing units, plywood, paperboard, acid manufacturing units, gold and silver smithy and ceramic units within KMA.

Kolkata had been placed among the most polluted cities of the world with respect to SPM levels according to Global Pollution and Health, a report published by WHO and UNEP. A health impact study w.r.t. air pollution was conducted during November 1996 to July 2001 to assess the degree of lung function impairment in persons chronically exposed to Kolkata's air. The study-population was comprised of persons from various occupations namely automobile service station workers, traffic policemen, drivers, firefighters, hawkers and roadside workers, factory workers, asphalt workers, canteen workers, office employees, house wives/maids and students. The study suggests that the lungs of average city resident of Kolkata is about 7 times more burdened compared to the rural counterparts due to air pollution. This has served as an emergency call since almost 47% of Kolkata population suffers from lower respiratory tract symptoms.

Developing a Strategy for Mitigating Air Pollution

The key steps in developing a pollution abatement strategy is to identify the main environmental concerns and build a mechanism for implementation. To identify the main environmental concern, at first the air quality is to be monitored systematically for a considerable period of time that will identify which pollutants are exceeding environmental standards. At the same time human exposure to air pollution is an important aspect that has been recognized for centuries. Toxicity of air pollution depends upon the route of entry, the level of pollutant, the susceptibility of an individual and the threshold level of the pollutant. Considering all the above aspects overall strategy is to be selected where cost-effectiveness will be the important factor and the action plan to be implemented w.r.t. the policy.

The West Bengal Pollution Control Board (WBPCB) has established the monitoring network for ambient air quality that measures the principal pollutants i.e. Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x) and Lead (Pb). The city Kolkata basically experiences unhealthy air because of high SPM & RPM. A study confirms that 50% of the total SPM comes from transport sector and 48% from industries.

Kolkata, The City of Joy has several historical landmarks. It is a mega city with high population density, several business activities as well as number of large and small-scale industries of different categories. Air quality of the city specially suspended particulate matter (SPM) and respirable particulate matter (RPM) in ambient air has already been a matter of great concern for the last few years. WBPCB has already inventorised different sources of air pollution. A detailed health care study has been carried out in Kolkata in collaboration with Academic and Research Institute, where it has been highlighted that exposure to high particulate matter concentrations in ambient air are linked to a number of health effects of concern. Although several steps have been taken under Air (Prevention and Control of Pollution) Act, 1981 to clean up air quality in general, WBPCB has conducted some special studies for different cluster of industries situated in Kolkata Metropolitan Authority (KMA) area.

The cluster of industries has been identified as one of the major sources of particulate matter to the ambient air from the emission of its coal fired boiler. Basically emissions from coal-fired boilers are much more compared to cleaner fuel (oil or gas) fired boilers. The main source of pollution from the small-scale industries is the particulate matter from the combustion of coal. Efficient fuel combustion depends on firing practices, efficiency of air supply and draft control, size and shape of the boiler, type of operation to use steam from boiler and exhaust gas temperature. Though the optimisation of fuel combustion reduces pollution load but complying with the National Emission Standards for PM 1200 mg/Nm^3 for such boilers is not possible without installation of adequate pollution control device.

Survey of Industries using Boilers

List of the industries using boilers was made from the information available with West Bengal Pollution Control Board within Kolkata Metropolitan Area. Inspection was carried out at all the small-scale industries to collect basic information (exact location of the unit, production processes and products, number of boilers with operational hours, firing cycle in hours, type and quantity of fuel used, pollution control measures adopted etc.).

Findings of Preliminary Survey

- The industries are mainly rubber unit, dyeing & bleaching unit, plywood industries, pharmaceutical units, paper-board manufacturing units, chemical industries and mostly are located within KMC.
- The boilers are being used to produce steam for the operation of press, vulcaniser, heating chamber, drier etc.

Targeted Particulate Matter Emissions Abatement Measures

There is considerable amount of emissions from the stack throughout the firing cycle, particularly during coal charging and coal churning in the firing gates of the boilers. Stack monitoring was conducted for number of boilers for industries of different types

and the emission was in the range more than National Standard of 1200 mg/Nm^3. The main factor of the proper combustion is type of fuel, CO_2 % and stack temperature of the flue gas. It was found that in general CO_2 % is low and the efficiency of these boilers is around 40 % - 50 %.

West Bengal Pollution Control Board has focused its efforts towards reducing particulate matter concentration in ambient air within KMA by implementing more stringent Emission Standards for PM of 150 mg/Nm^3 in comparison to 1200 mg/Nm^3 National Standards for boilers including usage of cleaner fuel like oil or gas in place of coal.

The Abatement Measures under ICEF Project

West Bengal Pollution Control Board (WBPCB) had launched the India Canada Environmental Facility (ICEF) Project on "Pollution Prevention and Waste Minimisation for Small Scale Units in Kolkata Metropolitan Area" on World Environment Day 2002. The main focus of the project is to improve the air quality of Kolkata and its urban agglomeration for a total project cost of Rs. 164.9 million.

The conversion of coal-fired boilers to oil fired was a time bound action plan under India Canada Environment Facility (ICEF) project where the industries, WBPCB and ICEF are the partners. Implementation of stricter emission standard and change of fuel has been introduced as a regulatory action where stakeholders were taken into confidence while preparing the project. This project is a reimbursement project where industries are being provided 50% (25% each from the ICEF and WBPCB) of the total cost involvement for the conversion from coal-fired boilers to oil or gas fired boilers).

At present all units have dismantled the coal-fired boiler within KMA and more than 70% of industries completed the change conversion. Financial assistance has already been provided to almost 100 industries under ICEF project. Majority of the industries have been installed and commissioned new oil fired boilers or thermic fluid heater where some industries have opted for retrofitting the old one.

Conversion of Coal-fired Boiler to Oil-fired Boiler under ICEF Project

Successful implementation of this project achieved the following benefits :

- Improving combustion efficiency
- Better work-place area
- Better work-zone air quality
- Improved air quality in Kolkata

Cost-Effectiveness of the Air Quality Management

In the oil-fired boiler or thermic fluid heater, the efficiency of the combustion efficiency is around 80% – 90% with an auto cut burner. The approximate cost for the installation and commissioning of oil-fired boiler is Rs. 0.3 million (100 kg/hr steam generation capacity) to Rs. 1.8 million (2 ton/hr steam generation capacity).

Comparison of conversion from coal-fired kiln to oil-fired boiler

Description / Parameter	Asok Rubber Industries		Waa Rubber Industries	
Stack connected to Boiler	Coal-fired	Oil-fired	Coal-fired	Oil-fired
Boiler (steam generation capacity)	2000 kg/hr	2000 kg/hr	1000 kg/hr	1000 kg/hr
Fuel used	Coal	LDO	Coal	LDO
Operational hours / day	8	8	8	8
Fuel Consumption / day	1200 kg	180 lit	2500 kg	350 lit
Fuel cost / day	Rs. 3,600	Rs. 4,500	Rs. 7,500	Rs. 8,750
Increase in fuel cost / day	Rs. 900		Rs. 1250	
Cost of fuel w.r.t. total cost of production	5 %		5 %	
Increase in fuel cost / day w.r.t. production	1.25 %		Rs. 0.83 %	
PM emission, mg / Nm^3	~ 1200	37	~ 1200	59
Reduction in PM laod / batch	> 90%		> 90%	

Conclusion

The conversion project has achieved more than 90% reduction in total particulate matter load emitted from all the boilers either converted into oil fired boiler or thermic fluid heater compare to coal-fired boilers. There is an increase in the fuel cost but that is marginal compared to the total cost for production. The other highlight performance of the project is that though the cost for fuel has increased, the steam / heat generation is steady with better quality of finished products and less rejection of materials. The project was framed since most of the small-scale industries using boiler or thermic fluid heater are within KMC and this conversion project has marked a visible change in emission pattern. Considering the cost involvement to use cleaner fuel with productivity, loan from financial institutions may be an alternative if financial assistance is not feasible to implement better air quality management program.

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