

Environmental and waste management in iron and steel industry

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ABSTRACT

The Indian Iron and Steel scenario has changed considerably after the announcement of Government Policy on de-control and liberalization. Several new entrepreneurs have entered the steel industry. It is heartening to see that the steel industry is set to carve a niche for itself in the domestic and foreign market. The rapid progress of steel industry has aggravated environmental and waste management problems. This has led to increasing pressure from Government and the public to speed up action plan for effective industrial waste management. The waste management in steel industry is an emerging complex issue and can be implemented after regulating through monitoring, analysis, legalization, addition of infra-structural facilities for enforcement, waste auditing, change of process technology etc. The paper reviews current knowledge of waste management in Indian Steel Industry, approaches to environmental improvement and examines various options to environmental management plan keeping in view of the importance of sustainable endurance of environment and other natural resources.

INTRODUCTION

The Indian steel industry has shown a phenomenon growth in the last few decades. Steel is one of the most basic materials required for industrialisation and plays a vital role in the country's economic development. India is lucky since it is endowed with natural resources required for a healthy and vigorous iron and steel industry. India is at present producing nearly 17 million tonnes of saleable finished steel per annum. It is heartening to see that India is exporting steel products to the tune of nearly one lakh tonnes. With the liberalisation of import tariff on finished steel items the Indian steel manufacturers are able to cut down the cost of production and is competing in the world market. Private industrialists are ready to invest in new steel projects.

India is expected to increase its production capacity to about 37 million tonnes of crude steel by 2001, but the estimate does not take into account the changes in economy and growth rate^[1]. As also with the devaluating of rupee and increased

duty on scrap there is going to be a great demand for pig iron to the extent of four million tonnes. Performance of our existing seven integrated steel plants is encouraging and has improved considerably. With the announcement of new industrial policy by the Government the Indian steel manufacturers have to face the challenges of global competitiveness on opening up of industries to the foreign investments and technical collaboration. Any how our steel industry is definitely will forge ahead. While these concerns are important and will undoubtedly play a significant role to boosting the technical nature of industry, they will become pale in comparison to what is likely to be most the serious issue viz. environmental pollution.

Development of steel industry has brought with it environmental degradation. Environmental conservation has become an increasingly more important aspect of our daily lives. With the rapid and extensive industrialisation and urbanisation in many parts of India, there is a dawning realisation that ultimate prerequisite for man's survival could well be the preservation of environment. We live under horns of dilemma. However, our expectations and our perceptions of what constitutes a minimum standard of living have put increasing pressure on both the public and private industrialists to ensure clean and healthy environment.

Environmental pollution in steel industry

Iron and steel industry which comprises, mining of ores, preparation of raw materials, agglomeration of fines in sinter plant, feeding of burden to blast furnace, manufacturing of coke in coke ovens, conversion of pig iron to steel, making and shaping of steel goods, granulation of slag for its use in cement plant, recovery of chemicals from Benzol and tar products etc. etc. All the above mentioned operations add to air, water, land and noise pollution. The environmental impact due to steel production is shown in Table-1. Flow chart linking pollutants and principal operations in integrated steel plants is shown in Figure-1^[2].

Environmental management

Environmental waste management means "Management" as the Act, manner or practice of managing, handling or controlling something. Waste management is a problem susceptible to the application of classical engineering analysis and solution. Hence by extension of the most fundamental planning and management techniques, the problem can be solved in a manner which will protect man and improve his environment. All waste materials are economic assets. It is only when they are accidentally or intentionally dispersed at lower concentrations into a benign or otherwise beneficial matrix such as air, soil or water that the essential management element or control is lost and human may become exposed to their short or long term hazards.

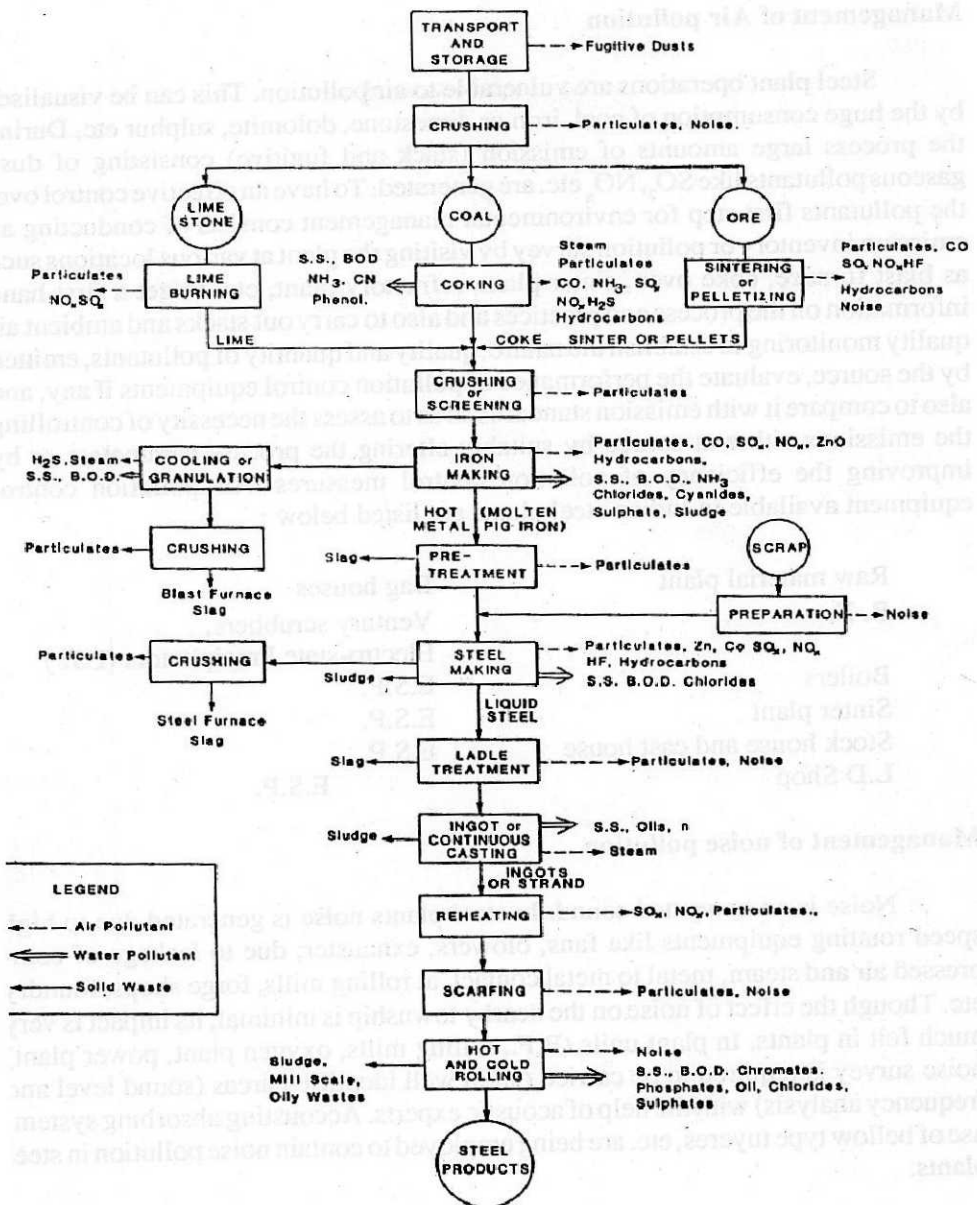


Fig.1 : Flow chart linking pollutants and principal operations in an integrated Steel plant

Management of Air pollution

Steel plant operations are vulnerable to air pollution. This can be visualised by the huge consumption of coal, iron ore, limestone, dolomite, sulphur etc. During the process large amounts of emission (stack and fugitive) consisting of dust, gaseous pollutants like SO₂, NO_x etc. are generated. To have an effective control over the pollutants first step for environmental management consists of conducting an emission inventory or pollution survey by visiting the plant at various locations such as blast furnace, coke oven, sinter plant, refractory plant, etc. to get a first hand information on the process and practices and also to carry out stacks and ambient air quality monitoring to establish the nature, quality and quantity of pollutants, emitted by the source, evaluate the performance of pollution control equipments if any, and also to compare it with emission standards so as to assess the necessity of controlling the emissions either at source by suitably altering the process parameters or by improving the efficiency of pollution control measures. Air pollution control equipment available in Indian steel plants are listed below :

Raw material plant	-	Bag houses
B. F.	-	Ventury scrubbers, Electro-state Precipitators (ESP)
Boilers	-	E.S.P.
Sinter plant	-	E.S.P.
Stock house and cast house	-	E.S.P.
L.D Shop	-	E.S.P.

Management of noise pollution

Noise is an unwanted sound. In steel plants noise is generated due to high speed rotating equipments like fans, blowers, exhausters; due to leakage of compressed air and steam, metal to metal contact, at rolling mills, forge shops, foundry etc. Though the effect of noise on the nearby township is minimal, its impact is very much felt in plants. In plant units (B.F., rolling mills, oxygen plant, power plant) noise survey is required to be carried out in well identified areas (sound level and frequency analysis) with the help of acoustic experts. Acousticing absorbing system, use of bellow type tuyeres, etc. are being employed to contain noise pollution in steel plants.

Waste water management

Steel plant consumes huge quantities of water as high as 150-200 tonnes/ton of steel produced. Water pollution survey has to be conducted to determine the source,

quality and quantity of pollutions viz. suspended solids, cynides, phenols, oils, greases, fluoride, ammonia, BOD, COD etc.

Waste water treatment options consists of cooling the stream, separation and disposal of oil and suspended solids, biological oxidation of soluble organics, neutralisation with acids and crystallisation and removal of inorganic soluble salts.

In steel plants in certain sections waste water is segregated and treated separately. Collective treatment by settling or coagulation is also practised. Recycling and reuse of water is adopted in various units. The cooling water is in continuous circulation through cooling and recirculating pond. If the waste water contains high pollutants the same is subjected to biological treatment, in trickling filters, by activated sludge treatment, etc.

Solid Waste Management

Solid waste such as power plant fly ash, acid sludge from by product plant, tar sludge, coke breeze, granulated B.F. slag, steel slag, calcined lime and dolomite dusts, steel scrap, etc., are generated in huge quantities causing environmental degradation. Like industrial waste waters, in this case also a preliminary survey is to be conducted to assess the source, quality, quantity, physical and chemical characteristics, pollution load, toxicity etc. before planning for dumping, selling or treatment.

Environmental management by environmental impact assessment(EIA)

EIA is a management tool comprising a systematic, documented periodic and objective evaluation of how well a steel plant will affect environment during planning phase before expansion/new operation. The EIA study is based on data collected by a team of environmental experts on the plant layout, human settlement, basic facilities provided, other industries around steel plant, analysis and monitoring with respect to air/pollution, water pollution, noise pollution, solid waste, impact on vegetation, human health etc. Based on the findings of EIA report an environmental management plan (EMP) can be prepared and implemented.

Environmental management by environmental audit (EA)

Recently EA has been introduced for the first time by Ministry of Environment and Forests for continuation of NOC's for industries. The subject is still evolving and its importance and modalities are yet to be understood by many organizations. EA is a management tool that is valuable only if it is a part of overall management system. It is a self assessed management system and will cover all relevant information pertaining to steel production units/departments such as management of waste mate-

rials, air, water, noise pollution levels, safety measures, etc.

Basic functions of EA include : (i) Auditing of environmental management philosophy of steel plant, (ii) Technical audit of plant, equipment, facilities and operating practices for compliance. EA is a management tool to verify the adequacy of EMP prepared based on EIA^[3].

EA for pollution prevention/waste minimisation (PP/WM)

A systematic audit of waste generating and handling of steel plant organisation can help to ensure that all opportunities for PP/WM are identified and evaluated. The six important steps in waste minimisation audit consists of preparation of ground, selection of audit team, finding the facts, identify options, evaluate options and finally implementation. The final report will cover input analysis, analysis of waste generated, waste management recommendations, compliance of pollution levels with standards, impact analysis and economic analysis.

Pollution prevention (PP) means not producing wastes and emission streams. PP not only offers an approach to reducing the risks associated with the most of environmental problems, it also makes good sense. PP programme includes option like source reduction, recycle or treatment to prevent pollution.

To sum up, WM/PP audit programme will not only reduce production cost, raw material cost, energy cost but also improve income through the sale of reusable waste and safety of employees. Reduction on the impact of industrial activity on the environment also makes commercial sense.

WM/PP Developments in steel industry

M/s Tata Steel, Jamshedpur has already implemented/likely to implement WM/PP programme activities which include :

1. Putting up a 10 MW power plant based on fluid bed combustion technology at Jamadoba coal washery using coal rejects.
2. Putting up of slag based cement plant (2.4 MT per year capacity) using granulated B.F. slag.
3. Manufacturing of fly ash bricks/light weight aggregate
4. Marketing of LD slag as soil conditioner

S.S.Datta et al has suggested micropelletisation of waste fines generated in steel industry as one of the method of WM/PP programme^{4,51}.

It is reported that at Vizag Steel Plant WM/PP is being adopted by smokeless charging techniques for raw coal fed to coke ovens. Dry quenching of coke in preference to wet quenching, mechanical, biological and chemical treatment of toxic effluents, re-circulating systems etc.⁶¹.

Other integrated steel plants are also implementing WM/PP programme with the help of R&D Centre for Iron & Steel, SAIL, Ranchi. All over the world a number of processes for iron making by smelting reduction process viz. HI SMELT, HSL, NKK, FLPR (Romelt), COREX, DIOS etc. are being developed with a view to utilize non-coking coals and create less pollution hazard. It is reported that COREX and DIOS units are flexible and almost pollution free⁷¹.

It is reported that COREX plant of different capacities has been set up in South Africa and South Korea using lump/pellet iron ores. Similarly DIOS plant has been set up in Japan using iron ore fines. A COREX plant using non-coking coals is being set up in India also⁸¹.

RDCIS, SAIL, has accessed some of the above processes by well developed modeling techniques for its suitability under Indian conditions. However, we have to wait and watch the real benefits due to newly developed smelting and reduction processes before applying it in Indian conditions.

RECOMMENDATION

Any industrial growth breeds pollutants and steel industry is no exception. Environmental management programmes must be put on a technically, rational and scientific basis rather than on emotional one so as to achieve the maximum benefit to society.

Indian steel plants should recognise that if they are to remain competitive they must take a fresh look at ways to minimise waste/prevent pollution arising from their production processes and supporting activities. A sustained WM/PP programme in steel plants could pay substantial dividends.

Integral steel units should also motivate employees to come forward with new ideas and achieve WM/PP target not only to reduce the impact of industrial activity on the environment but also to improve the Company's image and its relationship with the community.

Table-1: Typical emission from an integrated steel plant

	Waters	Stack emission	Fugitive of Secondary	Solids
Transport	Suspended solids, run-off water		Dusts: iron oxide, coal limestone,	Spillage, muds
Blending & bedding	Suspended solids run-off water		Iron oxides, coals, recycled dust	Dusts from bag-houses, cyclones etc.
Sinter & pellet plants	Scrubber waters suspended solids lime, acids	SO _x , NO _x , F, Co, particulates	Dusts from sinter plant coolers, transfer points Noise	Baghouse (etc.) dusts with alkalis filler cake
Coke ovens	Phenols, cyanides, tars, ammonia, thiocyanate, sulphides, chlorides	Smoke, SO _x , NO _x , steam gas flare	Coal or coke dusts, sulphurous or carcinogenic emissions, smoke, benzene, Bap, steam	Carbonaceous solids from bag-houses, pitch, tar refractories
Blast furnaces	Suspended solids, phenols, cyanides, fluorides, lead and Zinc compounds chlorides, heat	H ₂ Si, SO ₂ steam from slag cooling beds	Iron oxides, H ₂ S casthouse fume, CO, coke dust, noise	Baghouse (etc.) dusts, blast, furnace slag, refractories, filter cakes
Hot metal treatment	Alkalies, suspended solids	Particulates Alkalies, Fluorides	Na ₂ O, K ₂ O, lime dust, kish, Iron oxide fume	Baghouse dusts with high lime corrosive slags
Steel making	Scrubber Waters, suspended solids, zinc compounds	CO flare, CO ₂ , SiF ₄ , Fluorides, Iron oxides	Fine iron oxides alloy fume noise	Skimmer, EAF, BOS and ladle slags, refractories baghouse dust
Casting	Oil, fluorides suspended solids heat		Fume lead, SO _x fluorides	Slag from exothermic compounds refractories, filter cake
Rolling	Oils, suspended solids, chromates, acids alkalies	SO _x , NO _x , CO ₂ smoke	Scarfig fume and noise	Mill scale, oily mill scale, filter cake, ferrous sulphate
Coating	Chromates phosphates, alkalies, acids, oils, suspended solids		Chlorinated hydrocarbons, Solvents acid mist	Neutral sludges filter cakes carbon

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