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Waste management perspective in non-ferrous industries

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ABSTRACT

Indian non-ferrous metals industry has witnessed rapid growth over the past two decades. This progress has brought about environmental degradation as well. The liberalisation, globalisation and openness earlier introduced by the Government offer every scope for emphasising and validating ecological issues. This coupled with criteria adherence to conventional approaches involving resource utilisation has contributed significantly to the generation of liquid and solid waste in non-ferrous production industry. Developing countries in recent years have started shifting their feature of business strategy of environmental management from remediation technology to pro-active green solutions, that avoid the pollution mess in the first place. The paper reviews current knowledge of end of pipe technologies and their management, approaches to waste minimization options through reduction of source wastes, reduction of recycling and re-use. The paper also examines the various approaches to effective technologies to destroy or treat the wastes generated.

INTRODUCTION

Indian non-ferrous industry has been registering considerable growth during the past decades and also witnessing an upturn in its fortunes. The present economic scenario in the country is also highly conducive to all round growth and development of non-ferrous industry. Among the major non-ferrous metals mined, processed and produced for industrial applications are Aluminium, Copper, Zinc and Lead. The non-ferrous industrial sector has launched into expansion programme during the last five years which have its impact on the growth of electrical, electronic, transport, automobile and power segments of industries.

The expected resurgence of Indian economy due to liberalisation policy, raw material availability, increased domestic demand, vast potential for export etc. augur well for the face-lift of non-ferrous industry. India, corporate bodies are

entering non-ferrous sectors in a big way. The only discordant note is the threat of severe shortage of non-ferrous metals like copper and lead. Still, India has one of the most ambitious plan to go in for establishment of copper smelters under private sectors. Copper smelters are coming up at Tuticorin (in Tamil Nadu - by M/s Sterlite Group) and in Gujarat (by Indo Gulf, SWIL, METADIST)[1]. The Cochin based Kerala Copper and Chemicals is likely to establish a Greenfield Copper Refinery for copper cathode production. Table-1 gives current domestic production and estimated demand by the turn of this century.

Table-1 : Domestic production and estimated demand of copper

Metal	Domestic Production	Future demand
	(Tonnes in lakhs)	
Aluminium	4.28	5.76
Copper	0.50	2.60
Lead	0.64	1.54
Zinc	1.50	2.60

(Source : MMR Annual '95)

Lead is highly health hazard metal and research is going on to combat lead emission. The pollution control technology adopted has considerable impact on its operating and investment costs. Due to the above reasons, industrialists are thinking twice before venturing on lead production.

Current secondary lead refining practices are mainly batch processing, based on smelting in backyard smelters or unrecognised sectors utilizing lead scrap and wastes. They do not have any pollution control systems. Government of India has taken a serious view of pollution in lead industry especially of small backyard smelters. Government is also encouraging secondary smelter units to put up pollution control system to protect the environment. The prospects are bright for secondary sector because of energy consideration, limited resources of lead and its ore, impact on production cost and recycling[2].

The growth of non-ferrous industry has contributed to the problems of environmental degradation in both developed and developing countries. The ultimate impact is felt in the health and well-being of man, woman, children and ultimately the total ecology comprising the animal, aquatic life, insects and plants. Although somewhat delayed, fortunately, man has reacted and with foresight in

many locations, has reversed the degradation process with the installation of control systems. Still, we have a long way to go. The industrial sector is facing increasing pressure to eliminate or atleast reduce wastes and pollution. The awareness of impact of pollution has set in the mind of industrialists that they will have to be utterly open in their dealings with both Government and the society at large while aiming at clean or safe environment. The computer revolution has changed the way we anticipate the future. Knowledge of environmental phenomena, their anticipation, understanding and prognosis have increased tremendously with simultaneous advances in computer technology.

Though compliance and remediation are current focus of environmental awareness, the slug is now on environmental audit and pollution prevention.

ENVIRONMENTAL MANAGEMENT IN NON-FERROUS INDUSTRY

Aluminium

During the production of aluminium metal, the mined bauxite ore is digested with hot sodium hydroxide to form sodium aluminate from which hydrated alumina is precipitated and then calcined to produce alumina. The leached residue called Red Mud is dumped as waste. The alumina is electrolysed by fused salt electrolysis to get aluminium metal. Mining, raw material section, leaching section, cell house, alumina calciner unit, paste plant, boiler, melting unit etc. give rise to air, water and land pollution. Environmental management adopted in Indian Aluminium Plant is shown in Table-2.

Table-2 : Steps adopted for environmental management in various parts of aluminium industry

Location/Facility	Management
Mine	Afforestation
Raw material bay	Baghouse (Fugitive emission)
Calciner	Electro-static precipitator (ESP)
Steam Plant (Coal)	E.S.P.
Smelter	Dry Scrubber (Fluoride emission)
Red Mud Section	Pond with PVC Lining to avoid seepage (1 to ton red mud requires 0.4 M^2 area for dumping)

Indian aluminium industries have considered environmental protection as one of the key elements in their corporate management and have implemented for clean and safe environment. It is reported that M/s Hindalco, Balco, and Nalco have planted saplings of fast growing trees on the reclaimed area at open pit bauxite mining site. Slopes of the dumps are also contoured and planted with growing plants. Process and sewerage waste water are being handled in treatment plant. Ash pond is provided to collect the power plant waste ash by hydroslucing system.

Copper, Lead and Zinc

The main source of air pollution/water pollution in the production process of the above mentioned metals are from mining area, raw material section, mineral processing plant, roaster, smelter, refinery and fabrication unit operations. The emission of sulphur dioxide gases emitted during roasting/smelting is effectively controlled by adopting OUTTOKUMPU flash smelting process. Particulate matter and SO_2 gases which are major pollutants emitted during the production of zinc is recovered in cyclones and in wet "PEABODY SCRUBBER". SO_2 gases are converted into sulphuric acid.

Through EIA

For any scientific evaluation of impact on environment by industrial pollutants, it is important to collect base data of the environment for the site of industry before it is set up. For air pollution assessment one has to measure meteorological parameters, wind speed and direction, rain fall, atmospheric stability, temperature and perhaps solar radiation. For this, it is advisable to construct a mini-Met Station at the proposed industrial location to automatically monitor and record data. If stack is to be provided in the site, information is also needed on the movement of air masses above the ground. For water pollution assessment of the catchment area of the proposed site is to be considered. The raw water quality in terms of surface and sub-surface flows to be established for content of COD, BOD, TOC, TOD, colour, SS etc. For non-ferrous industries, the question of solid waste disposal is very much linked with ground water and hence is to be assessed. It is better to prepare EIA report based on one-year base line data of various environmental parameters. A socio-economic survey can also be conducted in the project area. Based on EIA, an environment management plan can be prepared.

Environmental Audit

The environmental audit is a management tool to objectively evaluate a company's environmental management performance in the existing industrial

facility. A systematic audit of waste generating and handling activities of industry can help to ensure that all opportunities of waste minimisation are identified and properly evaluated.

Pollution Prevention

Pollution prevention is defined as any practice which reduces or eliminates waste generated or released from a facility. Until recently, environmental authorities have focussed on end of pipe pollution control. The approach is costly and merely transfers pollutants from one media to another. Furthermore, as we are nearing twenty first century, we may encounter another level of environmental threats which are more complex and widespread than can be addressed by end of pipe controls. A novel approach is to implement a comprehensive pollution prevention programme at a plant or facility. Pollution prevention programme not only helps to reduce the impact of industrial activity on the environment, but also makes commercial sense. Pollution prevention programme involves three major techniques, (i) source reduction, (ii) recycle/reuse, and iii) treatment. Source reduction reduces wastes before it is generated. Recycle/reuse helps in recovering usable material from a waste. The final treatment is to reduce the volume and toxicity of a waste before it is disposed of. Of all the three cited above, source reduction is the best waste management because no adverse environmental impact could be realised from wastes not produced.

Approach to Pollution Prevention

The first stage of programme involves pre-auditing of the facility to get first hand information as detailed below :

a) Analysis of waste, emission and effluent discharge records, disposal records;
b) Specifications of raw materials and products, stock inventories production; and
c) Process flow diagrams, equipment operating manuals, process descriptions and piping and instrument diagrams, costs for materials, water, energy, operating, maintenance, storage, handling transport and waste treatment and disposal[3].

ENVIRONMENTAL MANAGEMENT USING CLEAN TECHNOLOGY

The clean technology in non-ferrous sector can be adopted to recover and reuse large amounts of expensive volatile chemical solvents, metals, water etc. Clean technology can also be used to process discarded solid or liquid material into commercial environmentally responsible products. Clean technologies give rise to good economic returns and also improves the intrinsic operating performance of a facility while reducing environmental cost.

India should also go in for clean technologies in non-ferrous sector because they are integral to production and safe for workers and they eliminate non-product waste outputs to the environment. Numerous examples can be cited in process metallurgy for source reduction of pollutants where new technologies have been developed involving investments of several hundred million dollars. As for example, Ontario Division of INCO, Canada have reduced the SO_2 emissions in their operations from 2 mt/y to 685 kt/y, over the period 1970-85 by a sustained research effort which led to increased rejection of pyrrhotite, an iron sulfide, from the ore during milling while maintaining acceptable nickel recovery. However, to meet the much lower 1994 sulfur dioxide emission target of 265 kt/y, INCO developed a simplified flowsheet of the new smelter nearly after two decades of research and invested over Canadian dollar 540 million. The important segment of INCO's sulfur dioxide abatement research programme was devoted to developing a new copper smelting-converting technology based on oxygen top blowing, nitrogen bottom stirring process to convert semiblister to blister copper[3]. Yet another example is the development of a clean, eco-friendly technology i.e. AusmeltProcess for the smelting of sulfide ores to recover metals such as copper, lead, silver, tin, antimony and nickel. The Ausmelt technology is applicable to smelting complex ores and concentrates wherever treatment would be difficult by conventional technology. The compactness of the Ausmelt technology allows compliance with environmental constraints not only in direct emissions but also in the production of clean products, separation of toxic materials and work place environment.

M/s Encycle, exas, USA has set up a hydrometallurgical unit to process variety of waste materials obtained from non-ferrous industries to recover lead, copper, zinc and other metals. The company makes a preliminary survey to determine the best place where the waste can be introduced i.e. in the existing plant or another plant. The process adopted separates copper, silver, zinc etc. into individual or mixed products and discharges the waste water to treatment plants. The valuable solid is sold for commercial use. The plant has facility to treat liquid wastes, metal bearing wastes, baghouse dust wastes etc. by leaching, purification, cementation, reduction etc.[4].

A two-stage pressure leaching plant for extraction of zinc from zinc concentrate is presently operating in Canada to combat the environmental problem posed by SO_2 emission. The company claims a 25% reduction in SO_2 emission level. The problem of treatment of zinc ferrite is avoided in this process[5]. R. David et al has reviewed the prospects of treatment of lead wastes/scraps using hydrometallurgical techniques. The processes proposed are attractive from environmental angle[6]. For primary lead production, Germans have perfected OSL processes and Russians KIVCET process. Both the process utilize oxygen enrichment which results in very low lead emission.

M/s KENNECOT UTAH Copper has perfected a new pyrometallurgical process i.e. flash melting and flash converting that satisfies the emission requirement of environmental authorities.

RECOMMENDATION

The impact of solid/liquid waste from non-ferrous industrial sector is one of the major issues of our time. There is growing pressure from Government and public to minimise wastes by realistic and practical environmental management plan. It is high time our non-ferrous industry should initiate to adopt new policies, innovative technologies and processes that can lead to pollution prevention. The policy should focus on a sustained Waste Management/Pollution Prevention management plan. The management plan should include source reduction, water usage minimization, waste stream segregation, process modification and management commitment. By adopting Waste Management/Pollution Prevention (WM/PP) programme, India can very well achieve excellence in all aspects of non-ferrous metal production activities for the benefit of the society.

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