EXECUTIVE SUMMARY

1.0 Zinc is widely used metal and used in protecting steel, diecasting and also as chemical compound. While zinc was known to the ancients, its production with modern technology started in India only in 1966, with the Smelter at Debari, While the zinc production worldwide was 7.2 million tonne in 1989, the Indian production capacity of zinc was only 99,000 tonne.

1.1 Zinc metal uses are based on a number of properties and these properties are being exploited for variety of applications in defence and other essential industries.

1.2 The principal processes for manufacturing are horizontal retorts, electrolysis, vertical retorts, electrothermic, overpelt and blast furnace (Imperial Smelting Process). Out of these, most important processes are electrothermic and blast furnace manufacturing, covering 93% of the total zinc production in the world. The electrolytic zinc process consists of dissolving zinc bearing materials to zinc sulphate solution which is purified to satisfactory electrolyte and recovered as metallic zinc by electrolysis. The Imperial Smelting process is pyro-metallurgical process for combined production of lead and zinc. This will include raw material handling plant, smelter and gas cleaning plant, smelting blast furnace, zinc refinery, lead refinery, and recovery of high value metals.

1.3 Zinc concentrates are the raw material for zinc smelter. Zinc ore consists of sulphate, sulphide mineral with galena, chalcopyrtite and copper sulphide minerals. Zinc concentrates from zinc-lead ores contain about 59% zinc andd complex ores have 54% zinc.

1.4 The energy requirements for zinc production by a modern electrolytic process and the Imperial Smelting process are 47.5×10^6 Btu and 42.5×10^6 Btu respectively. The pollution control/environmental requirements in terms of water, air, sulfur dioxide emission, etc., are important.

1.5 Secondary zinc production has started in India in the last few years. Secondary zinc is recycling process and thus adds to the economy. The main sources of secondary zinc are scraps, drosses and fluxes. The process of electrolyzing is similar to primary zinc products. A large number of recovery units with capacity of 1 tone per day to 15

tonne per day have started and they are importing basic raw material (zinc ashe) from abroad.

2.0 STRUCTURE OF INDUSTRY AND STATE OF ART

2.1 The zinc smelter capacity in India is 1,69,000 tonne per annum. The secondary producers may add about 15,000 tonne per annum. The production of zinc in India is increasing; it was 28,000 tonne in 1976 and 1,50,000 tonne in 1992. The overall performance of industry is good and rate of growth and financial health is strong. The present demand for zinc in India is in the range of 1,50,000 tonne per annum. The projected demand worked out are 1,98,000 tonne per annum by 1994-95 and 2,40,000 tonne per annum by 1999-2000 AD.

2.2 The four smelters are located at Debari, Visakhapatman and Chanderia of Hindustan Zinc Limited and at Benanipuram of Benani Zinc Limited. The two smelters in Rajasthan are based on indigenous lead-zinc ores and Visakhapatnam smelter was being worked on imported concentrates, but now is being worked on concentrate from Rajasthan as well as imported concentrates. Benanipuram smelter is based on partly imported concentrates. The economics of scale is based on type of technology, quality of concentrates. All the smelters were started with foreign collaborations and subsequently collaboration arrangements were entered with specific areas of improvements. Basically all smelters have done well and technology has been absorbed. R&D efforts have been made to modernize the plants and modifications, innovations and expansions have been made. Imperial Smelting furnace technology for zinc and lead smelting on pyrometallurgical process was imported.

2.3 The structure of down stream industry consists of galvanizing units, alloy die casting units, brass/bronze industry and chemical manufacturers.

2.4 Modernization of the zinc smelters are essential for the improvements in production and productivity, energy reduction, improving environmental conditions and cost effective methods of production. The emphasis should be for mechanized and automatic methods and recovery of precious and valuable metals.

3.0 INTERNATIONAL SCENARIO

The two contemporary technologies are roast-leaching electrolysis and Imperial Smelting process (ISP). 80% of production of zinc in world is by electro-winning process and 14% by ISP. The global production at present is about 7.2 million tonne (28% production is

from Western Europe, 22% from USA, 21% is from Asia and erstwhile USSR and China produces about 27-28%).

3.1 Production of zinc in USA, Europe and UK have decreased as a result of decline in mining of zinc ore and concentrates. Manufacture of Zinc in these countries is dependent on import of concentrates. Canada, Peru, China, former USSR have increased their production of zinc and there is increase in capacity build-up in Canada, Peru, China, India, Brazil, Mexico and some other countries. Addition of investment in zinc production is not expected.

3.2 Zinc consumption in the world has declined due to the technologies of economizing materials. The present consumption is only 27%. Substitution and economy of materials have reduced the consumption.

4.0 R&D EFFORTS, TECHNOLOGY ABSORPTION AND GAPS.

4.1 R&D activities in zinc development is in-house, in national laboratories/institutions/universities. HZL has well developed facilities of research and developments. The activities include exploration, improvement in flow sheets, control on operational activities, design of mining, operation of process parameters and recovery of various metals. Priority for R&D activities should be for exploration and energy conservation. Bureau of Standards have issued a number of Indian Standards for zinc in confirmation with other world standards.

4.2 Indigenisation of parts, sub-assemblies, capital equipments have taken place in zinc industry. 55-60% of capital equipments have been indigenized. Now perhaps basic engineering and know-how may be required to be imported. HZL has thus expanded Debari smelter from 18,000 tonne per annum to 49,000 tonne per annum capacity. Utilization has also improved steadily. Improvements have been proved in productionizing and yields better concentrates. Power and water has been constraints in the production and this has been taken care of broadly. Technology absorption efforts have by the way of zinc dust production from cathodes, drum filters, injection oxygen have improved on productivity and cost reduction. Recovery of various valuable metals has improved the cost of production.

4.3 Gaps in technology are cost effective zinc concentrates, computerization and automation, better zinc values, better leaching, purification and cell-house yields, energy reduction, environmental issues and productivity. The gap can be bridged by selected mining, moderniza-

tion and benefication, application of computerized energy audit, pollution control audit and by automation.

4.4 The thrust areas should be concentrated on productivity through improved technology, induction of higher mechanization, and conservation of energy. A number of thrust areas of research and development have already been identified by the Indian Zinc industry in the fields of geology, mining, benefication, metallurgy and newer application areas to face changes. Promotional activities for zinc consumption by the way of new application is also a thrust area.

4.5 The target definition will require acquisition of latest technology, design drawings, know-how, adoption of latest technology, and promotional activities. The R&D efforts have to be increased by completion of R&D projects and investing in R&D efforts. Promotional activities are to be taken vigorously by allocating more funds. Software for control system needs to be developed in India.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

5.1 Zinc is strategic metal required for variety of applications. World zinc production at present is 7.2 million tonne per annum and is likely to reach a level of 7.9 million tonne per annum by the end of the century. All the three grades of zinc slabs are now produced in the country. The total capacity for primary zinc production is 1,69,000 tpa and actual production average at 85% of rated capacity will be 1,45,000 tpa. Secondary zinc production at present is about 15,000 tpa. The end users have benefits of availability of prime western grade for galvanizing, availability of all the three grades of zinc, availability of stock centers throughout the country resulting in easy access, availability of sulfuric acid for fertilizer and chemical industry and recovery of metals.

5.2 The zinc industry in India is in good shape at present. Absorption and adoption of imported technology is excellent. Intensive training is very essential for this industry. The industry has made efforts in indigenisation in terms of spare parts, assemblies and equipments. The zinc industry being 25 years old has achieved stature and maturity. The industry will have to expand in coming years.

5.3 There are a number of improvements and developments abroad in the main technological process and equipments to enhance productivity, energy saving, pollution control, etc. Zinc values by improvements of roasting, leaching, cell-house have to be augmented and all these

developments will have to be incorporated in existing and future smelters. R&D efforts are to be directed for improving quality control, plant parameters of operations, computerization and use of micro-processors. R&D efforts will depend on training and talent of scientists and research workers. The technological gaps have been identified and efforts will have to be made to bridge them.

RECOMMENDATIONS

(i) In order to develop sufficient zinc concentrates it is recommended that the following steps may be initiated.

(1) Exploration of lead-zinc deposits in Rajasthan be carried out.

(2) Development of Amberata, Deri and Bamnia Kalan mines to meet the shortage of lead concentrates.

(3) Utilization of low-grade zinc deposits by development of new technology process.

(4) Joint sector development of zinc concentratess by participating in mines abroad to ensure availability of concentrates.

(ii) The existing smelters may be expanded by 50,000 tpa as the gap of demand is in the range of 30-40,000 tpa and one can also assume 85% capacity utilization.

(iii) Secondary zinc production could be encouraged by financial institutions and the Government. Modvat system may be applied for secondary zinc manufacturers, which will help to have good stability of production and revenue. This would also mean advantage to the manufacturers.

(iv) It may be necessary to have an exclusive institute devoted to Research and Development, designs and planning automation and computerization and standardization of equipments. This may act as a nucleus to get most of the job done through other research institutes/ universities by contract research.

(v) The above mentioned institute for zinc and lead could also be entrusted with training of personnel as well. Training may consist of theoretical and practical training in operations, computerization, modernization, etc.

(vi) Promotional activities by the way of dissimination of information, development of newer applications for zinc development, recycling/ recovery etc., should be entrusted to organisation like Indian Lead Zinc Information Center, New Delhi with financial support and co-

operation from producers of zinc.

(vii) A R&D programme may be taken up for development of a residue treatment process either to recycle higher iron containing materials to the steel industry or to produce residue suitable as environmentally safe store.

(viii) A R&D programme may be taken up for obtaining higher recovery efficiency in smelters by optimisation of process parameters, mechanization, introducing online controls etc. The recovery should be at par with international levels at 94% to 96%.

(ix) A R&D programme may be taken up for energy conservation in an effort to reduce power consumption for electrolysis.

(x) A development project may be initiated for recovery of various metals like germanium, gallium, thallium, iridium etc. from residues.

(xi) Technology upgradation efforts should not be limited only to what technology is available in current years. But to identify and develop new technologies on the anvil internationally and is likely to be commercialised in the coming years.

(xii) A R&D programme may be tkaen up for technology development in electro diposition of zinc by introduction of hydrogen diffusion anode (HDA). By this the voltage may be reduced from 3.3 - 3.5 volts to about 1.2 - 1.4 volts, thereby reducing consumption of electricity substantialy.