Environmental Management System
Its Advantages to Lead Recycling Plants

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Development of EMS

Environmental issues were not given much importance till early 70s. People all over the world were more eager for rapid industrialization and increasing their standard of living without much concern for environmental degradation and quality of life. However, the ill-effects of such uncontrolled developments were realized by certain enlightened people, who started Environmental Protection Movement in different parts of the world, especially in the developed countries. There were major accidental discharges causing great damages to the environment, which gave impetus to this movement. (To name a few, Mercury poisoning at Minamata in Japan during 1953-60, resulted in death of hundreds of people and many thousands were permanently paralysed; Acid rains were experienced extensively in Europe, causing thousands of lakes completely dead during 60s & 70s; Major oil spills caused enormous damage to the marine life amongst which were those near Land End, England in 1967 and Alaska Coast in 1977; Close to us in Bhopal, MIC leakage in 1984 killed more than 3000 people and thousands more were left disabled. The Chernobyl nuclear explosion in 1986 revealed what extent the environment can get affected by radio active substances. This explosion killed at least 2000 people, damaged the soil, water and vegetation over 60 sq.km area).

Concern for environmental protection led to stricter statutory controls on the industries for the quality of emissions and effluents, but that were not sufficient. It was felt that the environment protection should not be the concern of only the enforcing agencies, but **should also become integral part of Management System of each industrial unit.**

United Nations recognized the need for Environmental Management and first UN Conference on Human Environment was organized at Stockholm in 1972, when an independent commission was created; the World Commission on Environment and Development (Brundtland Commission). This Commission took up the task of reassessing the environment in the context of developments and published its report *Our Common Future* in 1987. This report introduced the term **'Sustainable Development'** and urged industries to develop **effective Environmental Management Systems**.

Sustainable Development is defined as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

In June 1992, UN Conference on

Late 80s and early 90s witnessed quality revolution in Indian industries, with the introduction of Quality System Standards, popularly known as ISO 9000. ISO stands for International Organization for Standardization, which was set up way back in 1948, mainly to establish product standards. However, to ensure consistency in product quality, it was felt necessary to organize the manufacturing activities in a systematic manner and therefore the Quality System Standards were developed and published under the series of ISO 9000.

This concept of the systems standards is now being applied to control significant environmental aspects of any industrial activity and the standards for these control systems are developed by ISO under the series ISO 14000. It is now possible for the industrial units to design **Environmental Management System (EMS)** for their activities as per the requirements stipulated in the Standard ISO: 14001 and get third party certification for the same. This singularly will demonstrate the industry's **commitment** towards protecting the environment.

Environment and Development (UNCED) also referred to as ***Earth Summit*** was held at Rio-de Janeiro, in which government leaders, business leaders and private groups met to consider how world can move towards sustainable development. Outcome of this Conference was ***Agenda 21*, or *Rio Declaration***. This forms the basis for subsequent international agreements / discussion on environmental issues.

Simultaneously the International Chamber of Commerce (ICC) developed the Business Charter for sustainable development in 1990. The ICC Business Charter contains 16 principles of sound environmental management. In another initiative, the chemical industry, concerned about its deteriorating public image, launched its Responsible Care Programme, begun in Canada in 1984 and now a condition of membership of the Chemical Industries Association. This movement has now taken roots in India, with more than hundred chemical units adopting this programme.

These developments led to initiatives on the part of EC countries, who developed EMS Standards known as **Eco Management Audit System (EMAS)**. These standards were published in 1993. Simultaneously the British Standards Institution developed similar standards known as BS 7750 and published in 1994 for third party certification. At the same time, ISO took initiative and developed ISO 14000 for world-wide application, which were published in 1996.

What is EMS ?

The main theme behind these EMS Standards is **"*Manage the system or it's chance and chaos*".** 'Environment' in this context means "*surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation. The 'environment' extends from within an organization to the global system*". The Environmental Management System as defined in ISO 14000 is "***Organizational structure, responsibilities, practices, procedures, processes, and resources for implementing and maintaining environmental management*".**

For effective EMS, an organization must have '**Top Management Commitment**' towards controlling adverse environmental impacts arising out of their business activities. From this commitment evolves an Environmental Policy, which becomes a guiding declaration for the specific structure of the EMS relevant to its business activities. It is expected that the Environmental Policy leads to Objectives and Targets for various activities, which can have identifiable impact on the environment, either positive or negative. It is also necessary that management must have a documented system, which will ensure systematic efforts achieving the said objectives and targets. EMS should provide for periodic internal audits to ensure that the system functions on continual basis as documented. It also provides a periodical management review to check whether the system is effectively functioning & leads to continual improvement of the organization's environmental performance. In short, ISO 14000 stipulates a set of 10 Management Principles for organizations considering EMS, which are as follows:

- Recognize that environmental management is one of the highest priorities of any organization.
- Establish and maintain communications with both internal and external interested parties.
- Determine legislative requirements and those environmental aspects associated with you activities, products and services.
- Develop commitment by everyone in the organization to environmental protection and clearly assign responsibilities and accountability.
- Promote environmental planning throughout the life cycle of the product and the process.
- Establish a management discipline for achieving targeted performance.
- Provide the right resources and sufficient training to achieve performance targets.
- Evaluate performance against policy, environmental objectives and targets and make improvements wherever possible.
- Establish a process to review, monitor and audit the environmental management system to identify opportunities for improvement in performance.
- Encourage vendors to also establish environmental management system.

EMS – An Effective Management Tool

Since the EMS focuses on continuous improvement in the environmental performance of the organization by way of reduction of emissions, discharges, wastes etc. This has direct bearing on the conservation of raw materials and natural resources. As no industrial output is possible without consumption of energy, a better utilization of the raw material and other resources directly conserves energy consumption and thus controls the degradation of the environment. In industries, the major costs of production are of energy and the raw material, industrial activity with the effective implementation of EMS becomes cost-effective and competitive.

The industrial waste is the major cause of environmental degradation. Statutory laws against the waste disposal have made the life very difficult for the Managements, which is very relevant in case of **"Lead Recycling Plants**". Every known production technology generates certain types of wastes. Therefore the best way to tackle this problem is to attempt to **reduce, reuse and/or recycle** such wastes. In short, wastes should be converted into wealth. EMS provides a management structure to look into all these aspects through adoption of suitable objectives and targets. In-built system of audits and reviews ensure attainment of desired results. Management can gain additional revenue through reuse and recycle of wastes. Thus the effective implementation of **EMS** leads to direct reduction of material costs.

The adoption of EMS also may lead to industrial restructuring, especially in developing countries. Since the developing countries, the industries have technologies which are less energy and resource efficient and cause more discharges to the environment, the adoption of EMS will make the management think on restructuring their

production processes and to adopt cleaner technologies either through indigenous development or through technology transfer and other means. It will also lead to the restructuring of the management to enhance their ability to receive, transfer, adopt and develop cleaner technologies.

In the present state of economy, which is already on the advanced path of liberalisation and globalisation, Indian industries will find **EMS as an effective tool** to implement such restructuring to make the business more competitive. Also it will encourage the small and medium size industries to come together in a cooperative approach to tackle their common environmental problems and to derive the benefits of resource utilization and energy saving and in the process comply with the legislative requirements. This movement has taken roots in India and many units are adopting this system.

LEAD RECYCLING

Historical

Lead is one of the Seven Metals known from very ancient times. Lead is know from very ancient times, as its use in fifth to seventh B.C. is now a well established fact. Even Chinese probably made lead coins in 2000 B.C. An early acquaintance of man with Lead was favoured by the ease of reduction of the metal from Ores, its low melting point and ductility, which facilitated its working. Lead is more metallic in properties while its oxides are amphoteric. Lead is versatile metal with wide range of applications. Egyptian graves have yielded both decorative and useful artifacts of the Lead or its compounds. Roman water pipes are perticularly very known. Germany, France and Austria have a long history of mining and Lead recovery.

Our earliest knowledge of smelting method is speculative. Probably Oxides or Carbonates Lead ores were smelted in presence of carboniferous materials, in pits or hollowed logs to produce single charge of metal.

By 1900 technology was well advanced making use of Pbs-Pbo roast reaction and reduction reactions. From 1900 to the present, the technology and knowledge of Smelting and Refining process were improved to their present levels.

Present

At present Lead is recovered from Primary raw materials like :

a) Galena – Lead sulphide

b) Cerussite – Lead carbonate

c) Minium - Lead Oxide ,

and

Secondary Raw materials like

d) Scrap Batteries

e) Drosses/Oxide

f) Residues, ash, pastes etc.

For the recovery of Lead from the above raw materials different processes are followed, i.e. from Blast Furnace to Rotary Furnace.

Lead Consumption

By far the greatest use of Lead today is for the manufacture of Lead - Acid Batteries.

Lead - Acid Batteries consumes about 75 – 80 % of the world's Lead production and represents the single largest application for Lead & Lead Alloys.

The production of Lead chemical compounds occupies the second place among its consumers after the Battery Industry. In industrialized countries 15 – 20 % of Lead is consumed for these purposes. Lead chemical compounds are used in the products of special types of glass, crystals, paints, PVC plastics stabilizers etc.

Cable and other Industries consume about 5 – 10 % of the Lead production.

Why Recycling ?

- To recover Lead
- To save Environment and Mother Earth
- Service to the Society – Today and for Future Generation

Raw Materials Available for Recycling

(1) Major : The most important source of raw material for the Industry will be Scrap Batteries, which will be about 80%.of the total raw material.

2) Lead Scrap, Lead Dross, Lead Paste, Lead Ash etc. which are waste or rejected product of Battery and other Lead consuming industries, and

3) Lead Pipes, Cable Sheathings are the other type of raw materials used for Lead recovery directly in the Refining and alloying section as they are in Metallic form. These raw materials require less process and therefore generate less waste and emissions compared to battery and other raw material to recover lead.

Basic Concept for Recycling Plants

Lot of thoughts and considerations should be given before finalising the Plant & Machinery for the Lead Recycling process. The Plant should be designed to process the Raw materials keeping environmental aspects in mind which will benefit both manufacturer as well as Society in general. Lead Recycling is very important and every one in Society expects it. Today technology has made recycling very simple and eco friendly.

Recycling

Manufacturing process in general for the recovery of lead from the scrap batteriesm and other raw materials is given below.(Process of Rotary Furnace Technology which is mostly followed in India is considered here for this Paper)

Manufacturing Process

Raw Materials

(1) Major : Scrap Batteries

(2) Alternative : Lead Dross, Battery Plates, Lead Oxides, Lead Pastes, Lead Ash, Lead Residues And Lead Ore Concentrates.

3) Lead Pipes, Cable Sheathings are the other type of raw materials used for Lead recovery directly in the Refining and alloying section as they are in Metallic form. These raw materials require less process and therefore generate less waste and emissions compared to battery and other raw material to recover lead

Scrap Batteries

Lead acid storage batteries are fed into crusher of battery breaking system. In this

system the batteries are crushed and the crushed contents of the batteries are washed and seperated into metallics, lead paste and polypropylene. In india most of the recycling units break and separate the components manually due to economic compulsions. But many are planing to put the crushers/breakers to make the breaking system cleaner and faster.

The paste and the fine metallics are directly taken to smelting section for further processing.

The polypropylene chips are cleaned and despatched to the p.p. Container manufacturers or any other application where polypropylene is required. Separators are reused or used in recycling industry in some cases and/or burnt along with paste and plates in furnace.

Other Raw Materials

Other raw materials such as battery plates, drosses and oxides are directly fed to rotary furnace with chemicals to recover lead.

Manufacturing Process

Lead is manufactured in two stages.

(A) Smelting Process

(B) Refining Process

Smelting Process

In this process, the primary aim is to recover lead from the raw materials. The lead paste, fine lead metallics seperated from the scrap batteries or any other lead bearing raw materials, are directly fed into the rotary furnace along with calculated quantities of chemicals such as coal, soda ash and iron chips. The charge is then heated with oil fired burner.

Under the heat from the burner and with the chemicals, few of the reactions that normally take place during the smelting process are as follows.

On completion of the reduction reaction / smelting, lead is tapped in to the preheated discharge p0t or in to the steel trays/moulds.the molten lead in the discharge pot is then stirred with an agitator and the dross/oxides/slag powder formed on top of the metal bath is skimmed out. The cleaned metal from the pot is pumped to the lead moulds/trays.

The slag from the furnace is tapped out from a separate tapping hole in to the slag moulds/trays.the iron slag in excess quantity separates from the molten slag as a matte layer because of its greater density.

The lead in moulds is allowed to cool and the solidfied lead blocks are shifted to the refining section. This lead which is in raw form with many impurities associated with it is called crude or recycled lead. A sample of this lead is sent to laboratory for chemical analysis.

The tapped slag is allowed to cool and solidfy.this slag is then broken in to small pieces and segregated to separate heavy slag containing lead, metallic lead if any and the light slag. Metallic lead and the heavy slag is moved back to smelting section for the recovery of lead. Light slag is stored separately for disposal. Flue dust generated during the smelting process is added back to the furnace / recycled on regular basis to recover lead from it.

Refining Process

The process involves purifying of crude lead produced in the smelting section. When lead is reduced/recovered from different types of raw materials a large number of other metals become co-reduced and are tapped from the furnace in the crude lead. Zinc if any will escape in the flue dust, whilst copper, tin, arsenic, antimony and silver are reduced in the crude lead and have to be removed if found out of specification in the refinery. On many occassions nickel, cobalt, selenium, cromiium and tellurium can also be present.

The crude lead produced in the smelting section is charged in to the kettles and is melted. At low temperature of about 330 c, stirrer is introduced to mix the lead. Dross/crystals floating on surface of the molten lead is skimmed off. Well-dried dross is a black powder of lead oxide, and copper with nickel, iron, cobalt etc. During this process sulphur and sawdust are used as refining chemicals for the removal of cu, ni, zn, fe etc. Copper is removed as cu2 s.

Little quantity of caustic soda is also used if required. After removing the **impurities to the specification**, temperature of the metal is increased by starting the burner. Further process is continued either in the same kettle or in the next kettle depending on the **planned end product**.

For the next process, temperature is increased >450 degree centigrade to oxidise the impurities. Arsenic, antimony and tin are removed by haris process, by adding caustic soda and sodium nitrate to the lead bath. The **chemical reactions**, which takes place during this process, are given below. (tin may be removed at lower temperature also)

During the process a small amount of lead is concurrently oxidised to **sodium plumbite**.

The drosses are stored seperately and are treated to produce **antimonial lead.**

For manufacturing of pure lead all the **impurities** are brought down to trace level or below the **spcified limits**.

For the manufacturing of **lead alloys** to the required **specification**, calculated quantity of pure metals such as antimony, tin, copper calcium or selenium are added either in vergin form or in master alloy form.

During the **refining process** samples are drawn from the lead bath and sent to laboratory for the chemical analysis.

After the completion of refining or **blending process**, sample is checked again for the chemical composition of the molten lead in the kettle so as to take further action.

Only after conforming to the planned specification the lead is casted in to ingots by means of a casting machine.

Environmental Issues

Spent/scrap batteries are by its own nature an **environmental hazardous** material because they contain lead metal, lead oxides, lead sulphates, sulphuric acid and thermoplastic materials.

The good thing about spent batteries is that their components can be easily recycled. **However the processing of spent batteries**

must be made in a very professional manner following very specific techniques that must include advanced and sophisticated equipments and procedures for control of pollution to eliminate the possibility that such a process become an environmental threat.

Air Pollution Control

Flue gases from the furnace and smoke from some furnace satellite operations like charging & tapping and the gases from refining & alloying operations are the main issues to be addressed and taken care. Therefore lead recycling units should be fully aware of the pollution hazard involved in the operation and therefore must install very efficient pollution control systems to avoid any pollutants getting in to the atmosphere.

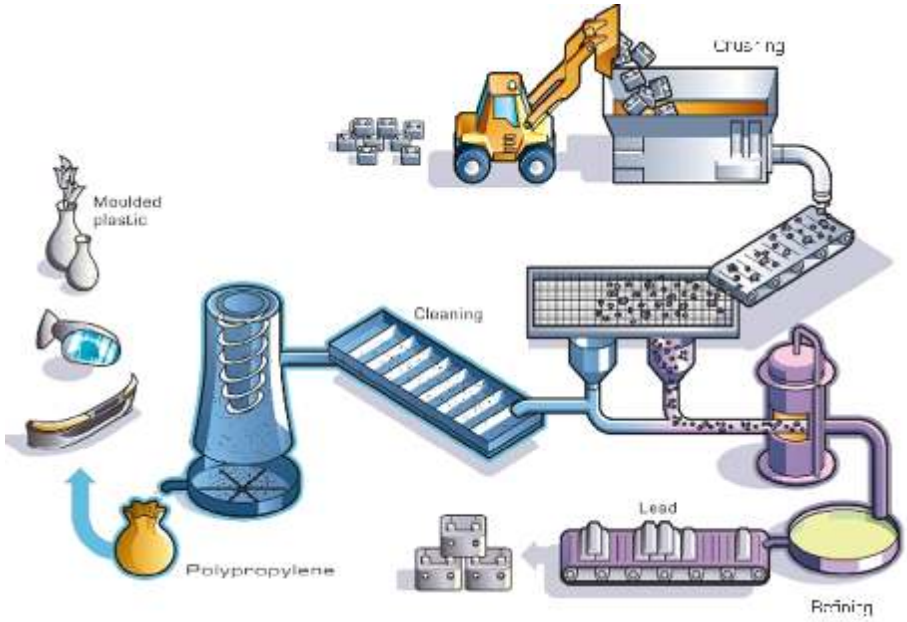
Water Treatment Plant

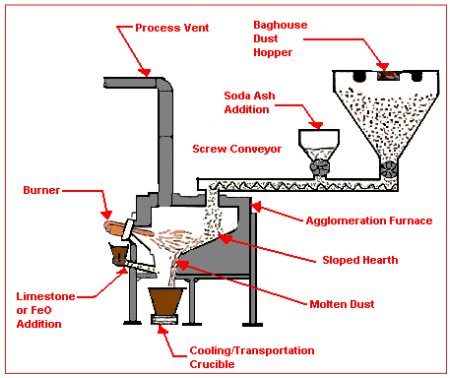
The only source of liquid effluent from the plant is from Battery Breaking System as the spent batteries regularly contain Sulphuric Acid solution. Therefore an acid neutralization and treatment plant is required to be installed. The neutralized and filtered water can be used for gardening and other purposes like cooling of moulds etc.

Byproducts can also be produced from the acidic effluent water by installing a separate Plant for the same.

Solid Waste

(a) Flue Dust/Drosses : Flue Dust generated during the Smelting Process is recycled along with other Raw Materials on regular basis to recover Lead from it. Same discipline should be followed for the Drosses generated during Refining Process.





(b) Slag : The slag from the smelting Process is the most important of the solid waste for both of its quantity and its characteristics. The slag is alkaline in character and contains high Iron as iron Sulphide which is a product generated during the reduction of Lead Sulphates.

With proper Smelting process Soda iron slag is produced which is chemically stable in nature. Other type of Slag produced during the smelting process is Ferro Silicate Slag which again is chemically stable.

(c) Poly Propylene Scrap : The P.P Scrap generated during the Battery breaking and separation process is washed, cleaned of to confirm the elimination of traces of paste and acid. The clean P. P. Scrap having commercial value is used in recycling Industry.

(d) PVC and P. P. Separators : Part of this waste is mixed with the paste and lead scrap charge during smelting.

Other separated part is to be washed and cleaned properly to remove traces of Lead and acid before disposing to the actual users as raw material in recycling industry.

Advantage of having Proper EMS / Eco – Friendly Recycling Process

1. Increased Revenue
   - Reduced Operation Cost
   - Reduced Litigation Cost
   - Reduced Accidents and Injuries
   - Better recovery leading to More Profit
2. Improved Community Relations
3. Improved Customer Trust & satisfaction and
4. Clean environment for Today and the Next Generation