E- WASTE MANAGEMENT

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Abstract

The electronic industry is the world's largest and fastest growing manufacturing industry in the world. Discarded electronic and electrical equipment with all of their peripherals at the end of life is termed e-waste. The quantity of c-waste generated in developed countries equals 1% of total solid waste on an average and is expected to grow to 2% by 2011 and is one of the fastest growing waste streams.E-waste consists of ferrous and non ferrous metals, plastic, glass, ceramics, rubber etc. E-waste is valuable source for secondary raw material but harmful if treated and discarded improperly as it contains many toxic components such as lead, cadmium, mercury, polychiorinated biphenlys etc. Recycling e-waste in a crude manner, as is done now will lead environmental pollution. A review of the study conducted of uncontrolled dumping and crude recycling of e-waste reveals the gravity of the problem. Technologies are suggested for environmentally sound management of c-waste. Legislation is the need of the hour for enforcing environmentally sound management. The major portion of the e-waste generated domestically as well as illegally imported are recycled in crude manner leading to pollution of the environment. Lack of legislation in our country at present is aiding this hazardous form of recycling. Therefore there is urgent need to frame and implement rules for regulating this waste and to find environmentally sound, economically viable methods for recycling and disposing of this necessary evil. The necessity of environmentally sound management of e-waste is brought out with the help of a case study of uncontrolled dumping of e-waste. We have collected data of disposed materials percentage and which is causing harm to environment and for reducing this we have explained some techniques from which it can be controlled without causing any effects to environment.

Keywords: *E-waste, composition, recycles potential, control techniques.*

Environmentally Sound Treatment Technology

Environmentally sound E-waste treatment technologies:-

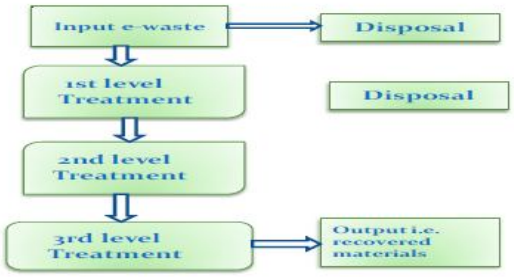
Environmentally sound E-waste treatment technologies are used at three levels as described below:

1. 1st level treatment
2. 2nd level treatment
3. 3rd level treatment

Analysis:-

All the three levels of e-waste treatment are based on material flow. The material flows from 1st level to 3rd level treatment. Each level treatment consists of unit operations, where e-waste is treated and out put of 1st level treatment serves as input to 2nd level treatment. After the third level treatment, the residues are disposed of either in TSDF or incinerated. The efficiency of operations at first and second level determines the

quantity of residues going to TSDF or incineration. The simplified version of all the three treatments is shown in figure



1st Level Treatment:-

Input: e-waste items like TV, refrigerator and Personal Computers (PC) Unit Operations: There are three units operations at first level of e-waste treatment

1. Decontamination: Removal of all liquids and Gases
2. Dismantling -manual/mechanized breaking
3. Segregation

All the three unit operations are dry processes, which do not require usage of water.

1. Decontamination

The first treatment step is to decontaminate e-waste and render it nonhazardous. This involves removal of all types of liquids and gases (if any) under negative pressure, their recovery and storage.

2. Dismantling

The decontaminated e-waste or the e-waste requiring no decontamination are dismantled to remove the components from the used equipments. The dismantling process could be manual or mechanized requiring adequate safety measures to be followed in the operations.

3. Segregation

After dismantling the components are segregated into hazardous and nonhazardous components of e-waste fractions to be sent for 3rd level treatment.

Output:

1. Segregated hazardous wastes like CFC, Hg Switches, batteries andcapacitors
2. Decontaminated e-waste consisting of segregated non-hazardous Ewastelike plastic, CRT, circuit board and cables

2nd Level Treatment:-

Input: Decontaminated E-waste consisting segregated non hazardous e-waste like plastic, CRT, circuit board and cables.

Unit Operations: There are three unit operations at second level of E-waste treatment

1. Hammering
2. Shredding
3. Special treatment Processes comprising of

(i) CRT treatment consisting of separation of funnels and screen glass.

(ii) Electromagnetic separation

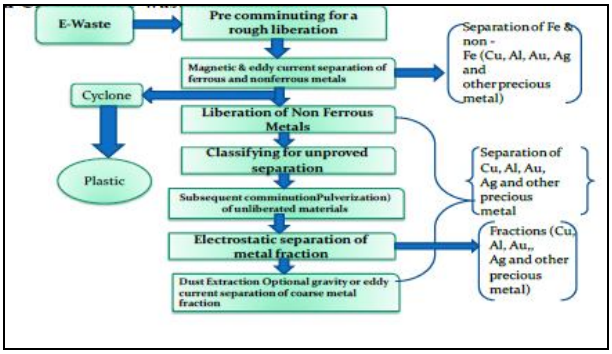
(iii) Eddy current separation

(iv) Density separation using water

Process

The two major unit operations are hammering and shredding. The major objective of these two unit operations is size reduction. The third unit operation consists of special treatment processes. Electromagnetic and eddy current separation utilizes properties of different elements like electrical conductivity, magnetic properties and density to separate ferrous, non ferrous metal and precious metal fractions. Plastic fractions consisting of sorted plastic after 1st level treatment, plastic mixture and plastic with flame retardants after second level treatment, glass and lead are separated during this treatment. The efficiency of this treatment determines the recovery rate of metal and segregated E-waste fractions for third level treatment. The simplified version of this treatment

Technology showing combination of all three unit operations is given in Figure



The efficacy of the recycling system is dependent on the expected yields/output of the recycling system. The expected yields/ output from there cycling system are dependent on the optimization of separation parameters. These parameters are given below:

1) Particle size

2) Particle shape

3) Feeding rate/ RPM

4**) Optimum operations**

Figure shows the non- ferrous metal distribution (which forms the backbone of financial viability of recycling system) as a function of size range for PC scrap. It can be seen that aluminum is mainly distributed in the coarse fractions (+6.7 mm), but other metals are mainly distributed in the fine fractions (−5 mm).

Scrap

Size properties are essential for choosing an effective separation technique. Therefore, eddy current separator is best for granular nonferrous materials having size greater than 5mm. The eddy current separation will ensure better separation of Al fraction in comparison to fraction containing Cu, Ag and Au.

Particle shape is dependent on comminuting and separation. Since hammer mills and screens will be used in the proposed technology, the variations are expected to be the same as that of Best Available Technology (BAT).

The feeding rate can be optimized based on the speed and width of the conveyor.

CRT treatment technology:-

The salient features of CRT treatment technology are given below.

1. CRT is manually removed from plastic/ wooden casing.

2. Picture tube is split and the funnel section is then lifted off the screen section and the internal metal mask can be lifted to facilitate internal phosphor coating.

3. Internal phosphor coating is removed by using an abrasive wire brush and a strong vacuum system to clean the inside and recover the coating. The extracted air is cleaned through an air filter system to collect the phosphordust.

Different types of splitting technology used are given below.

NiChrome hot wire cutting:- A NiChrome wire or ribbon is wrapped round a CRT and electrically heated for at least 30 seconds to causes a thermal differential across the thickness of the glass. The area is then cooled (e.g. with a water-soaked sponge) to create thermal stress which results in a crack. When this is lightly tapped, the screen separates from the funnel section.

Thermal shock:- The CRT tube is subjected to localized heat followed by cold air. This creates stress at the frit line where the leaded funnel glass is joined to the unleaded panel glass and the tube comes apart.

Laser cutting:- A laser beam is focused inside and this heats up the glass. It is immediately followed by a cold water spray that cools the surface of the glass and causes it to crack along the cut line.

Diamond wire method:- In this method, a wire with a very small diameter, which is embedded with industrial diamond is used to cut the glass as the CRT is passed through the cutting plane.

Diamond saw separation:- Diamond saw separation uses either wet or dry process. Wet saw separation involves rotating the CRT in an enclosure while one or more saw blades cut through the CRT around its entire circumference.

Coolant is sprayed on to the surface of the saw blades as they cut. This is to control temperature and prevent warping.

Water-jet separation:- This technology uses a high-pressure spray of water containing abrasive, directed at the surface to be cut. The water is focused through a single or double nozzle-spraying configuration set at a specific distance.

3rd Level E-waste Treatment:-

The 3rd level E-waste treatment is carried out mainly to recover ferrous, nonferrous metals, plastics and other items of economic value. The major recovery operations are focused on ferrous and non ferrous metal recovery,

which is either geographically carried out at different places or at one place in an integrated facility. The following sections describe the unit operations, processes, available technology and environmental implications.

Input/ WEEE Residues	Unit Operation/ Disposal/ Recycling Technique	Output
Sorted Plastic	Recycling	Plastic Product
Plastic Mixture	Energy Recovery/ Incineration	Energy Recovery
Plastic Mixture with BFR	Incineration	Energy Recovery
CRT	Breaking/ Recycling	Glass Cullet
Lead bearing residue	Secondary Lead Smelter	Lead
Ferrous metal scrap	Secondary steel/ iron recycling	Iron
Non Ferrous metal Scrap	Secondary copper and aluminum smelting	Copper/ Aluminum
Precious Metals	Au/ Ag separation	Gold/ Silver
Batteries (Lead, Acid/ Nickel metal Hydride (Ni-MH) and Li – ion	Lead recovery and smelting remelting and separation	Lead
CFC	Recovery/ Reuse / Incineration	CFC/ Energy recovery

Plastic Recycling:-

There are three different types of plastic recycling options i.e. chemical recycling, mechanical recycling and thermal recycling. All the three processes are shown in figure In chemical recycling process, waste plastics are used as raw materials for petrochemical processes or as reductant in a metal smelter. In mechanical recycling process, shredding and identification process is used to make new plastic product. In thermal recycling process, plastics are used as alternative fuel. The two major types of plastic resins, which are used in electronics, are “thermosets” and “thermoplastics”. Thermosets are shredded and recycled because they cannot be re-melted and formed into new products, while thermoplastics can be re-melted and formed into new products.

Recycling options for managing plastics from end-of-life Electronics

In thermal recycling process, plastics are used as fuel for energy recovery. Since plastics have high calorific value, which is equivalent to or greater than coal, they can be combusted to produce heat energy in cement kilns.

Chemical Recycling Process**:-** Chemical recycling process is shown in figure 6.6. This process was developed by the Association of Plastic Manufacturers in Europe (APME). The different steps in this process are given below

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De-polymerization of plastics and conversion processes

Process:-

1. Mixed plastic waste is first de-polymerized at about 350-400°C and dehalogenated (Br and Cl). This step also includes removal of metals

.2. In hydrogenation unit 1, the remaining polymer chains from depolymerised unit are cracked at temperatures between 350-400° C and hydrogenated at pressure greater than 100 bar. After hydrogenation, the liquid product

is subjected to distillation and left over inert material is collected in the bottom of distillation column as residue, hydrogenation bitumen.

3. In hydrogenation unit 2, high quality products like off gas and sync rude are obtained by hydro-treatment, which are sent to petrochemical process.

Metals Recycling

Metals recycling have been described below in terms of lead recycling, copper recycling and precious metals recycling. After sorting of metal fractions at 2nd level e-waste treatment, they are sent to metal recovery facilities. These metal recovery facilities use the following processes to recover metals.

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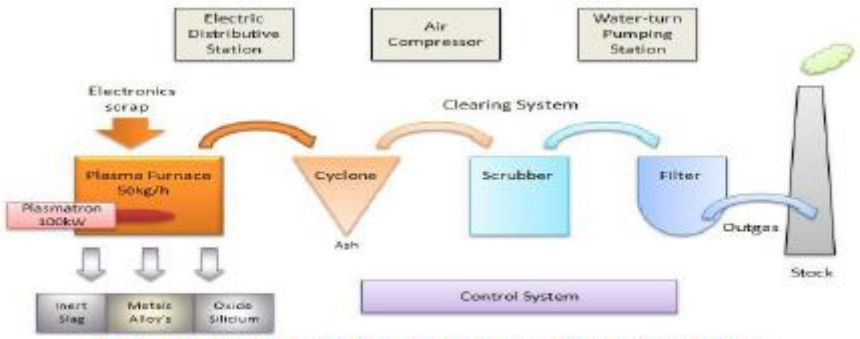

EQUIPMENT STRUCTURE OF E- WASTE PLANT

Conclusion

Electronic and electrical equipments cannot be avoided in today‟s world. So also is the case of waste electronic and electrical equipments.

As long as this is a necessary evil, it has to be best managed to minimize its adverse impacts on environment.

Through innovative changes in product design under EPR (Extended **Producer)**

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