A Case Study on Recycling & Reuse of E-Waste

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Abstract- *Every electronic product has a certain life period. The E-waste is one of the fastest growing environmental problem of the world, as there is a lack of awareness among the people about its serious impacts.The useful life of consumer electronic devices is relatively short, and decreasing as a result of rapid changes in equipment features and capabilities.More than 20 million tons of E-waste is produced in every year and disposal of which is the big challenging problem.By using machineries the collected e-scraps can be dismantle, segregation and separation of metal and fibres. E waste like Printed Circuit Boards(PCB) is generated a large quantity and it cannot be recovered into reuse. The Printed Circuit Boards(PCB) fibre is mixed with concrete as a ingredient. These processes are described and compared on the basis of available technologies, resources and machineries in E-waste.Every electronic product have a certain life period. The E-waste is one of the fastest growing environmental problem of the world, as there is a lack of awareness among the people about its serious impacts.The useful life of consumer electronic devices is relatively short, and decreasing as a result of rapid changes in equipment features and capabilities.More than 20 million tons of E-waste is produced in every year and disposal of which is the big challenging problem. By using machineries the collected e-scraps can be dismantle, segregation and separation of metal and fibres. E waste like Printed Circuit Boards(PCB) is generated a large quantity and it cannot be recovered into reuse. The Printed Circuit Boards(PCB) fibre is mixed with concrete as a ingredient. These processes are described and compared on the basis of available technologies, resources and machineries in E-waste.*

Keywords- environmental problem, life time, printed circuit boards(PCB).

I. INTRODUCTION

Electronic waste or E-waste describes when a electronic products discard after its end of life period. E- waste can be produced from many sources such as personal computers DVD players,mp3 players, laptops, LCD,LED televisions sets, mobile phone, etc.,, The electronic industry is one of the fastest growing industries in the world. The whole world is facing severe problems of E-waste. Advance countries are trying to find out the solution for this problem. Indian government carried out a survey and suggested some guidelines for this problem. The growth of software industries is a major role to generation of e-waste. Even today, India is among the world's largest consumer of mobile phones with 1.5 million tonnes of e-generated in 2018, most of the consumers are still unaware of how to dispose of their e-waste. Most Indians ends up selling their e-waste to the informal sectors, which poses severe threats to human lives, with improper and highly method of extracting the trace amount of precious metals from it and handling e-waste for profit.

The Printed Circuit Board (PCB1) manufacturing process is very complicated, involving many special chemicals and valuable materials. These materials discharge into the environment in the forms of wastewater, spent solution and solid waste. After years of research endeavors by academia, research institutes and the recycling industry, many valuable resources have been identified and the recycling of these resources have been very successful in commercial scale. Recycling of resourceful wastes generated by the printed circuit board industry includes (1) recovery of copper metal from edge trim of printed circuit boards, (2) recovery of tin metal from tin/lead solder dross in the hot air leveling process, (3) recovery of copper oxide from wastewater treatment sludge, (4) recovery of copper from basic etching solution, (5) recovery of copper hydroxide from copper sulfate solution in the plated through holes (PTH) process, (6) recovery of copper from the rack stripping process, and (7) recovery of copper from spent tin/lead stripping solution in the solder stripping process.

II. KEY BENEFITS

E-waste is the most rapidly growing segment of the municipal waste stream and the Global E-waste Management Market is expected to reach $49.4 billion by 2020, with compounded annual growth rate (CAGR) of 23.5% (2014–2020), with maximum share of e-waste management market attributable to information technology (IT) and

telecommunications, followed 124 E-Waste in Transition - From Pollution to Resource by household appliances and consumer electronic goods. E-waste contains many valuable, recoverable materials such as aluminum, ferrous metals, copper, gold, and silver. In order to conserve natural resources and the energy needed to produce new electronic equipment from virgin resources, electronic equipment should be refurbished, reused, and recycled whenever possible. E-waste also contains toxic and hazardous waste materials including mercury, lead, cadmium, chromium, antimony, and many other chemicals. Recycling will prevent them from posing an environmental hazard.

Today, the world is advancing too fast and our environment is changing progressively. Attention is being focused on environment and safeguarding of natural resources and recycling of waste materials. One of the new waste material used in concrete industry is PCB(Plastic Circuit Board). For solving the disposal of large amount of PCB waste material, reuse of PCB in concrete industry is considered as the most feasible application. In generally waste PCBs contains about 30% metals and 70% non metals. Metals in consist of large quantity of base metals such as copper, iron, aluminum and tin, and precious metals like tantalum, gallium, platinum, gold, silver and palladium. Hazardous metals such as chromium, lead, beryllium, mercury and cadmium are also present.

III. MACHINARIES USED FOR E-WASTE RECYCLING

SHREDDER / PALLETIZER:

The Palletizer is nothing but the Shredding machine. It will chop the Printed Circuit boards into small pieces. The boards will be cut into pieces by 17 cutting knives located inside. The total process is carried out in the closed system and the shredded pieces will be passed through the conveyor to the collection bins. At the collection point, one filter bag is provided to ensure there is no dust is being flown. This heavy duty Palletizer can crush at a rate of 300 Kgs per hour.

SHREDDER / PALLETIZER PULVERIZER / HAMMER MILL:

The Hammer mills / Pulverizer are connected with Collection Hopper and Filter Bag House. The Shredded board pieces will be crushed in the pulverizer where the Blower will push out the crushed particles to the collection Hopper. The shredded material will be fed into this Hammer mill to bring out fine powder. The Higher density material will be collected at the collection Hopper and the Low density material will be sent to the Filter Bag House. There are 16 number of filter bags located in one unit which can filter up to 10 micron size particles. It will control the dust generation as per the Air Pollution Control Measures.

BALL MILLER:

A ball mill, a type of grinder, is a cylindrical device used in grinding (or mixing) materials like ores, chemicals, ceramic raw materials and paints. Ball mills rotate around a horizontal axis, partially filled with the material to be ground plus the grinding medium. Different materials are used as media, including ceramic balls, flint pebbles and stainless steel balls. An internal cascading effect reduces the material to a fine powder. Industrial ball mills can operate continuously, fed at one end and discharged at the other end. Large to medium-sized ball mills are mechanically rotated on their axis, but small ones normally consist of a cylindrical capped container that sits on two drive shafts (pulleys and belts are used to transmit rotary motion). A rock tumbler functions on the same principle. Ball mills are also used in pyrotechnics and the manufacture of black powder, but cannot be used in the preparation of some pyrotechnic mixtures such as flash powder because of their sensitivity to impact. High-quality ball mills are potentially expensive and can grind mixture particles to as small as 5 nm, enormously increasing surface area and reaction rates.

The grinding works on the principle of critical speed. Critical speed can be understood as that speed after which the steel balls (which are responsible for the grinding of particles) start rotating along the direction of the cylinder device thus causing no further grinding.

BALL MILLER

CERAMIC BALLS

SHAKING TABLE / WATER SEPARATOR TABLE:

The crushed powder from the Hammer mill will be blended with water to make a paste form. It will be feed in to the shaking table. The table will be on continuous shaking at a constant frequency and the water from the collection tub will be kept on circulating on the table. The charged paste will be dispersed with water due to shaking, and the High density material (Metallic particles) will be moved aside and light density material (Non-Metallic particle/fiber) will be collected one side. Because the material is blended with water, there is no dust generation will be taken place.

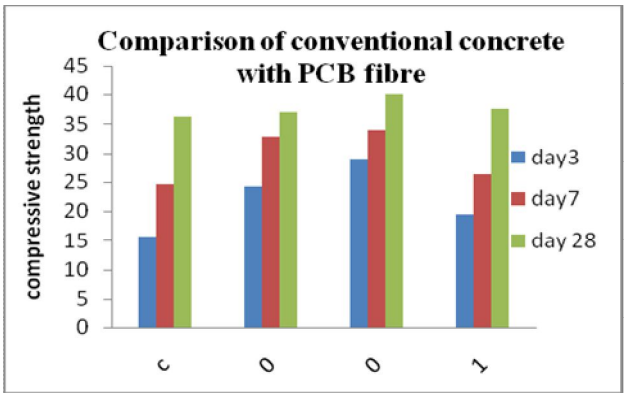
SHAKING TABLE / DENSITY SEPERATOR

IV. PROPERTIES OF PCB FIBER

Fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers. Within these different fibers that character of fiber reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation and densities.

Fibre-reinforcement is mainly used in shotcrete, but can also be used in normal concrete. Fibre-reinforced normal concrete are mostly used for on-ground floors and pavements, but can be considered for a wide range of construction parts (beams, pliers, foundations etc) either alone or with hand-tied rebars.

V. COMPARITIVE ANALYSIS OF NORMAL CONCRETE & PCB FIBER CONCRETE



VI. CONCLUSION

Based on the analysis & research made, this study concludes as follows:

- All type E-waste can be recyclable with sorting of waste materials and segregation of metals and non metals.
- Metals like gold, silver, copper, palladium, including rare metals, can recovered into reuse of new products. Non metals like PVC, plastic, lithium, cadmium, etc can be recyclable.
- PCB fiber cannot be recyclable so it is used for landfill. Landfill causes hazardous to our environment. As a substitute of this PCB fiber is mixing into the concrete as a ingredient.
- Compressive strength of PCB fiber concrete is compared with conventional concrete. Results of 28 days describes that 0.5% and 0.75% of PCB fiber concrete increases in strength and 1% of PCB fiber concrete remains same strength of conventional concrete.
- At 3rd day compressive strength of concrete gives nearly 50% higher than conventional concrete. So glass epoxy fiber gives strength quickly and these increases construction speed. This is the allied method to reuse of PCB fiber.

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