Recycling of Mobile Phone Waste

Md. Rubel Miah*, Abu Md. Saifuddoha, Md. Shohel Parvez, Abdun Noor, Chandan Chakraborty, Taslima Tabassum

Abstract— The purpose of this paper is to identify and address various wastes in mobile phone a Bangladeshi context. Critical observations and research techniques were used to identify and address various wastes in mobile phone. Major findings obtained from the study are as follows such as lead, beryllium, brominated flame-retardants, chromium, arsenic, cadmium, and antimony are considered toxic and harmful to the environment and human health. 90% of the materials within a mobile phone can be recycled. Mobile phone parts such as Batteries, Circuit boards, Handset housings and casings plastics, Accessories include plastics can be recycled to make new products. The paper addresses various wastes in mobile phone, which was hardly ever attempted before. Wastes activities are then individually attacked to reduce or eliminate them from the system. Suggestions to make the whole chain more productive can be generalized and can be replicated in the context of other developing countries.

Index Terms— Recycling, Mobile Phone, Waste, Environment, Pollution, Human Helath, Plastics

1 Introduction

Today in the modern communicative world, mobile phone has become an indispensable part of human life. In this case, our country is also indifferent to others. An important statistics shows below the position of Bangladesh according to mobile phone users:

Bangladesh (position: 14)85,455,000(Number of mobile phones user) 150,093,000(Population) 76.4(% of population) Dec. 2011[21] (Last updated date). But these billions of mobile phone users, have they thought about two questions:

1. Is the mobile phone Eco-friendly or environment friendly??
2. Is the mobile phone recyclable??

At firstly, many components of mobile phones such as lead, beryllium, brominated flame-retardants, chromium, arsenic, cadmium, and antimony are considered toxic and harmful to the environment and human health. At secondly, 90% of the materials within a mobile phone can be recycled. Mobile phone parts such as Batteries, Circuit boards, Handset housings and casings plastics, Accessories include plastics can be recycled to make new products. That's why it is decided to recycle mobile phone waste to make the environment safer and better.

- *Md. Rubel Miah is currently pursuing Master degree program in industrial & production engineering in Bangladesh University of Engineering & Technology,Bangladesh, PH-8801753702216. E-mail: rubel_ipe@yahoo.com*
- *Abu Md. Saifuddoha is currently pursuing bachelor degree program in industrial & production engineering in Khulna University of Engineering & Technology, Bangladesh, PH-8801911600367. E-mail: saifsf08@gmail.com*
- *Shohel Parvez is currently pursuing Lecturer program in industrial & production engineering in Jessore Science & Technology University,Bangladesh PH-8801673912772 E-mail:sparvez.ipe@gmail.com*
- *Abdun Noor is currently pursuing Master degree program in industrial & production engineering in Bangladesh University of Engineering & Technology,Bangladesh, PH-8801921803231. E-mail: bd.abdunnoor@gmail.com*
- *Chandan Chakraborty is currently pursuing Bachelor degree program in Leather engineering in Institute of Leather Engineering University of Dhaka, Bangladesh, PH-8801686886978. E-mail: chandanle27@gmail.com*
- *Taslima Tabassum is currently pursuing Bachelor degree program in Leather engineering in Institute of Leather Engineering University of Dhaka, Bangladesh, PH-8801924859194. E-mail: ttabassumle@gmail.com*

1.1 Impacts

Two impacts have been observed due to mobile phone waste. They are:

- Health impacts: Cancer, Asthma, Nerves breakdown, Hearing problem, Visual problem, Infant-mortality, disable baby birth.
- Environmental impacts: Air pollution, Water pollution, Land pollution and life threat for wildlife. The energy and raw materials used to produce new mobile phones every year contributes significantly to CO2 emissions and global warming.

So, this paper discussed about the adverse effects of mobile phone waste and through recycling try to reduce that adverse effect over humans and the environment.

2 Importance

Only 3% of mobile phones are currently being recycled in the world. In Bangladesh, still mobile phone recycling is non-introduced and unavailable. Bangladesh has generated 10,504 metric tons of toxics waste in cell phones alone in the last 21 years. Therefore, it can be estimated till June 2010 the volume of mobile phone waste is around 24,932,160 (24.93 million) [6], [8]. Now, the total number of mobile phone user in Bangladesh is almost around 86 million. 0.005 Million metric ton/year of mobile phone waste is produced every year in Bangladesh.

So it is very important to make proper use of these huge mobile phone wastes. Recycling mobile phone waste is significantly possible. This paper contributes to how to recycle mobile phone waste.

2.1 Recycling objectives and benefits

There are several benefits of recycling mobile phone: they are:

- 300 grams of gold, 140 grams of platinum and palladium, and 140 kilograms of copper can be recovered from approximately 1 ton of recycled mobile phones.
- The Battery recycling process focuses on maximizing the recovery of cobalt and other metals such as copper from the batteries for resale. The remaining products can then

be used in smelting works, cement factories and also as road building materials.

- Circuit boards contain small amounts of gold and silver that can be used in jewelry and other products.
- Handset housings and casings are made of plastics that can be shredded and used to make products such as fence posts and pallets. Accessories include plastics and metal can be shredded, sorted and used to make new plastic and metal products [2].

3 THE METHODOLOGY

3.1 Recycling procedure

Both branded and non-branded mobile phones have a warranty for 1 year and especially non brand sets are generating mobile phone waste. Recycling procedures of mobile phone waste is completed through these following four steps:

Step 1: Dismantling and sorting

Dismantle and sort into the following components - batteries (Lithium Ion), printed circuit boards, handsets, chargers/accessories, plastics, metals and paper/cardboard packaging.

Step 2: Battery recycling

Lithium-ion and lithium ion polymer (Li-Ion) batteries are reprocessed through pyrolysis (heat treatment). The recycling process generally begins by removing the combustible material, such as plastics and insulation, with a gas-fired thermal oxidizer. The plant's scrubber eliminates the polluting particles created by a burning process before releasing them into the atmosphere. This leaves the clean and naked cells with their valuable metal content. The cells are then chopped into small pieces and heated until the metal liquefies. On-metallic substances are burned off; leaving a black slag on top that a slag arm removes. The alloys settle according to weight and are skimmed off cream from raw milk while in liquid form [3].

Caution: Under no circumstances should batteries be incinerated, as fire can cause an explosion. Wear approved gloves when touching electrolyte. On exposure to skin, flush with water immediately. If eye exposure occurs, flush with water for 15 minutes and consult a physician immediately.

Step 3: Circuit board recycling

Circuit boards are stored and processed for precious metals including gold, silver, copper and lead. To extract these precious metals from circuit boards, with the need to safely remove components and recycle circuit boards, many different processes have been developed. The wide range of component types that may populate a board dictates the need for various approaches. Each technique can be characterized by its range of use, cost and safety to the component, labor demands, and form of heating.

Hand soldering tools have been used since the advent of electronics. Today, much of the hand soldering is used for reworking of damaged or faulty boards. It also is implemented as a component recycling process [3].

a. A hot bar/soldering guns

A Hot Bar is essentially a custom tip for a soldering gun used for specified component type and size. Using direct contact heat to the leads of a component, it provides much localized heating. It can safely remove high price components with some degree of user experience.

Due to this fact, the Hot Bar does require good user control for safety and therefore can be labor intensive. Another drawback is the maintenance of the tip. Contamination and general tip maintenance also can cost the operation time. Consequently, hand soldering finds limited use in the field and is reserved for special cases involving very high value components such as new components from a bad run in the manufacturing process.

b. Specialized Conviction or vacuum tools

As an advance towards specialized approaches, tools that can automatically heat capture and remove specific components are used. The convection-vacuum tool uses custom "sockets" that surrounds the component. Through the socket walls, the application of forced hot air around the lead frame melts the solder. These bench top setups have a suction device that attaches to the component face during the heating process. Once the solder is melted, the component is captured in the socket and removed from the board.

This lead arrangement is very fragile; being susceptible to bending which could render the component valueless. The process does not require much user training and has little error in overheating. It is a more costly approach with respect to heating time. Another drawback, similar to hand soldering is that the user must change sockets for every new size package.

c. Solder baths

A very common form of soldering is the direct contact of melted solder to the circuit board. In manufacturing, wave soldering is performed in which actual waves are produced in the solder bath, causing contact with the board suspended over the pool. As a derivative, recyclers use small pools of solder to provide focused contact directly under the component to be removed.

The process is more cumbersome than others due to the user dealing with a liquid bath. Care must be taken not to overexpose component packages to the molten solder, which causes overheating. As an environmental consideration, the use of molten solder containing lead also presents a compromise in the philosophy of reducing lead waste. As a case in point, a particular recycler revealed how their use of an aluminum foil layer over the pool to prevent splashing actually produced new hazardous waste. Once wrinkled or penetrated too much, the aluminum foil "skin" on top of the pool would now have to be treated as hazardous waste due to its contact [4].

d. Infrared heating

Infrared heat (IR) is used as another form of non-contact heating. Quartz halogen lamps can easily be the sources. Exposing the board to the light can rapidly bring the solder up to its melting point around 183° C. However, heating is not specific to the lead frame. All items in the general neighborhood of the chip are heated, with some variance due to absorptivity differences. This brings in a component safety issue with respect to how much and how quickly a component can be heated. Unfortunately judgment is primarily qualitative with respect to what is too hot, or too fast. In many cases, the operator will continue to heat faster and hotter so long as they do not see charring of the resin board or physical damage to the chip package. From this, it follows that a degree of operator experience is required. With each application of heat, the user must be able to judge how to operate the lamp. On the other hand, the value of this process lies in its speed. With high labor costs in this field, it is important to be able to heat as fast as possible. IR does not use hazardous materials in its process and is not component-specific. Another benefit of this process is that very little maintenance is required. For improved accuracy and thereby safety, more focused light beams are sometimes used to limit the exposure to the thermally fragile chip packages which are made up of plastics and ceramics [1].

e. Forced hot air

Forced hot air can be used in a similar fashion to IR heating. Usually heat guns similar to paint stripping guns are used for this process. The benefit of mobility is gained using these portable guns. The operator can easily redirect the flow of heat to optimize safe heating of the leads. Once again operator experience is needed, but not to the extent needed with IR heating. Convection heating is usually less rapid than IR heating and therefore reduces the chance of overheating. Forced hot air heating has a large range of applications and is widely used in recycling. It provides a low capital cost, generally simple process, which needs little or no maintenance. The process is basically waste-free and has found fairly widespread use in recycling.

Step 4: Plastic recycling

Bio plastics or recycling materials fast market growth of more than 8-10% per year. Bio plastics cover approximately 10-15% of the total plastics market and will increase its market share to 25-30% by 2020 [7].

There cycling of plastics is carried out in a five processes.

Process 1- Plastics collection: Handset housings and casings plastics are collected from roadside, special recycling bins and directly from customers.

Process 2 - Manual sorting: At this stage, the plastic is sorted into three types: PET (Polyethylene terephthalate), HDPE (high density polyethylene) and others.

Process 3 - chipping: the sorted is cut into small pieces and ready to melt down.

Process 4 – Washing: This stage removes contaminants such as paper labels, dirt and remnants of the product originally contained in the plastic.

Process 5 – pelleting: the plastic is then melted down and extrude into small pellets ready for reuse.

4 Discussion & Conclusion

The future mobile phone will have over 70 percent bio plastics or recycling materials, make it over 30 percent more energy efficient compared to oil-based plastics and reduce CO2 emissions by 35 percent. Environmental and human health impacts are associated with recycling of mobile phone waste. They are:

- Ensuring the discard of older damaged mobile phone to the environment. So the harmful effect of toxic substances over environment is reduced.
- Disposal of mobile phone waste can cause some serious diseases to human. By introducing this recycling procedure the hazardous impacts of older damaged mobile phone over human health is reduced
- It is estimated that up to 90% of these greenhouse gases can be saved by recovering materials from mobile phones than using virgin resources.
- Reduces the landfill of our country.

Preventing the contamination of the soil and enter the food chain. Preventing Air pollution, Water pollution, Land pollution and life threat for wildlife.

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