**Original Research Article****DOI: 10.26479/2019.0503.54****E-WASTE HANDLING – A CASE STUDY OF E-FRIENDLY AND ECO-BIRDD RECYCLING UNITS, BANGALORE****K. L. Prakash\*, Shaikh Mubarak N.**

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**ABSTRACT:** E-Friendly and Eco-Birdd Recycling-waste units, Bangalore were randomly selected, during February to April, 2018. E-friendly unit performing with proper segregation, dismantling, shredded waste sort out and upgrade scrap to usable and saleable gives to the recycling, treatment of waste as per guidelines of KSPCB and safety precautions and measurements as per labors act. Similarly, E-Birdd unit has separates the metallic and non-metallic substances by free hand technique. The separated metallic substances were quantified and stored for export. The dismantled product of metal was chemically treated and not accessible waste were melted and leached with acid for further purification. PCBs components were recycled as having more economic value. The electronic items of plastic and glass such as the fax-machine, light bulbs and dry cell gadgets were recycled. The metal components of Resistors, connectors, diode's, transistors were removed before disposal. Treatment and disposal of effluent and incineration was done by the association of both units with GOMTI and Greencept. It is recommended to minimize e-waste by maximum usage of electronic gadgets, till their end of life, e-waste is managed at the source level; It would be better to have a single gadget with all the functionality, uses, long lasting durability and designed for minimum of 20 to 30 years, instead of making the advancement one after the other by launching upgraded electrical and electronic goods which generates significant amount of previous gadgets as the e-waste.

**KEYWORDS:** E-waste, metal extraction, recovery, recycling, E-friendly technique.

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## 1. INTRODUCTION

The creation of innovative and new technologies and the globalization of the economy have made a whole range of products available and affordable to the people changing their lifestyles significantly. New electronic products have become an integral part of our daily lives providing us with more comfort, security, easy and faster acquisition and exchange of information. But on the other hand, it has also led to unrestrained resource consumption and an alarming waste generation. Both developed countries and developing countries like India face the problem of e-waste management [2]. Electronic waste, or e-waste, refers as all the items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use (Step Initiative, 2014). E-waste is also referred to as WEEE (Waste Electrical and Electronic Equipment), electronic waste or e-scrap in different regions and under different circumstances in the world [11, 24]. Whereas European WEEE Directive defines Electrical or electronic equipment that waste including all components, sub-assemblies and consumables, which are part of the product at the time of discarding. It includes a wide range of products – almost any household or business item with circuitry or components with power or battery supply. There are six groups of e-wastes mainly from temperature exchange equipment, Screens, monitors, Lamps, small and large equipments; and Small IT and telecommunication equipments. Hence the significant amount of e-waste generates from developed countries like China, Australia and USA etc [26]. Each type of e-waste has different waste quantities, economic values, as well as potential environmental and health impacts, if recycled inappropriately [6, 16, 25, 30, 31]. Consequently, the collection and logistical processes and recycling methods are different for each category; secondly the consumer's attitudes when disposing of the electrical and electronic equipment also vary [4, 5]. E-Waste or Waste Electrical and Electronic Equipment (WEEE) are the term used to describe old, end-of-life or discarded appliances using electricity [15]. It includes computers, consumer electronics, fridges etc. which have been disposed of by their original users. Precious metals are used in electronics for their superior conductivity and resistance to oxidation. Gold is used as solder and a connection pad where good electrical connections are paramount; this is easily seen on cell phone battery connections and on some audio cables viz., Silver is used in batteries, solder and switches, Palladium is used in capacitors and solder pad, Cell phones and other electronic items contain high amounts of precious metals like gold or silver. It was observed that in every 1 million recycled cell phones, 35,274 lbs of copper, 772 lbs of silver, 75 lbs of gold, and 33 lbs of palladium can be recovered. The fraction including iron, copper, aluminium, gold and other metals in e-waste is over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70% [29]. PCBs contain high amounts of precious metals; about 20 wt% copper, 0.04 wt% gold, 0.15 wt% silver, and 0.01 wt% palladium. These Electronic wastes can cause widespread environmental damage due to the use of toxic materials in the manufacture of electronic goods. The extraction of these metals from PCBs is both profitable and

environmentally worthwhile [1, 3, 17, 20]. Globally, 44.7 million metric tons of e-waste was generated during 2016 and it is expected to increase to 52.2 million metric tonnes, or 6.8 kg/inh, by 2021, In Asia; around 18.2 Mt, or 4.2 kg per inhabitant, Approximately 2.7 Mt was documented to be collected and recycled during 2016[4]. Whereas, Oceania generated the highest quantity per inhabitant: 17.3 Kg/inh. However, Oceania generated the lowest quantity of e-waste in the world in 2016 at 0.7 Mt, and could only document 6% of its e-waste that was documented to be collected and recycled (43 kilotons (kt)). The European continent, including Russia, generated an amount of e-waste per inhabitant comparable to Oceania (16.6 Kg/inh). In total, the e-waste generation for the whole region is 12.3 Mt. About 4.3 Mt of e-waste was collected to be recycled in Europe, showing the highest regional collection rate of 35% compared to e-waste generated. The lowest amount of e-waste per inhabitant was generated in Africa; 1.9 kg/inh. The whole continent generated 2.2 Mt of e-waste, and with current data, only 4 kt were documented as collected and recycled; this is less than 1%. In 2016, the America generated 11.3 Mt of e-waste: 7 Mt for North America, 3 Mt for South America, and 1.2 Mt for Central America. The whole continent generated 11.6 kg/inh of e-waste, and approximately 1.9 Mt of e-waste documented was collected and recycled. The e-waste generation between developed and developing countries is quite large and an average of 19.6 kg/inh, and 0.6 kg/inh respectively. Only 20% of E-waste Generated is documented to be collected and recycled. Of those 44.7 Mt, approximately 1.7 Mt are thrown into the residual waste in higher-income countries, and are likely to be incinerated or land-filled. Globally, only 8.9 Mt of e-waste are documented to be collected and recycled, which corresponds to 20% of all the e-waste generated. In India, as per Comptroller and Auditor- General's (CAG) report, over 7.2 MT of industrial hazardous waste, 4 lakh tonnes of electronic waste, 1.5 MT of plastic waste, 1.7 MT of medical waste, 48 MT of municipal waste were generated annually. A total Quantity of WEEE (Waste Electrical and Electronic Equipment) generated in India. Observed that, Maharashtra tops and other states leading in the generation of e-waste are Tamil Nadu, Andhra Pradesh, Uttar Pradesh and West Bengal during 2011 [21]. Increasing levels of e-waste, and improper and unsafe treatment, and disposal through incineration or in landfills pose significant challenges to the environment and human health[8, 12, 19, 22] and to the achievement of the sustainable goals of developments. A better understanding and more data on e-waste will contribute to the achievement of several goals of the 2030 Agenda for Sustainable Development. It will help address the SDGs related to environmental protection and health, employment and economic growth, because of sound management of e-waste can create new areas of employment and drive entrepreneurship, in addition to Goal 3 (Good health and Well-being), Goal 6 (Clean water and Sanitation), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), Goal 14 (Life below Water), and Goal 8 (Decent Work and Economic Growth). E-waste, when treated inadequately, poses serious health issues since it contains hazardous components, including contaminating air,

water, and soil, and putting people's health at risk[23]. Dismantling processes that do not utilize adequate means, facilities, and trained people pose additional threats to people. Target 12.5 aims to substantially reduce waste generation through prevention, reduction, repair, recycling, and reuse. An increasing number of people on the planet are consuming growing amounts of goods, and it is critical to make production and consumption more sustainable by raising awareness levels of producers and consumers, specifically in the area of electrical and electronic equipment. Target 8.8 calls for the protection of labor rights and promotes safe and secure working environments for all workers, including migrant workers, particularly women migrants, and those in precarious employment. The sound management of e-waste can create new employment and contribute to economic growth in the recycling and refurbishing sector. Now, e-waste is often processed in the informal sector, and many e-waste disposal and recycling jobs are unsafe and not protected by formal regulation. It is therefore necessary for countries to formalize the environmentally sound management of e-waste and to take advantage of the business opportunities it offers. In Australia, it is about 10% of e-waste was recycled and 80% was disposed by landfills during 2007–2008 [28]. In this connection, the present study was aimed at establishing first-hand information on the quantity of e-waste generated, metal recovery from e-waste and disposal techniques of unrecyclable e-waste. Establishment of e-waste collection, exchange and recycling centers should be encouraged in partnership with governments, NGOs and manufacturers [18].

## 2. MATERIALS AND METHODS

E-Friendly and Eco-Birdd Recycling-e-waste units, Bangalore were randomly selected, during February to April, 2018.

### Study area

The work carried out in the unit of recycling is studied and status of the e-waste treated and disposed was observed. It was done on 24<sup>th</sup> of February 2018 to April 28<sup>th</sup>, Every Saturday and Monday respectively one after the other unit.

1. The unit e-friendly e-waste recycling Bangalore, has the capacity of 1 tonne of e-waste per day storage and are the primary dismantlers of the e-waste extracted. The next unit is the eco-birdd e-waste recycling Bangalore has the capacity of 2 tonnes of e-waste per day. Dismantling, extraction of the metal process and acidic treatment were keenly observed and documented. Disposal of effluent and land fillings was carried out by, association of both units with different agency of effluent treatment and incineration such as GOMTI and Greencept (GOMTI is the agency providing the incineration services, Kumbalgodu, Bangalore and Eco green is the effluent and waste water treatment plant, located in Seshadripuram, Bangalore). The environmental condition and the hygiene with the safety measures provided to workers were studied. The recoveries of the various types of reusable items were noted down. Disposal

mechanism employed such as, land filling and incineration of the waste are observed and details of recycling units were given in table no. 1.

2. Eco-Birdd recycling is India's First Informal to Formal E - waste management Company begun its operations in 2010, head quartered at Bangalore. We provide end to end solution for all electronic waste generated in an eco-friendly way and sustainable model. We collect e waste from PAN India and managed in Bangalore. Eco-Birdd was cluster of recyclers joined together to form revolutionary tale of saving the environment. Eco – Birdd is authorized form Karnataka State Pollution control board (KSPCB) Govt of Karnataka. And has guidance from German Development Corporation (GIZ). Eco-Birdd is one stop solution under one window for all kind of E- waste management and recycling to lead the recycling revolution by adopting appropriate technology in obtaining the best out of e - waste while ensuring protection of nature Eco Birdd has Adopted ISO 9001,14001,18001 For Proper Disposal of E-waste.

Eco Birdd Recycling unit target to

- Maintain the Customer Satisfaction Level at a minimum of 90%.
- Ensure zero workplace incidents.
- Ensure the personnel are trained on the topics of QEHS at least once in a quarter.
- To reduce the use of electricity by 2% per annum.
- To review legal requirements once in 6 months and/or when the legal requirements are amended, added or removed by the legal authorities.
- Reduce wastewater discharge by 1% per annum.
- To review our organization's processes once in six months for continual improvement of the processes.
- To do at least 1 continual improvement per annum in each of Quality, Environmental, Health and Safety aspects.

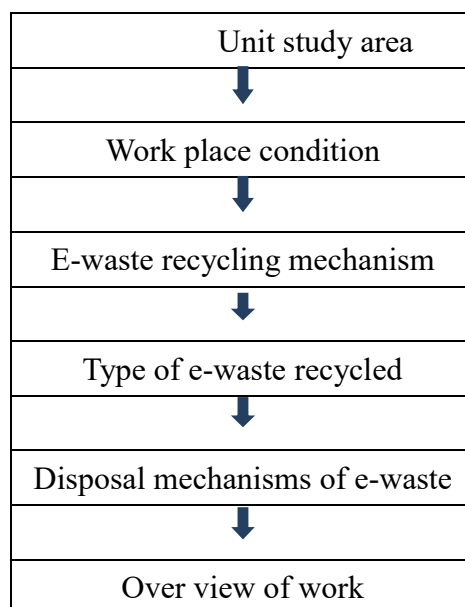
**Table No. 1. Details E-friendly and Eco-birdd e-waste recycling units, Bangalore**

Sl.No.	E-waste recycling unit	E-friendly	Eco-birdd
1	Location	#17, 1 <sup>st</sup> floor, 1 <sup>st</sup> cross, Azeezsait Industrial town, Nayandahalli Bangalore	#185, 1 <sup>st</sup> main, 1 <sup>st</sup> cross, Azeezsait Industrial town, Nayandahalli Bangalore
2	Established	2000	2009
3	Certifications	KSPCB certified	KSPCB certified
4	Registration	Under KSPCB	Under KSPCB
5	E-waste treatment techniques	Primary e-waste dismantling	Primary and secondary dismantling, and metallurgical techniques used in recycling of e-

			waste
6	E-waste treatment and storage capacity	1 tonnes/day	2 tonnes/day
7	No. of employs working	15	15
8	Safety measures	Disposal mechanism	Associated with greencept and GOMTI, for land filling , effluent treatment and incineration respectively
9	Disposal mechanism	Associated with greencept and GOMTI, for land filling, effluent treatment and incineration respectively	Associated with greencept and GOMTI, for land filling, effluent treatment and incineration respectively

### Hierarchy of Work flow in both recycling units

#### Visit to E-waste units



### 3. RESULTS AND DISCUSSION

#### Field study and Findings

##### Study area 1

E Friendly recycling is one of the authorized and it is located in Bangalore. This unit services as dismantler and trader in e- waste from past 18 years. The main constant effort is towards the transformation of dismantling e-waste from local vendors to authorized professional e-waste recyclers. The basic processing of the e-waste is done by the dismantling of the different electronic waste. The unit was established in the year 2000 and is recognized by the Karnataka State Pollution

Control Board (KSPCB). It aims at making the waste generated from the electronic products to reused and recycled as much as possible. E-friendly and waste recycler's unique ability to sort into different categories and upgrade Scrap to turn usable and saleable gives to the recycling, the technical aspects of the treating waste with the guideline on the safety and precautions. The working of the e-waste treatment is as per the industrial guideline and norms. The recycling unit is around 150 square feet area. It has the capacity of storing 1 tonne of the E-waste. About 15 employees were working with a different designated capability of the work. The employees were provided with all the safety precautions and measurements as per labors act. As such environmental concern, the unit was certified by KSPCB as following the state pollution control board standards. The long term vision of the unit is to establish lasting relationship with their customers and Professional partners by exceeding their expectations and gaining their trust by contributing to greener environment with ethical business practices, quality workmanship and service minded attitude. It is the company's responsibility as a member of local communities in which it operates to proactively contribute to the environment through its business activities as well as non-business activities.

### **E-Waste Collection and recycling**

E-friendly and waste recycling installed customized collection bins in electronic retailers and Service centers. The experts were well equipped to handle any size pickup servicing small business large corporations and entire cities. E-friendly and waste recyclers offer a complete onsite pickup point service to the customer. The electronic waste was stored and transported as per the industry norms approved by KSPCB with special rubber matted rack fabricated truck.



**Fig 1. showing the e-waste storage house**



**Fig 2. Packed e-waste**

### **Pre-picking**

End-of-life electronics recycling process begins with a conveyor line in which items that should not be shredded, such as batteries, UPS battery systems, toner cartridges, and fluorescent lights, CRT monitors, are removed by hand before they enter the main stream.





**Fig 3. Segregation of e-waste Storage compartment**

### **Water separation**

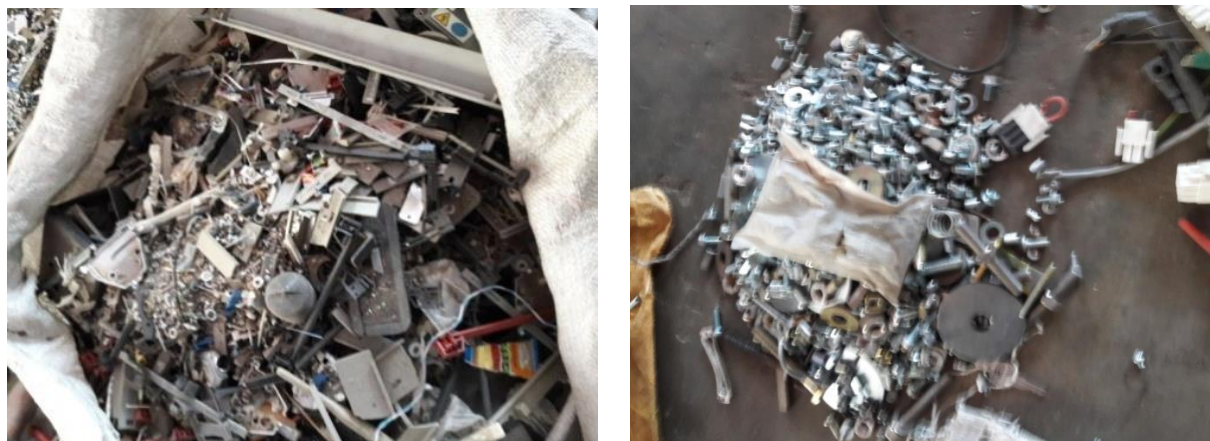
Water is used to separate plastic from the glass in which separation of e-waste on the basis of settling capacity in water. The suspended waste is freely removed and effluent is sending for treatment and discarded safely.

### **E-Waste Shredding**

“Garbage in, garbage out” is the vital to recycling end-to-life electronics. If the quality of the material stream fed to the recycling line is poor, then the quality of outputs will also be poor as well. This means that starting with “homogenous” lots of e-waste is necessary to effectively refine electronics into quality commodities. After e-waste has been pre-picked, it was flowed into the shredding line to be sized down for commodity separation. The main shredder breaks material down into small fragments and the final shredder reduces it further into poker chip-sized fragments that were optimal for the separation process. The dismantled e-waste is shredded; the primary level of recovery of the metal content waste is separated out. The keen hand work of dismantling with proper guidance and handling technique was done to maximum recovery of whole component was done. Further the unbreakable or unable to dismantle waste is regarded as the secondary e-waste, which was recycled by the advanced techniques.







**Fig 4. Shredded and fragmented waste after dismantling**

### **Shredded materials**

After e-waste has been shredded into optically-sized fragments, it was entered into the separation line where it was segregated into various commodity types using sophisticated technologies including eddy current, optical identification, and magnetic separation. The first separation stage divided the material into metallic and non-metallic content, and the second stage further separated the metal stream into different varieties.



**Fig 5. (a) dismantled computer part, (b) shredded copper, (c) shredded wire, shredded (d) speaker and (e) PC**

The following are the dismantled e-wastes studied in the unit

1. PCB Boards
2. Assembly boards
3. Connectors
4. Power supply connectivity
5. Printers
6. Green chips,
7. UPS
8. CPU
8. Computer items and many other such electronic items

**Recycling Method**

The e-waste collected was segregated first into the reusable and non reusable waste. The dismantling was done; such reusable items were carefully removed and sent to agencies that make use of it. Hydrometallurgical method was used for the further separation of complex and rejected e-waste through leaching with the acid and alkali solution. The e-friendly recycling unit was taking all types of e-waste as having experts for dismantling and separation of complex e-waste to the dismantled waste. During dismantling, the minor amount of reusable items were extracted and made it for useful purposes such as the working components of the discarded computer, TV, electronic machines and etc. The basic extraction/metals recovered from the primary stage of dismantling. Threshing, sieving, free hand separation and such techniques were employed. The recovered items were exported to the Moradabad, Delhi, Hyderabad where these items converted into the raw materials for different agencies of E-waste treatment. Whereas, plastic wastes such as the dismantled PCB boards were sent to E-Parisara (E-waste recycling unit, Bangalore) and many other recognized units, for treatment of non reusable wastes and disposed off.

**Overall view of the unit**

The E-friendly recycling unit is primary level recycling unit which as the tied up with the different recycling units and contributed to management of e- waste generated by reusing and recycling mechanism. The in turn are making the waste to be use full and to make maximum conversion of waste into raw materials. The electronics items were recovered as having more economic value as they are the complex arrangement of all the different metals, jam's, and many other things. Similarly, the non-degradable, hazardous, items such as the plastic, polymers and poisonous gas were also recovered. The processing of almost 1 tonne per day capacity of the unit is effectively associated in recycling as it's the one the best way of managing the waste generated. E-friendly ensures of not making the waste to out of out, instead it was performing well in the favor of the environment. The effluent was treated and discharged without harming to the environment.

**Study area 2**

The eco-birdd recycling unit ensures to recycling, dismantling, disposal of the electronic, electrical, and equipment waste. They even expertise's extraction of precious metals from the e-waste generated. Established in the year 2009 is one of the e-waste recycling units in Bangalore. The unit Area of the plant is 2950 sq.ft, of Industrial Area. The Installed Capacity of storage of the e- waste is around 350MTA (approx. 2 ton/day). No of the employees working in the unit are 15 with all the safety precaution and guidelines. Eco Birdd Recycling Company Pvt. Ltd. shall strive to be the leader in providing quality and E-Waste Recycling services that meet or exceed the requirements of our customers and other stakeholders. They express our sincere commitment to:

- Establish, implement, monitor, maintain and continually improve the Organization's QEHS Management System;

- Improve customer satisfaction by satisfying and exceeding customer requirements;
- The Continual improvement of QEHS management system by periodic review of the Organization's processes and by suitably improving the processes Provide adequate training, information and instruction to our employees on quality activities, environmental protection, workplace health and safety;
- Reduce operating costs and add value to our services;
- Improve environmental, quality, health and safety performance through conservation of natural resources, waste minimization, prevention of pollution and prevention of ill health and injuries to our employees, customers and other stakeholders by providing a safe working environment;
- Prevent Environmental, Health and Safety Incidents by taking appropriate steps;
- Ensure Compliance to the legal and other regulations applicable to Eco Birdd Recycling Company Pvt. Ltd.;

### **The collection the e-waste**

The e-waste is collected from the household to the different sectors such as the schools, hospitals, industries, bulk genitor's, producers, consumers, NGO'S and such sectors. They are been taken to the treating e-waste from the scrap dealers.



Fig 6. Collection, Storage and Segregation

The storage is done after the segregation of hazardous and non-hazardous waste. They are kept followed by the disposal separately in the different compaerts of storage [9, 13, 14]. The reusable items are separated from the waste and the dismantling products are take from the process

### **Dismantling**





(c)

**Fig 7. (a), (b) and (c) Dismantling of computer component and PCBs**

The dismantling is done with all the guideline and safety precautions. All the safety items are given to the labors such as goggles, mask, hand gloves and environment is also maintained such that no harm to be happen any of worker and outsider.

### **Segregation**

The separations of metallic substances from non-metallic were done from the free hand technique. The separated metallic substances were weighed and stored for export and even to export those agencies, who recycle them to new.

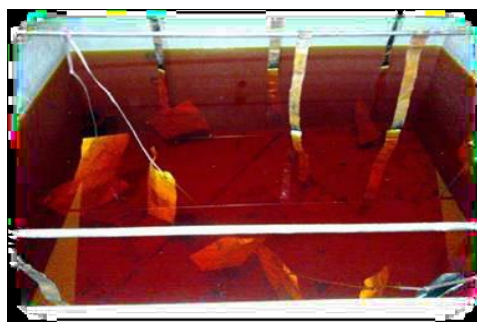


**Fig 8. Metal Recovery by free hand and ling method**



**Fig 9. Dismantle waste treated with chemicals melting with high temperature**





**Fig 10. Furnance with acid treatment**

The dismantled product is having the metal emended is treated with the chemical treatment methodology. As the dismantling of such waste is not accessible, it has to melted and leached with acid for the further purification.

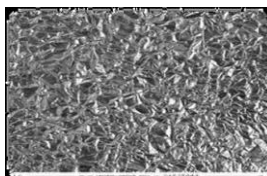
### **Recovery of scrap metal from dismantled waste**



Iron



Copper



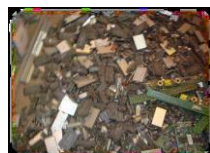
Aluminum



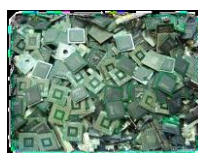
Brass



Resistor



IC's



chips



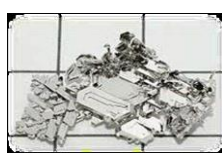
Connectors



Gold coated



Silver coated



Platinum



Coated mater

**Fig 11. Different metal extracted in Eco-Birdd recycling unit**

## Environmental Management Measures

### Solid waste

Typically, Eco Birdd would generate an average of 20 Kgs of solid waste per day the waste shall be stored at hazardous waste storage room and disposed off to TSDF.

### Liquid Waste

The waste water which is generated from Eco Birdd recycling while recovering of precious metals that waste water will be send off to CEPT.

### Air Emissions

The dust generated during the dismantling unit may contain traces of lead, cadmium and other heavy metals. It was extracted using a dust extractor (hood) provided with cyclone chamber.



**Fig 12. Working place of dismantling, cyclone chamber, Connection with bag filters**



**Fig 13. Bag installed in cyclone chamber and cyclone bag filter with stack**

This further separates the dry and the dust from air stream .the bag filters to be cleaned stored in sealed in Hazardous waste store room and dispose off to TSDF the effluent is sent to the green C E P T.

### Overall view of the unit

Eco-birdd recycling unit is well recognized e-waste recycling unit; it is running the unit with the dismantling to the extraction metals and other reusable items. The guidelines of the state pollution control board and ISO standards are been well maintained. This recycling unit is eco-friendly and



has no harm towards the environment. Recycling of the e-waste is the main motto the of the treatment unit. As much a possible the reuse of the waste has been mainly focused. Around 2 tonnes of the waste is been processed and the retained waste is take for land filling and disposal sites. Extraction of the metal is the major aspect the treatment. The export the usable items such as the computer components were economically feasible. The hazardous and waste separated from the recycling is making to segregate and dispose it in proper manner

### Quantification of recovered E-waste

The e-waste recycled from both the units followed recycling methods such as the dismantling and the segregation in the primary level e-waste recycling. The secondary level e-waste was recycled by extracting the metal present in those e-wastes. The various types of e-waste and electronic waste recycled by primary and secondary level, mainly focused on retaining reusable items and extracting metals present in them as much as possible is depicted in table 2.

**Table 2. Details of metal extraction and cost recovery of electronic e-waste in E-friendly and Eco-Birdd e-waste recycling units, Bangalore**

Type of e-waste	Reusable component	Method of recycling	Metal extracted	Amount drawn in Rs/kg of recycled e-waste
<b>PCB</b>	Connectors, didoes, Coils	Dismantling, Pyrometallurgy, Hydrometallurgy	Gold, Copper, Silver, Aluminum	200-250
<b>Assembly boards</b>	IC, Connectors, didoes, Coils	Dismantling	Gold, Silver, Aluminum	80-100
<b>Power supply connectivity</b>	Aluminum coil	Dismantling	Aluminum,	50
<b>Green chips</b>	Nill	Dismantling, Pyrometallurgy	Gold, silver (sharps)	150
<b>Computer monitor</b>	IC, Connectors, didoes, Coils	Dismantling, Pyrometallurgy, Hydrometallurgy	Gold, Copper, Silver, Aluminum	150-200
<b>CPU</b>	IC, Connectors, didoes, Coils	Dismantling, Pyrometallurgy, hydrometallurgy	Steel, Copper, Silver, Aluminum	25-30
<b>Printer</b>	Nill	Dismantling,	Iron, steel,	20-30

		Pyrometallurgy, hydrometallurgy	Aluminum, Gold clotted pins	
<b>Fax machine</b>	Mother board, connectors,	Dismantling, Pyrometallurgy, hydrometallurgy	Iron, steel, Aluminum	10-12
<b>Mobile phones</b>	Dc motor, micro phone, mother board	Dismantling, Pyrometallurgy, hydrometallurgy	Silver, aluminum, steel, copper	30-50
<b>Batteries (all types)</b>	Nill	Pyrometallurgy,	Copper, Aluminum	5 - 8
<b>Circuit boards</b>	IC, Connectors, diods, Coils	Dismantling, Pyrometallurgy, hydrometallurgy	Gold, Copper, Silver, Aluminum	50-60
<b>TV</b>	IC, diodes, mother board	Dismantling, Pyrometallurgy, hydrometallurgy	Copper, Silver , Aluminum	50-60
<b>LCD</b>	Mother board	Dismantling, Pyrometallurgy, Hydrometallurgy	Iron, steel, Aluminum, Gold clotted pins	80-100
<b>60 and 100 Watt bulbs</b>	Nill	Dismantling, Pyrometallurgy, hydrometallurgy	Tungsten, Aluminum	15
<b>IC</b>	Nill	Dismantling, Pyrometallurgy, hydrometallurgy	Aluminum, copper	5-10
<b>Discarded wire</b>	Nill	Dismantling, Pyrometallurgy, hydrometallurgy	Copper, aluminum,	40-50
<b>Electric boards</b>	Connector, diods,	Dismantling, Pyrometallurgy, hydrometallurgy	Copper, aluminum,	30-40
<b>laptops</b>	Mother board, connectors, diodes	Dismantling, Pyrometallurgy, hydrometallurgy	Iron, steel, Aluminum, Gold clotted pins	60-70

The above table 2 indicated that, most of the e-waste generated is more of computer waste. The other electronic wastes are as much as contributing in the e-waste. All most all the daily life

electronic items are seen one or the other way regarded as the e-waste, depending on their usage and way of handling. PCBs being the major e-waste recycled which have the economic value around rupees 200 to 250. Since it contains all the different metals in higher as well as lower amount, the entire PCB board could be reused depending on its condition. If not it could undergo recycling and extraction metals could be done [7]. Whereas the electronic items made more amount of plastic and glass such as the fax-machine, light bulbs, dry cell gadgets could be recycled and also have economic value around 20-30 rupees, but they are not focused for the recycling but mainly meant for the disposal. All the other electronic and electric e-waste have sufficient amount of metals having economic value around rupees 150 to 250. The extraction could be extracted by employing the proper recycling methodology. Resistors, connectors, diode's, transistors, and all most all the complex connectivity has the metal in them, which have to be removed out before ending it for disposing. Additionally, it is expected that educational programs and learning resources will educate and encourage the public to seek sustainable products for betterment of future generations [27].

#### 4. CONCLUSION

Bengaluru, the silicon city, e-waste recycling is a multi-crore market where e-waste is received in Gowripalya and Nayandahalli. The e-waste scrap dealers send the segregated and dismantled e-waste parts to Delhi and Mumbai every alternative day. The e-waste recyclers earn around Rs. 2-3 lakhs a month from selling the dismantled e-waste to Delhi. There are a few recycling centers in Karnataka like e- Wardd, e- Parisara, K.G. Nandini Recyclers, Ash Recyclers, New Port Computer Services India Pvt. Ltd. Recyclers and E-R3 Solutions Pvt. Ltd. In the formal sector, E-Parisara has been encouraged by the Central and State Pollution Control Board which would like it replicated in all major cities in the country. The Boards' initiative attempts to carefully recycle old computers, components and other e-waste, generated by both IT companies and electronic manufacturers. The centre has equipment to recycle up to three tonnes of waste a day, but is dealing with around one tonne presently. According to the owner, many corporates such as IBM, Tata Elxsi, ABB and Phillips are among its clients. But many major IT firms are yet to send their e-waste or stipulate difficult conditions for not sending their e-waste. Bangalore being a major sector IT and BT companies, the use technology is almost advanced and recognized throughout the world. The electronic and electrical gadgets and equipments are day by day growing spontaneously, which in turn rapidly generating a lot of e-waste continuously. The upgradation of the new advance electronic and electrical gadgets is one of the reasons for making the disposal of working and good condition electrical gadgets. They are dumped directly with the municipal waste, which is making the waste to be more hazardous and non-degradable. There are around more than 30 registered e-waste recycling units in Bangalore. There are other several unregistered, unauthorized and small scale units of e-waste managing which are only practicing the smelting, dismantling and segregation processes.

The best way of minimizing the e-waste is by adapting the proper use of those electronic gadgets, till their end of life. Instead of disposal of e-waste we can make use of it by recycling and retaining the raw materials such as the metals [10]. The other uses could be making artistic monuments and fascinating creatures such as the junk arts, artificial flower decorations and many such things. The best way of managing e-waste is at the source level, the necessity of such advanced electronic equipment and gadgets must be avoided, if they are not required or needed at present. Mankind must have to overcome from the profit and loss strategies in terms of economy which do not concern about the environment. It would be better to have a single gadget with all the functionality, uses and long lasting durability, instead of making the advancement one after the other by launching upgraded electrical and electronic goods which makes the previous gadgets as the e-waste.

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### **CONFLICT OF INTEREST**

Authors have no conflict of interest.

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