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Exploring Electronic Waste Recycling Methodologies in India: A Big Challenge

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ABSTRACT-

This is a study on various different methods which are used for recycling of the electronic waste (e-waste). The e-waste is generated from number of electronic gadgets that we use in our everyday life, we are bounded by them. When the life of these gadgets exceeds its span they are given to the scrap dealers which remove the good and expensive parts and the rest is dumped openly. This results in hazardous damage to the ecosystem and environment. Therefore, it is necessary for the e-waste to be recycled with its awareness to the society. In India, there are various cities like Mumbai which contributes to maximum e-waste production annually. This develops a necessity of an effective recycling regime for e-waste in India.

Introduction

Let us understand the term 'e-waste'. It does not belong to the category of the normal waste. E-waste contains the discarded televisions, mobiles phones, personal computers, cathode ray tubes, air conditioners, refrigerators, washing machine, electronic games, etc. In the year 2021-2022, India produced about 160.15 MT of e-waste and of which only 37% was recycled which still a big problem of the nation.

The electronic waste contains various expensive metals for example platinum, gold and silver and also contains the hazardous materials like lead, cadmium, barium, lithium, mercury, nickel, chrome, arsenic, CFCs, PCBs, etc are dangerous for humans. These poisonous elements have its adverse effect on the ecosystem which also harms plants, animals and flora and fauna.

India comes under one of the most highly populated country in the world. In the recent decade, there has been huge development in technology, which is resulting in production of various time-saving electronic and electrical gadgets like mixers, grinders, washing machine, etc. In the long run this equipment are discarded and replaced by its latest version. This results in collection of huge amount of e-waste in dumping yards and in informal sector.

The main contributors to e-waste are the government sector, private sector and the manufacturers and the remaining is the public. Rapid growth in the technology has led in building heaps of the outdated gadgets which is drastically contributing to the production of e-waste globally.

The pollution due to e-waste is big concern globally. Air and water becomes poisonous. Dumping grounds of e-waste made the soils to loose its fertility, hence affecting farming activities and vegetation. The volume covered by dumping ground is totally polluted due to the exposure of the threatening elements present in the e-waste. Also, plastics and many such low rated materials used in electronics gadgets are generally burnt in an open space causing huge amount of air pollution.

State wise e-waste production

In India, the production of e-waste has risen to a great extent with rising development in technology. This has led to huge production of e-waste in the country. A percentaged data is shown in fig 1.2 which shows the major states contributing to the production of e-waste in India in 2021-22.

Fig 1.2 : Top 5 E-waste producing states in India in tonnes/year

In India, about 35 percent of e-waste is generated in western part of India, while southern region contributes to about 30 percent. Northern ranks third with the contribution of 21 percent and the eastern region accounts 14 percent in e-waste generation in India.

A recent study by the researchers of UPES Dehradun has stated that the percentage of e-waste is increasing by around 25 percent every year and is said to be increased as more population will have an access towards electronic items.

City wise e-waste production

Fig 1.3 shows the scenario of production of e-waste in the cities of India with maximum e-waste production in 2021-22.

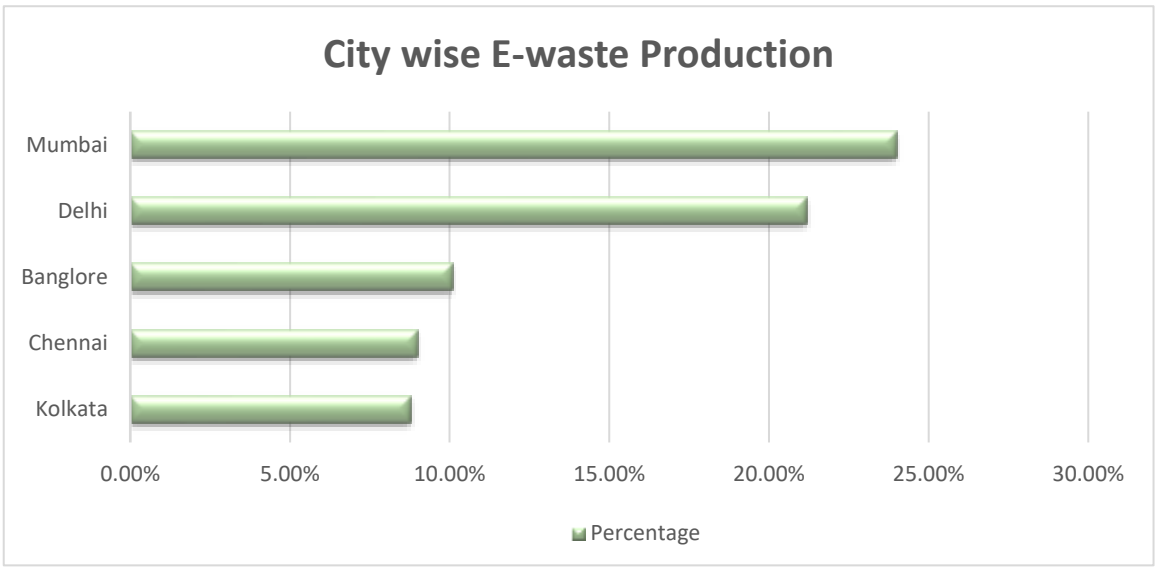

Fig 1.3 : City wise e-waste production in tonnes/year

The Indian business capital, Mumbai, ranks number one in the list of cities contributing to e-waste in the country. Delhi being the national capital lags and achieves second position in the country's e-waste generation. The IT hub of India is contributing to e-waste at the third rank. Most of the e-waste in India is produced by these three metropolitan cities as more of the population resides in these cities. Also, huge development is seen in information and technology in these cities, so it is obvious that they are at the peak of e-wate generation in India.

In India, about 60% of e-waste production is done by 65 cities and on the other hand, 10 number of states contributes to 70% of the total e-waste in India. From a recent data of 2021-2022 the rate of recycling was only 32.9 percent which shows that large amount of e-waste is still unprocessed. But the rate of recycling is being increased as compared to past years.

Process of recycling

The recycling of e-waste is the process of collecting the used-up material and treating them in such a way so that the recovered material can be used again. There are certain steps included in the recycling of e-waste.

Fig 1.4 : Process of recycling

1. Collection and segregation :

Recycling of e-waste begins with collection of electronic gadgets. Authorised collection centres and scrap dealers gather e-waste from consumers, businesses and institutions. At collections points, e-waste is segregated into different categories based on its types and its condition(working or non working).

2. Dismantling :

Further these devices go through dismantling process. This involves taking apart the products to access their internal components. Dismantlers remove batteries, wires, and outer casings to expose the circuit boards, chips, and other valuable and hazardous components.

3. Component Recovery :

After the process of dismantling various components are recovered like valuable metals such as gold, silver and palladium are extracted from circuit boards and connectors using chemical and mechanical processes. Plastic casings and non metallic parts are separated for proper disposal or recycling.

4. Material separation :

Shredding or mechanical processes are used to break down the remaining materials into smaller pieces. Magnet and eddy current separators are used to separate ferrous and non ferrous metals. Gravity tables and air classifiers help further separate material based on density.

5. Safe disposal of hazardous components :

Hazardous material such as lead-acid batteries, mercury-containing bulbs, and certain chemicals are safely disposed of or treated to prevent environmental contamination.

6. Refurbishment and Reuse :

Some e-waste items, particularly those in good condition, can be refurbished and resold. This reduces the need for recycling and extends the lifespan of the products. Reusable components are tested, repaired, and integrated into other devices.

7. Recycling and recovery of valuables :

Once materials are separated, valuable metals like copper, aluminium and precious metals are sent for further refining and processing. These materials are then reused in the manufacturing of new electronic products.

8. Environmental compliances :

Throughout the recycling process, strict adherence to environmental and safety standards is crucial to prevent contamination and health hazards. Proper disposal of hazardous waste is essential to protect both workers and the environment.

Recycling methods in India

Generally e-wate recycle is done mainly in two ways in India. They are majorly formal recycling and informal or non-formal recycling.

Non formal recycling of about ninety-five percent of e-waste is recycled in informal sector and remaining five percent is recycled in formal ones. Of about 3000 units are in the informal or non-formal sector of e-waste recycling. This type of recycling is practised all over India like Karnataka, Uttar Pradesh, Andhra Pradesh, Maharashtra, West Bengal, Kerala, etc. In this recycling there are various types of processes involved such as collecting the e-waste from the scrap dealers from various areas. After that they are sorted and dismantled for removing the active and reusable parts or modules having high resell costs. The leftover material is chemically treated to recover the expensive metals. This sector has insufficient resources which leads in contamination of soil, air and water. The main aim of this non formal recycling sector is to recover only the expensive metals and other metals which are least expensive cannot be recovered.

Formal Recycling

The percentage of formal recycling is very less in the country. However, this type of recycling cause less damage to environment. In this, processes like sorting, dismantling and shredding of e-waste takes placed and the pre-processed components are exported to developed countries for recovering expensive metals. Also, the leftover is treated in an eco-friendly way. The recovery rate of formal recycling is very high and hence the recovery technology can be implemented by units which may prove economical. Moreover, some technologies has no landfill contact. The complete solution of e-waste recycling is still a challenge before the country, and has to be tackled as early as possible by looking at the increasing and alarming rate of e-waste generation in all over the country.

E-waste management

Fig 1.4 : E-waste management Common techniques of e-waste handling in India are shown in the above fig 1.4

Dump :

The process of dumping also known popularly as landfilling. In this process, the lands are dug in large trenches wherein the e-waste is buried and covering it back by the soil.

Ignite :

The second method which is largely practised is igniting the e-waste. It is the combustion controlled process in which e-waste is ignited in an incinerator unit where the temperature is approximately between 900 to 10,000 degree Celsius. This process helps in reducing hazardousness of the material.

Recover :

It is the process of eliminating the hazardous substances like plastics, PCBs, etc and sorting the non-ferrous material which can be recycled.

Handling of e-waste after recovery

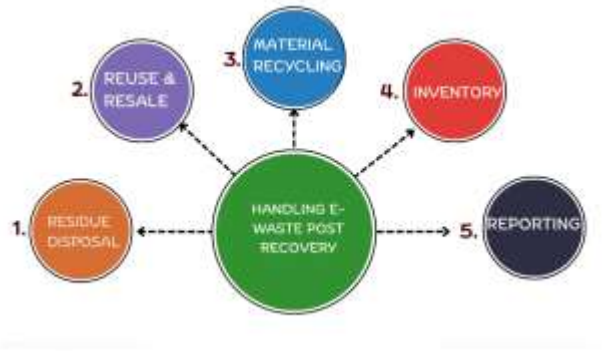

Fig 1.5 : Handling e-waste post recovery

Handling of e-waste after recovery or recycling is a crucial aspect of ensuring that the process is environmentally sustainable and that any remaining waste is managed responsibly. Some of the key considerations are given below :

1) Responsible Disposal of Residues :

Even after recycling, there may be some residues left behind, such as non-recyclable materials or contaminants. Dispose of these residues in accordance with local, national and international regulations for hazardous or non hazardous waste.

2) Reuse and Resales :

Recovered or refurbished electronics that are still functional can be resold or donated to individuals or organizations in need. Implement quality control to ensure that reused products meet safety and performance standards.

3) Recycled Material :

The recovered materials, such as metals and plastics, should be properly utilized in manufacturing new electronic products. Ensure that these materials are not lost to landfill but contribute to resource conservation.

4) Inventory Management :

Keep an inventory of recovered and recycled materials to track quantities, quality and usage. This data can be valuable for reporting and improving recycling processes.

5) Reporting and Compliances :

Comply with reporting requirements and regulations related to e-waste management and recycling. Maintain records of recycling activities and provide documentations to regulatory authorities when required.

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Conclusion

India faces a growing challenge in managing electronic waste (e-waste) due to the rapid proliferation of electronic devices. To address this issue, various recycling methodologies have been implemented in the country. These methodologies range from informal recycling by marginalized communities to more advanced environmentally friendly approaches. In the coming years, it is imperative for India to adopt a multi-faceted approach to e-waste recycling. This should include investing in formal recycling infrastructure, supporting innovation in eco-friendly technologies, and implementing stringent regulations for both producers and recyclers. Furthermore, public awareness and education campaigns should be conducted to encourage responsible consumer behaviour and promote the importance of recycling. As the technology is accelerating with its booming speed, there are huge chances of increase in e-waste production. Therefore, it is necessary to find more solutions on its recycling. E-waste recycling in India is complex but vital endeavour to manage electronic waste responsibly. It requires a multi-pronged approach involving formal and informal sectors, government regulations, corporate responsibility, public participation, and ongoing innovation. The e-waste is not completely treated or recycled in India itself, the author looks towards it, as an opportunity.

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