

Some studies on the deterioration of E-waste using Saline water, Termite soil and ferric chloride

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Abstract

Plastic is non-biodegradable material, it's demand is increasing day to day, because of light weight, highly electrical resistance, easy to shape and long life, more used in electrical and electronic equipment for makeup wire insulator, equipment body, Plates, switches, and many other purposes. If E-waste are open dumping, plastics has many adverse effects on the human life and environment, that's way we need recycling, recovery and disposal of plastic to prevent from the adverse effect. E-waste also contains harmful materials like arsenic, mercury, cadmium and led, which affects the environment and human life. The present study deals with the treatment of E-waste by three methods like Saline water treatment, termite soil treatment and ferric chloride treatment. In the experiment work 1.130 kg E-waste PCB taken and manually dismantled PCB, after dismantling the total weight of PCB is 1.100 kg, first manually separated the metal, glass, light LDPE films and plastic and noted that the weight of metal is 375 gm; glass is 10gm, light LDPE film is 25 gm and plastic is 690 gm. The E-waste plastic treated by saline water and results showed that the after ten days green layer of E-waste plastic removal started and after 25 days copper layer colour changed into light brown whereas variation in pH between 6 to 7. The second treatment of E-waste plastic carried out by termite soil after 30 days it has been observed that upper layer of green colour is light dull and degradation slowly started. Third treatment of E-waste plastic carried out by ferric chloride after 30 days it has been observed that upper layer of green colour is dull and degradation started whereas variation in pH between 4.5 to 5.5. The degradation of E-waste by the above method is slow process and continuous, required continuous monitoring.

Keywords: E-waste, Saline water treatment, Termite soil treatment, Ferric chloride treatment

1. Introduction

The electrical and electronic waste (e-waste) is one of the fastest growing waste streams in the world. Every year, hundreds of thousands of old computers, mobile phones, television sets and radio equipment are discarded, most of which either end up in landfills or unauthorized recycling yards (Saoji 2012) [7]. The main components of electronic waste are approximately: 45 % ferrous metals, 10 % non-ferrous metals (mainly Cu and Al), 22 % plastics and 9 % glass (Ficeriova *et al*, 2008) [3]. Three categories of WEEE account for almost 90% of the total waste generation, which includes 42 % large house hold appliances, 34 % ICT equipment and 14 % consumer electronics (Gupta *et al*, 2009) [4]. Because plastics are highly flammable, the printed wiring board and housings of electronic products contain brominated flame retardants, a number of which are clearly damaging to human health and environment (Rani *et al*, 2012) [6]. In India, primarily two types of disposal options based on the composition are in practice. These are Landfilling and Incineration. However, the environmental risks from landfilling of E-waste cannot be neglected because the conditions in a landfill site are different from a native soil, particularly concerning the leaching behaviour of metals (Borthakur and Singh 2012) [1].

E-waste is much more hazardous than many other municipal wastes because electronic gadgets contain thousands of components made of deadly chemicals and metals like lead, cadmium, chromium, mercury, polyvinyl chlorides (PVC), brominated flame retardants, beryllium, antimony and

phthalates. Longterm exposure to these substances damages the nervous systems, kidney and bones, and the reproductive and endocrine systems, and some of them are carcinogenic and neurotoxic. Primitive recycling or disposal of e-waste to landfills and incinerators causes irreversible environmental damage by polluting water and soil, and contaminating air (Saoji 2012) [7].

E-waste is not treated as hazardous unless proved to have higher concentration of certain substances. E-wastes contain over 1000 different substances many of which are toxic and potentially hazardous to environment and human health, if these are not handled in an environmentally sound manner. The growth of e-waste has significant economic and social impacts. The increase of electrical and electronic products, consumption rates and higher obsolescence rate leads to higher generation of e-waste (Jain *et al*, 2011) [5]. As there is no separate collection of e-waste in India, there is no clear data on the quantity generated and disposed of each year and the resulting extent of environmental risk. The total waste generated by obsolete or broken down electronic and electrical equipment in Indian has been estimated to be 146000 tons per year (Dr. Mohite 2013) [13]. The total electronic waste generation in Maharashtra is more than 20,270.6 tonne, out of which Navi Mumbai accounts for 646.48 tonne, Greater Mumbai 11,017.06 tonne, Pune 2,584.21 tonne and Pimpri-Chinchwad 1,032.37 tonne. The estimate includes 50, 000 tonnes of such e-waste imported from developed countries as charity for reuse, which mostly end up in informal recycling yards either immediately or once the re-used product is

discarded. The authorized e-waste recycling facilities in India capture only 3% of total e-waste generated; the rest makes its way to informal recycling yards in major cities like Delhi, Mumbai and Bangalore (Saoji 2012)^[7].

Materials and method

E-waste (PCBs) collected from local electronic shop of Ujjain, Madhya Pradesh, India. For the experimental work 1.130 kg PCBs has been taken into consideration. The collected sample has been dismantled manually by using piler and screw driver, after dismantled the total weight of PCBs observed to be 1.110 kg. ranging 1 by 1 inch size of the E-waste has been prepared out of the PCBs sample.

Saline water treatment method

The E-waste (PCBs) taken were first crushed with the use of piler and screw driver nearby 1x1 inch in shape. About 50 grams of sodium chloride (NaCl) was added in 250 ml of water in 500 ml volumetric flask at atmospheric temperature and 2.62 gm PCBs plastic pieces charged in solution. The samples were kept for 30 days then plastic pieces were removed from solution and dried. After drying of PCBs plastic pieces weight comes out to be 2.30 gm whereas pH changed from 5 to 6.

Termite soil treatment method

In this method the E-waste (PCBs) taken were first crushed with the use of piler and screw driver nearby 1 by 1 inch in shape. About 200 grams of termite soil mixed in 100 ml water in 1000 ml volumetric flask and 4.338 gm small pieces of E-waste plastic mixed in stock solution at pH- 6.5 and the sample were kept for 30 days. Each day appropriate amount of water added the flask in order to maintain the humidity and the deterioration of PCBs E-waste has been noted, after 30 days plastic pieces removed from the termite solution.

Ferric chloride treatment methods

In this method about 0.5 gram ferric chloride mixed in 200 ml water in 250 ml volumetric flask and 5.0 gm PCBs plastic pieces charged in solution then starring for 10 min. The material is allowed for settling. The pH of sample and physical characteristics of the waste considered in the study, the above mentioned procedure is followed every day and the sample characteristics are noted for a period of 30 days. After the specified period the PCBs E-waste was taken out and dried. The weight of the sample noted. The last pH after 30 days noted

3. Results and discussion

It has been observed that the treatment method i.e. saline water, termite soil and ferric chloride are economical and feasible. In the saline water treatment method results showed that the after ten days green layer of E-waste plastic removing started and after 25 days copper layer colour changed into light brown and variation in pH observed to between 6 to 7 and in the termite soil treatment after 30 days observed that upper layer of green colour is light dull and degradation slowly started. The process is slow but continuous require more time to achieve complete deterioration. The treatment of PCBs waste with ferric chloride solution has promising results. The pH, colour and physical characteristics of PCBs waste has been considered.

In order to inherent the deterioration process another chemical ferric chloride has been considered. Properties of PCBs waste change gradually with time, It seen that some of the material get deteriorated in the solution as observed by the net loss in PCBs waste.

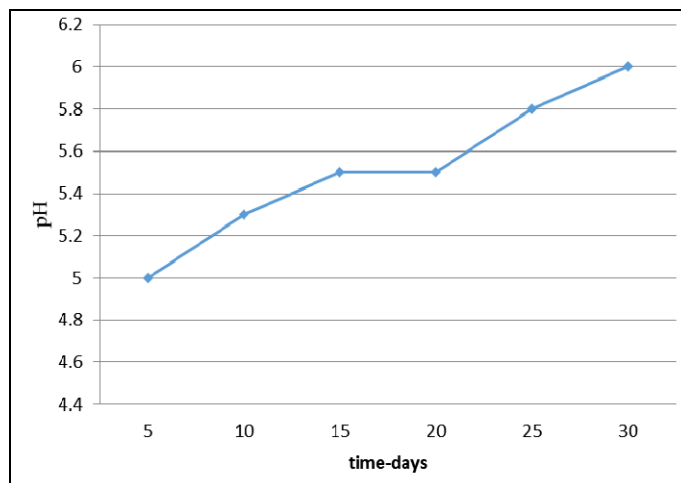


Fig 1: Shows the pH variation in saline water treatment of E-waste plastic

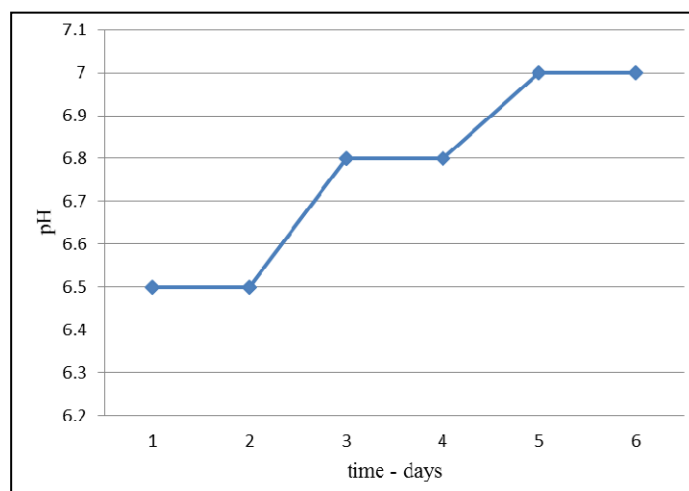


Fig 2: Shows the pH variation in termite soil treatment of E-waste plastic

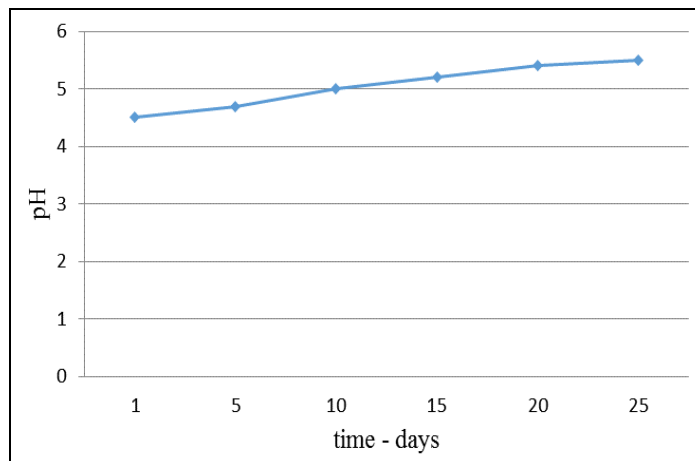


Fig 3: Shows the pH variation in ferric chloride treatment of E-waste plastic

4. Conclusion

The study indicated that the saline water, termite soil treatment and ferric chloride are effective and feasible methods for treatment of E-waste plastic. In the saline water treatment observed that the after ten days green layer of E-waste plastic removal started and after 25 days copper layer colour changed like light brown, and variation in pH between 6 to 7, Weight of plastic changed 12.21%, in the termite soil treatment concluded that the after 30 days upper layer of green colour is light dull and degradation slowly started. Weight of plastic is change from 3%, and in the ferric chloride treatment noted that the after 30 days weight of plastic changed 14% and variation in pH between 4.5 to 5.5.

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