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Recovery of Plastic from E-waste: A Review

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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. E-waste contain 15-20% plastic, 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 contain harmful materials like arsenic, mercury, cadmium and led, which affects the environment and human life. The review paper contains the e-waste challenging problems such as handling, pollution problems, transportation, recovery and some key factors which are responsible for e-waste in India and methods for recovery of plastic and other precious materials from e-waste.

Keywords: Electronic waste, recovery of plastic from e-waste, e-waste management.

Introduction

The electrical and electronic waste (e-waste) is one of the fastest growing waste streams in the world. Electronic waste, E-waste comprises of wastes generated from used electronic devices and house hold appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal (Divya *et al.*, 2012) [11]. Activities related to electronic waste (e-waste) is one of the emerging problems of the 21st century. E-waste refers to end of life electronic products such as computers, televisions, and mobile phones made of plastics, metals, other trace elements (TEs), etc [Ngoc *et al.*, 2009] [32]. The electronic industry is the world's largest and fastest growing manufacturing industry. During the last decade, it has assumed that role of providing a forceful leverage of the socio-economic and technological growth of a developing society (Dr. Mohite, 2013) [15]. Electronic products are made from valuable resources, including precious and other metals, engineered plastics, glass, and other materials, all of which require energy to source and manufacture (Jain *et al.*, 2009) [20]. 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) [17]. It is observed in recent years that large volume of e-waste is being from western countries to Asian countries like China, India, etc. for disposal. The western countries are, therefore, compelled to find out alternative destinations for disposal, where the labour cost is comparatively low and the environmental laws are not en-forced so strictly (Chatterjee 2012) [6]. 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) [19]. When not recycled the e-waste is incinerated and landfilled. These methods involve not only wasting valuable metals, but also creating a potential risk for the environment. One of the most important components in the e-waste are the PCBs (printed circuit boards) where the precious metals concentrations are ten times higher than in rich precious metals bearing ore. A typical PCB composition is: 30% plastics, 30% refractory oxides and 40% metals (Montero *et al.*, 2012) [31].

Effects of E-waste

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.

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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)^[37]. 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)^[36]. 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)^[5].

E-waste Indian Scenario

Despite a wide range of environmental legislation in India there are no specific laws or guidelines for electronic waste or computer waste. As per the Hazardous Waste Rules (1989), 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)^[21]. 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)^[15]. 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)^[37]. The current data shows that by 2012 global e-waste will reach 53 million tons from 42 million tons in 2008 thus growing at a CAGR (Compound Annual Growth Rate) of 6 percent. E-Waste is continuously growing in developed countries by 2010 it has grown to 2% in comparison to previous 1%. While in developing countries e-plastic waste contribute 0.01% -1% of total solid waste generation (Gupta *et al.*, 2009)^[19].

Due to rapid growth of e-waste, need to proper management to E-waste because it contained valuable material, review the some literature related to electrical and electronic plastic waste may help to find out economic way to e-waste treatment, recovery, handling and Utilization.

Relevant literature

Recent year Damal *et al.*, 2015^[10], studied the utilization of electronic waste plastic in concrete and Experiment were conducted on the E-waste plastic particles as fine aggregates in concrete with replacement ranging from 0% to 21.5% i.e. (7.5%, 15% and 21.5%) on the strength criteria of M30 Concrete. It was observe the compressive strength of concrete optimum when fine aggregate was replaced by 7.5% with

Electronic plastic waste. Where the compressive strength of concrete is gradually decreased when fine aggregate were replaced beyond 15% with Electronic plastic waste.

Williams *et al.*, 2015^[48], Studied the Catalytic pyrolysis of waste plastic from electrical and electronic waste, in the pyrolysis used two zeolite catalysts, Y zeolite and ZSM-5, they obtained oil produced from uncatylsed pyrolysis of plastics from (CRTs and refrigerators) was more than 80% and zeolite catalysed decreases by 5-10% oil yield and increases in gas yield.

Akaha *et al.*, 2015^[2], Feedstock recycling of waste plastics is becoming more crucial as a method to convert plastics back into a source of useful platform chemicals. Although thermal cracking presents easier options, the products have limited utility and present a higher energy burden than the method proposed in this paper, that of catalytic hydrocracking a mildly exothermic process. The paper reports the use of metal loaded zeolite catalysts at much reduced temperatures (200 °C - 350 °C) to convert mixed plastic waste at significantly shorter reaction times (typically 5 min), making the continuous processing of polymer waste a possibility.

Mustofa Kamal and Zainuri, 2015^[24], The objective of the research was to Conducted experiment studies on conversion of plastic into oil, obtained liquid fuel from pyrolysis of waste plastics that is safe for humans as well as environment, with a heating value and fuel quality meet the standardized compliant. The method used for the research is plastic waste pyrolysis heated at 900 °C, and the resulted vapour was condensed through a crossflow condenser. The method resulted in a liquid fuel with a calorific value of 46,848 J/g, which is greater than that of plastic waste processing at a temperature of 425 °C that is only 41,870 J/g.

Sharma *et al.* 2015, Studied the degradation characteristic of waste PVC. Waste PVC poses serious environmental problem because of its high chlorine content (56%) and non-biodegradable nature. Treatment of waste PVC by incineration or pyrolysis produces toxic chloro emissions which adversely affect environment, ecology and human health. Catalytic degradation of PVC was performed using a fluidized bed reactor with catalyst such as Fe₂O₃, ZSM-5 and Pd/Al₂O₃ in the temperature range 100 – 430 °C. Maximum liquid yield of 12.17% was obtained using catalyst ZSM-5 at 3:1 feed to catalyst ratio.

Gaurav *et al.*, 2014^[18], worked on the conversion of LDPE plastic waste into liquid fuel by thermal degradation. In the experiment plastic wastes (low density polyethylene) used for the pyrolysis to obtain fuel oil which has the same physical properties fuels like petrol, diesel etc. Pyrolysis process was run without oxygen at temperature at 300 °C and observed that about 4% solid black residues was obtained in the reactor, which was collected from the reactor. The Liquid fuel yield and density was 90%, 0.75 g/ml respectively.

Menad *et al.*, 2014^[29], studied the characterisation method of electrical and electronic equipment wastes. Mechanical process used in the work. Two different samples from different recycling industries were characterised in this work. The first sample heterogeneous contained different types of plastics, metals (ferrous and nonferrous), Printed Circuit Board (PCB), rubber and wood. The second sample contained mixture of mainly plastics. It was found the first sample all aluminium particles was free (100%) in all investigated size fractions and free 95% of plastics particles. The second sample was separated by automatic sensor sorting in four different products: ABS, PC-ABS, PS and rest product. The results show that the grade and liberation degree of plastic products ABS, PC-ABS and PS was close to 100%.

Abatnath and sahu 2013 ^[1], Investigated the conversion of different waste plastics into fuel oil by thermal cracking at different temperature and measured the residue, oil, and gas produced for comparison which type of waste plastic can produce higher amount of oil. It was observed the yield of the different waste plastics was 1.17% for the pyrolysis of low density polyethylene, 15% from the pyrolysis of polystyrene, and 13.88% from the pyrolysis of high density polyethylene, the plastic that more number of C-C combinations, the yield was higher than C-H yield.

Premkumar *et al.*, 2014 ^[34], Studied the degradation has testing of LDPE. It was obtained from waste saline bottles, made of low density polyethylene (LDPE), by degradation using fly ash as catalyst. The oil obtained was fractionated into the following four fractions viz., fraction boiling below 100 °C, fraction boiling in the range 100-150 °C, fraction boiling in the range 150- 200 °C and fraction boiling above 200 °C. The GCMS spectrum of this fractions shows that it contains large hydrocarbons with 4-9 carbons atoms.

Senthil Kumar *et al.*, 2014, focused on the conversion of waste plastic into low-emissive hydrocarbon fuel by two process namely vacuum and catalytic cracking (activated carbon, activated carbon with granulated charcoal and activated carbon with calcium oxide). It was observed that the yield was better in the case of individual plastic material as opposed to mixed feed in all cases except polypropylene under non-catalysed vacuum process.

M. Garib Alla *et al.*, 2014 ^[30], Studied the collection of SMW from the Khartoum State produces around 1,040,250 tons of solid municipal waste annually 12.7% of it plastic which is 132,112 tons. It was observed that the liquid (oil) yield of thermal pyrolysis of plastic waste is between 80-90%. Modification made by Aspen Hysys program for thermofuel process to improve the efficiency of the process.

Janajreh and Alshrah 2013 ^[22], studied the Remolding of Cross-Linked Polyethylene Cable Waste by Thermal and Mechanical Property Assessment, the average 12% of MSW were plastics (LDPE, Polypropylene, PET, Polystyrene). It was observed that the amount of waste infusion increased the sample ductility and strength was mildly reduced. The tests showed that the molded XLPE has a higher viscosity than LDPE at phase shift of 10.75° for XLPE compared to 9.88° for LDPE.

Quan *et al.*, 2013 ^[35], studied the Combustion and Pyrolysis of Electronic Waste by thermal degradation and used thermogravimetric analysis (TG). In the research three materials keyboard, telephone wire, and printed circuit board (PCB) were studied and compared with each other. TG experiments were performed at a heating rate of 10 °C/min up to 700 °C and Arrhenius model was used to obtain the kinetic parameters from the TG data, and finally concluded the kinetic analysis results revealed that the activation energy for first step pyrolysis of keyboard, PCB waste and telephone line were 166.08, 149.28 and 96.76kJ/mol, respectively, the activation energy at the first process of combustion was little more than that of the pyrolysis first step.

Sarker *et al.*, 2012 ^[16, 38, 40-42] Investigated none coded waste plastics conversion by thermal degradation into liquid fuel at different temperature without using catalyst or chemical and experiment performed at 300- 420 °C for 7-8 hours. The obtained products were liquid fuel 85%, light gas 9% and black carbon residue 6%, fuel density was 0.77 g/ml.

Sarker and Rashid 2012 ^[16, 38, 40-42], Investigated the municipal waste plastic into flue resource by thermal degradation, Experiment performed in the stainless steel reactor at temperature 120-400 °C and each experiment runed 5-6 hrs.

After completing of experiment it was observed that the density of HDPE-2, LDPE-4, PP-5 and PS-6 were 0.782g/ml, 0.771g/ml, 0.759g/ml and 0.916g/ml respectively.

Chen Yuan *et al.* 2012, studied the brominated flame retardants (BFRs) in waste electrical and electronic equipment plastics and printed circuit boards. Two kinds of BFRs in three WEEE plastics (cell phone shells, computer housings and TV housings) and PCBs were detected with GC/MS. The results showed the plastics used as mobile phone shells had no BFRs. TBBPA was only found in computer housings. Among PBDEs, congeners of heptabromodiphenyl ether, octabromodiphenyl ether and nonabromodiphenyl ether were frequent ones, and detected in both TV housings and computer housings. But the contents of N9BDE were lower than the other two, only 180 mg/kg and 5.3 mg/kg in computer housings and TV housings respectively, while pentabromodiphenyl ether and hexabromodiphenyl ether were determined in PCBs.

Sarker and Rashid 2012 ^[16, 38, 40-42], Investigated the Polyvinyl Chloride Waste Plastic Treatment by Zinc Oxide (Zno) With Activated Carbon to reduce some chlorine percentage and Produced Hydrocarbon Fuel For Petroleum Refinery In thermal degradation process 5% Zinc Oxide (ZnO) could reduce chlorine content result in polymer chain generating product with heavy molecular weight and some uncontrolled Cl content and performed at 75-400 °C and obtained fuel that was treated with silver nitrate solution to remove chlorine percentage and noted that the 35.6% of liquid product, light gas 34.4% and residue 29.93% were produced fuel can be used for feedstock refinery for potential energy generation.

Sarker *et al.* 2012 ^[16, 38, 40-42], Investigated the Polystyrene (PS) waste plastic conversion into aviation/kerosene category of fuel by using fractional column distillation process. A post-commercial PS polymer waste was thermal degraded and fractionally distilled without catalysts using a steel reactor operating thermally at ambient pressure under fume hood without vacuum system. Two types of temperature profile was used for this experiment such as PS waste plastic liquefaction purposed, temperature used 100-400 °C and fractional column distillation temperature was used 180-305 °C for collection kerosene or aviation grade fuel. It was note that the fuel production 23%, residue was 77%. Where as fuel density was 0.89 g/ml.

Dr. Sarker and Rashid 2012 ^[16, 38, 40-42], Studied the conversion of plastic waste into oil. E-waste to oil production process performed with sodium hydroxide and activated carbon in laboratory scale batch process. Temperature range was 200-420 °C and sodium hydroxide was added 5% and activated carbon was added 5% with e-waste plastic. Electronic waste plastic was use 75 gm by weight. Under labconco fume hood experiment was placed in presence of oxygen without vacuumed system. Oil density was found to be 0.90 g/ml. Electronic waste plastic to oil production conversion rate was 33.6%, gas production rate was 16.53% and left over residue 49.87%.

Stelmachowski and Słowiński, 2012 ^[44], studied thermal degradation of polyolefins in the laboratory-scale set-up Reactors. It was observed that the final product consisted of a gaseous (2-16% mass) and a liquid (84-98% mass) part. No solid product was produced.

Jha *et al.*, 2011 ^[23] studied the prospective scenario of E-waste recycling in India. It was noted the e-waste comprises of 30% plastics, 30% refractory, and 40% metals. The Indian R&D work related to e-waste recycling was directed towards the development of feasible process consists of mechanical pre-treatment and pyro/hydro-metallurgical techniques.

Kumar and Singh 2011 ^[26], Investigated the recovery of hydrocarbon liquid from waste high density polyethylene by thermal pyrolysis. A simple pyrolysis reactor system used to pyrolyse waste HDPE at a temperature range of 400 °C to 550 °C and the liquid fractions obtained were analyzed for composition using FTIR and GC-MS. It was noted that the Liquid yield was increases as the holding time increases from 1 hr to 4 hr at 400 °C to 450 °C, but as the holding time increased from 4 hr to 6 hr, the liquid yield decreases. The physical properties of the pyrolytic oil showed the presence of a mixture of different fuel fractions such as gasoline, kerosene and diesel in the oil.

Sarkar *et al.* 2011 ^[39], Investigated the Waste Polyethylene Terephthalate (PETE-1) Conversion into Liquid Fuel by catalytic thermal degradation process. In the experiment PETE used 40 gm and catalyst Ca(OH)₂ 80 gm, at 400-530 °C. It was observed that 6.3 ml yellowish colour liquid PETE fuel, 20.6 gm residue, 8.7 gm water and PETE fuel was produced density having of 0.90 g/ml.

Almustapha and Andresen 2011 ^[3], studied catalytic degradation of High Density Polyethylene (HDPE) polymer, It was carried out in a fixed-bed reactor at 400 °C using two sulfate modified Zirconium catalysts with aim of obtaining valuable and recyclable liquid products. It was found that catalytic degradation shows how the catalysts improved the polymer degradation by achieving high conversion of about 99.8% with CAT1(7%SO₃) promoting high percentage of gaseous products(68%) of mainly aromatics and CAT2(3.5%SO₃) promoting high liquid products (about 53%) of mainly olefinic compounds.

Bajus and Hajekova, 2010 ^[4], Studied that thermal cracking of individual and mixed plastics into oil/waxes. The main objective of this project work was converting the seven components mixed plastics into oil/wax product for use as hydrocarbon fuel oil or chemical feedstock. The effects of the parameters like on the composition of pyrolysis products, with special emphasis on the oil/waxes were studied.

Chiemchaisri *et al.* 2009 ^[8], Studied on the recovery of plastic wastes from dumpsite as refuse-derived fuel and its utilization in small gasification system. used wastes contained 24.6–44.8% polyethylene plastic bag. The plastic wastes were purified by separating them from other components through manual separation and trommel screen after which their content increased to 82.9–89.7%. Subsequently, they were mixed with binding agent (cassava root) and transformed into refuse-derived fuel (RDF) briquette. It was absorbed the maximum plastic content in RDF briquette was limit to 55% to maintain physical strength and maximum chlorine content. The produced gas contained average energy content of 1.76 MJ/m³, yielding cold gas efficiency of 66%.

Othman *et al.* 2008 ^[33], Studied the Determination of Physical and Chemical Characteristics of Electronic Plastic Waste Resin by Using Proximate and Ultimate Analysis. In the research electronic plastic waste resin sample identified by using FT-IR Spectrum 2000 and physical observation method. The proximate analysis result for the weighted average of residual content, volatile matter, ash content and fix carbon of electronic plastic waste sample were 0.57%, 83.44%, 11.10% and 10.82% respectively (dry basis). The ultimate analysis result for the weighted average of nitrogen, carbon, hydrogen and oxygen content of EP-waste sample was 3.27%, 70.14%, 6.81% and 14.73% respectively(dry basis). Heating value of EP-waste resins varies from 1447235 to 4535828 KJ/Kg and the weighted average was 3087242 KJ/Kg (7375 kcal/kg). The weighted average of total chlorine and total bromine content of EP-waste sample were 45310.06 ppm and 3.77 ppm and the

weight average of heavy metals concentration for cd, cr, Hg, Pb and As are 0, 0.01, 0.01, 3.22, 0 ppm respectively.

William and Williams 2007, studied the separation and recovery of materials from scrap printed circuit boards Printed circuit boards by pyrolysis in the fixed bed reactor. Experiment based on three waste fractions, computers, televisions, and mobile phones, were pyrolysed in a fixed bed reactor at 800 °C and noticed that the computer printed circuit boards pyrolysed to form average mass balance of 68.9 wt% residue, 22.7 wt% oil, and 4.7 wt% gas. Pyrolysis of the television circuit boards had average mass balance of 60.0% residue, 28.5% oil, and 6.5% gas and pyrolysis of the mobile phone circuit boards had average mass balance of 82.2 wt% residue, 15.2 wt% oil, and 2.3 wt% gas.

Choi and yoo 2007, Studied the removal of PVC from plastic waste by combination of air classification and centrifugal process. The experiment the gravity separation tests used with a capacity of 0.5 t/h and obtained the purity of PO (polyolefins) 99.65% could be achieved with PVC content of less than 0.3% in the final product.

Lin and Yang, 2007, Worked on the pyrolysis process, a commingled post-consumer polymer was pyrolysed over spent fluid catalytic cracking commercial catalyst (ECat-1) using a laboratory fluidised-bed reactor operating isothermally at ambient pressure. The influence of reaction conditions including catalyst, temperature, ratios of commingled polymer to catalyst feed and flow rates of fluidising gas was examined. The conversion for spent FCC commercial catalyst (82.7 wt%) gave much higher yield than silicate (only 14.2 wt%) and the highest yield (nearly 87 wt%) was obtained for ZSM5.

Walendziewski 2005, Studied the waste polymers cracking in a continuous flow tube reactor at temperature range 420–480 °C and raw material feeding rate 0.3 to 2.4 kg/h. Results contained typically 20–40% of gasoline fractions (range of boiling point 35–180 °C) and 60–80% of light gas oil fractions (initial boiling point >180 °C). The solid carbon residues were similar to coal cokes and contain 50% mineral components and calorific values 20 MJ/kg and they were solid fuels of quality similar to brown coals.

Tange and Drohmann 2004 ^[45], studied composition of plastic fire retarding agent area where plastic can be used as fuel. The Bromine was use as the building block for some of the most effective flame retarding agents available to the plastics industry. Brominated flame retardants (BFRs) used to protect against the risk of accidental fires in a wide range of electrical and electronic equipment (EEE). This represented the 15% of total EU coal imports and approximately 5% of EU energy needs for power generation. The advantages for energy potential from plastics waste providing a 15% reduction in coal Imports and a 20% reduction of Greenhouse gases It was found the replacing fuel by plastics reduces the global warming and reducing overall greenhouse gas CO₂ emissions as per the Kyoto objectives.

Dodbiba and Fujita 2004 ^[12], Studied separation of plastic materials for recycling, using electrostatic separating unit (electric field strength of 150 kV/m) the recovery and the purity of collected PVC product was higher than 70% and 90% respectively. And by the triboelectric cyclone separator, the experimental results shown the recovery of each collected product was higher than 75% while the purity was higher than 95%.

Dodbiba *et al.* 2003 ^[14], Studied the Separation of ABS, PS and PP Plastic Mixture by triboelectrostatic. In the experiment plastic mixture was charged by friction in tribo-cyclone. And 400 kV/m DC electric field created by using two parallel plate electrodes made of Cu. Efficiency of the separation strongly

depended on tribocharging time, air inlet velocity, and electric field strength and it was observed that ABS, PS and PP with a grade of 92.1%, 84.9% and 90.0% respectively achieved with recoveries above 73.0%.

Mastral *et al.* 2002^[28], Studied the pyrolysis of HDPE in a fluidised bed reactor and influenced of the temperature, residence time and gas composition on the product distribution. Experiments were conducted at five different temperatures, 650, 685, 730, 780 and 850 °C were carried out and residence time was varied from 0.64 to 2.6 s. At 640°C the main product obtained was a waxy cream coloured material (wax). The yield of product varied from 79.7 wt.% at 0.8 s to 68.5wt.% at 1.5 s. At these conditions the gas yield varied between 11.4 wt.% at 1 s and 31.5 wt.% at 1.5 s. The higher gas yields was obtained at 780 °C, 86.4 wt.% of gas and 9.6 wt.% of oil.

dodbiba *et al.* 2001^[13], Studied the electrostatic separation of the shredded plastic mixtures by using a tribo-cyclone, Tribo-electrification of shredded plastic mixture at controlled air relative humidity and temperature. The DC electric field of up to 333 kV/m is created by using two plate electrodes made of Cu and having a given cross-section configuration. The plastic flakes of the mixture was drawn to either positive or negative electrode according to the polarity of the charge and separated by falling into different bins. Each plastic component were separated with a grade higher than 95% and recovery higher than 75%.

Conclusion

Based on the literature survey it has been concluded that the e-waste generated has great potential to produce adverse effect on chemical plant kingdom number of method of are available for degradation of this plastic waste in fuel oil. All this method has several advantages and disadvantages. E-waste is not a waste, it is treated as to waste resource. E-waste collection, Treatment, recovery and disposal, is to be needed at national and regional level for reducing adverse effect of e-waste. Newer approaches are still required to make the system feasible.

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