International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 2, Issue 5 (Sep-Oct 2014), PP. 01-03

IDENTIFICATIONS OF ELECTRICAL AND ELECTRONIC EQUIPMENT POLYMER WASTE TYPES USING MFI, DENSITY AND IR

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Abstract:- The main objective of this work is to reduce polymer Waste from Electrical and Electronic Equipment (WEEE) disposal to landfill and hence reduce their negative impacts to environment, and to produce useful products suitable for demanded application using WEEE waste as raw materials and to reduce virgin materials used in production of Electrical and Electronic equipment by using WEEE through Identifications the materials used in manufacturing of the EEE.
Four type of (EEE) (Keyboard, colored and Black printer and Mouse) were chosen and the analytical result (Density, Melt Flow Index and Infer Red) showed that the polymer type was used in manufacturing of this samples was ABS material for three type and the forth one Mouse is recycled material. This result emphasizes and achieves the three goals of this paper that the recycling processes can solve the problem of polymer waste.
Keywords: Waste from Electrical and Electronic Equipment, IR, MFI, ABS.

I. INTRODUCTION

According to modern systems of waste management, waste may be classified to different types including:

1. Municipal waste includes: households waste, commercial waste, and demolition waste
2. Hazardous waste includes industrial waste
3. Bio-medical waste includes clinical waste
4. Special hazardous waste includes radioactive waste, explosives waste, electrical and electronic waste.

Considering the fourth type, electric and electronic equipment including personal computers, Compact Disks, TV sets, refrigerators, washing machines, and many other daily-life items is one of the fastest growing areas of manufacturing industry today. This rapidly advancing technology together with the increasingly short product life cycles have led to huge volumes of relatively new electronic goods being discarded. This has resulted in a continuous increase of Waste of Electric and Electronic Equipment (WEEE) with estimates of more than 6 million tones annual production or up to 10 kg per person per year in 2005. It has been estimated to be as high as 12 million tons in 2015.
Since 1980, the share of plastics in Electrical and Electronic Equipment (EEE) has continuously increased from about 14% to 18% in 1992, 22% in 2000 and estimated 23% in 2005. In 2008, the plastics share from European waste electrical and electronic equipment (WEEE) over all categories was estimated to amount to 20.6 %.

Figure1: Wasted Electronic Devices such as computer Monitors

Figure2: A collection of WEEE Waste

Despite of all advantages of Plastic in different uses, but wastes represent a significant environmental impact necessitate some measures to get rid of it.
Although, a variety of techniques have been developed for the recycling of polymers in general and particularly for WEEE, the high cost associated with these methods usually leads to a disposal of plastics from WEEE to sanitary landfills. The main drawback that obstructs material recovery from plastics contained in WEEE is the variety of polymers that are being used, resulting to a difficulty in sorting and recycling. Another relevant drawback in dealing with treatment of WEEE is that very often they contain brominated aromatic compounds, used as fire retardants. So there are many procedures to recycle polymer waste one of it is thermal treatment of such chemicals is likely to produce extremely toxic halogenated dibenzodioxins and dibenzofurans. During last years some work has been carried out on the development of different methods to recycle or give added-value to WEEE.

II. Materials

A. WEEE materials

Four different samples of WEEE viz.: keyboard, mouse, colored printing cartridge and black printing cartridge were selected based on the rate of their consumption.

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Figure3: Selected WEEE samples

B. Preparations of samples

Selected samples were cleaned with soap and water, then dismantled to separate polymer materials from the other materials ,then crushed and grinded for a laboratory analysis to determine and identify the type of the polymer and additives used in the samples under question.

Figure4: Preparation of Samples

C. Testing and Identification Methods:

The type of polymers was determines using relevant chemical and instruments.

1. IR Spectrophotometer

Finely crushed solid samples were and grinded with KBr, then pressed to make a disc, the disc was used as background in the **IR spectrophotometer.**

Then the device was operated as required for the intended test.

Figure 5: Shimatzu IR Spectrophotometer device

2. Density

Samples densities were tested using Pycnometer the empty weight of the pycnometer was determined m_0. , then filled to about 1/3 with sample and measure the weight m_1.

Water was then added to pycnometer as well as capillary hole in the stopper was filled with water. Water that leaked through the capillary hole was dried with a filter paper and total weight m_2 was measured. The pycnometer was emptied and filled it with distilled water only. Filter paper was used to dry the spare water again and weight m_3 was measured. The experiment was then repeated for all samples

3. MFI (Melt Flow Index):

Approximately (6 gm) of sample was loaded into the barrel of the melt flow apparatuses, which has been heated to a temperature 190°C. A weight specific for the material was applied to a plunger and the molten material was forced through the die. Melt flow rat values were calculated in 8 mg/10 min using the following model:

$$MFR(\theta, m_{nom}) = \frac{t_{ref} \cdot m}{t}$$

where

θ is the test temperature, in degrees Celsius;

m_{nom} is the nominal load, in kilograms;

m is the average mass, in grams, of the cut-offs;

t_{ref} is the reference time (10 min), in seconds (600 s)

t is the cut-off time-interval, in seconds.

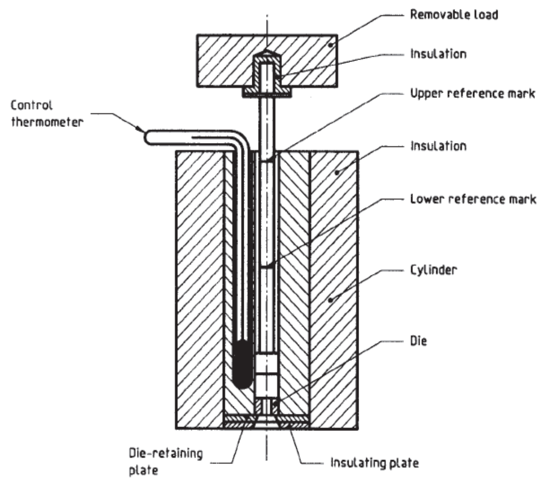

Figure 6: MFI apparatus

III. Results

The results for both MFI and density were shown in table 2 and the results of the IR analysis where shown in figures 8-12:

Sample	Density	Melt Flow Index MFI
1	**1.053**	**17.82**
2	**1.129**	**21.23**
3	**0.538**	**18.05**
4	**0.649**	**16.91**

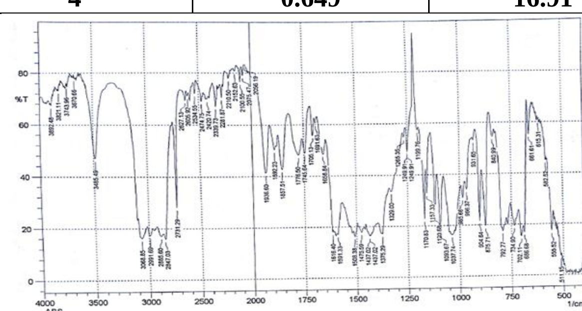

Figure 7: MFI Keyport sample

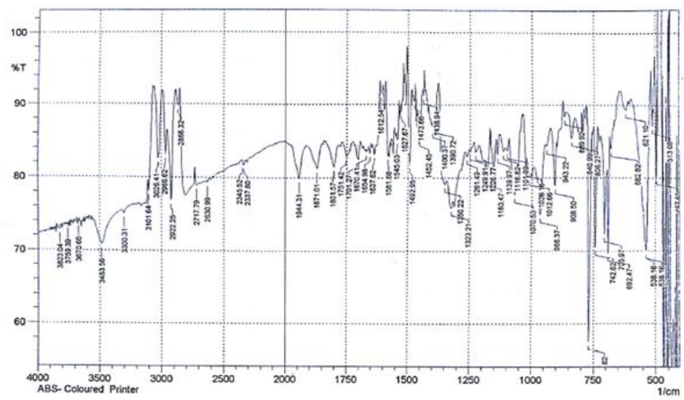

Figure 8: MFI colored printer

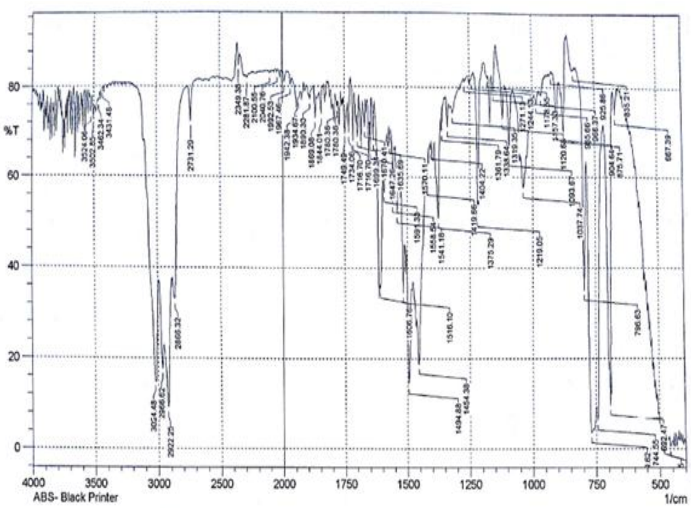

Figure 9: MFI Black printer sample

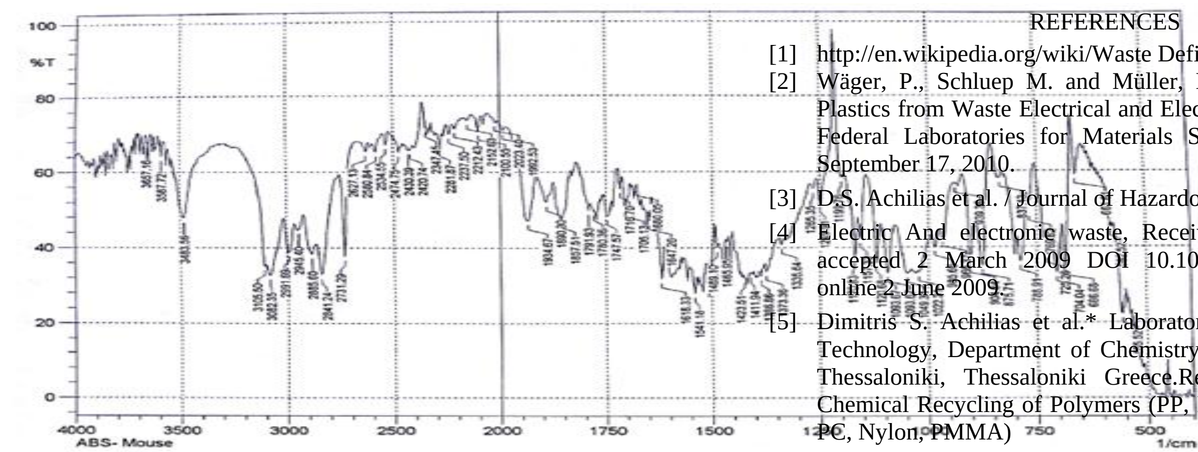

Figure 10: MFI Mouse sample

IV. Discussions

Density

According to the current work results the density of all samples in the range of (1.1 -1.05) for three samples (Keyboard, Colored and Black printer) and 0.64 for Mouse. Compared to literature which points the main polymer used to manufacturing EEE is PE with density range (0.88 – 0.94), PC with density range (1.2 – 1.22) and ABS with density of (1.04). This means the material used is not one of these materials because the density is lower than the range of all materials used in manufacturing EEE.

MFI

According to literature the MFI of PE, PC and ABS is range from (2 – 60), the Results show that the MFI of all samples in the range of (16.908 -21.228) for all samples (Keyboard, Colored and Black printer and Mouse) compared to (2 – 60) in the literature. This means the material used in manufacturing is not one of these materials because the cutting time for all samples was confirmed with standard 15 second but Mouse sample has cutting time 10 second even the MFI in the range.

IR

Results show that the IR of all samples in the range of (459.7 - 3892.48) for three samples (Keyboard, Colored and Black printer) and (555.52 – 3042) for Mouse, that means there was some bands or groups not available in material used in manufacturing Mouse or it was cracking in re- process.

V. Conclusions

The analytical results confirmed that the material used in manufacturing three samples (Keyboard, Colored and Black printer) have similar properties and the fourth one Mouse has different properties; this results confirmed by re-analysis for allsamplesandrepeatitseveraltimesforthefourthoneMouse.
Mentioned results confirm that the material used in the manufacture of the three samples was ABS material according to similarity obtained between the properties of samples with the properties of ABS material, but sample of Mouse showed a difference results for all materials used in the manufacture of EEE, suggesting that the material may be recycled material.

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