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STRUCTURAL AND MECHANICAL STUDIES OF WASTE PRINTED CIRCUIT BOARDS

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ABSTRACT

Accumulation of Electronic waste has become a concern for most environmental problems. The effects of dumping Wasted Printed circuit boards, WPCBs and its residues on environment is hazardous to water, air and land pollution which may lead to health hazards such as rise to anemia and skin related disease and environmental hazards such as acid rain, water contamination etc. The specimen fabrication was carried out by recycling Waste Printed Circuit Boards(PCB) into granular size of 100 microns. The material has been tested for its tensile compression and hardness to determine their mechanical properties. The PCB material was subjected to SEM and EDAX analysis for determining their structure, porosity and material composition. PCB reduces the environmental effects of E-waste PCBs by the recycling technique, improves the material strength. Reduction in the material weight and cost provide the material sustainable for mechanical applications.

Keywords: E-Waste, PCB, SEM, EDAX, Mechanical Testing.

I. INTRODUCTION

Waste Printed Circuit Boards (WPCBs) accumulation has increased overtime due to the extensive use of electronic goods. A study reported that the Printed circuit board (PCB) comprises of nonmetals >70%, copper ~16%, solder ~4%, iron, ferrite ~3%, nickel~2%, silver ~0.05%, gold ~0.03%, palladium ~0.01%. Recycling of PCB should be made on the basis of considering its thermal, physical and chemical properties as it causes serious injuries when exposed to thermal and chemical environment. PCB material is used as a supplementary material Mechanical testing has been carried out to determine their tensile compression and hardness strength of the material. Structural analysis i.e. Scanning Electron Microscope analysis and Electron Dispersive Spectroscopy analysis have been carried out to determine the morphological structures and surface finish properties of the material.

II. LITERATURE SURVEY

Jessica Hanafi et al designed a new method for material recovery and characterization. The PCB sample collection was carried out by Donate & Win concept and the recovery materials is carried out by three main steps they are disassembly, mechanical recycling and chemical recycling. James et. al (2012) has carried out

fatigue testing on polycarbonate material. The surviving material that was employed in the fabrication of Riot shield was polycarbonate material. Trying out the polycarbonate material in the spaces where the crack growth is initiated is carried away. Wide scope of stress intensity calibration was applied to fix the stress in the cloth. The two principal features are accurate identification of an appropriate mean crack tip position and masking the plastic region is run out to deliver a significant curvature through the heaviness of the polycarbonate specimen. The advance crack growth and multiplication in the polycarbonate is analyzed with respect to crack dimension, crack tip position and crack form. The phenomena such bas stress intensity factor is observed in polycarbonate and its effects such as crack blunting and crack closure are observed. Qjong-Li Wu et al performed a computational analysis for various analyses by sobol's sensitivity analysis. This sensitivity analysis is carried out for various applications such as Monte Carlo sampling and re sampling. This technique has good control of the estimation accuracy with respect to the number of samples.

III. 3.MATERIALS

Among the e-waste materials available, PCB has been selected for recycling since it posses superior mechanical properties. The material was first powdered to a size of less than 200 microns. The powdered was subjected to sieving process by which a particle size of 100 microns has been made. E glass fiber which posses very good mechanical properties is added to enhance the mechanical properties. Epoxy resin which posses' superior bonding properties had been used as reinforcement.

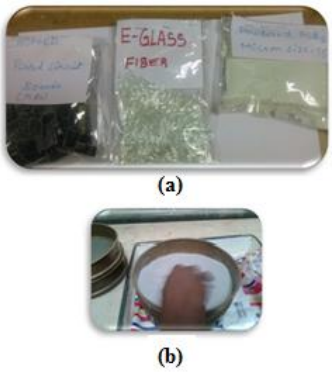

Fig.1 (a) Materials (b) PCB Powder Sieving Process

IV. SAMPLE PREPARATION

Sample preparation was made by considering material properties. Three samples were made to determine the material strength. Table 1 shows the material composition that has been used to prepare the samples.

Table 1 Samples and Weight ratios

Sample. No	PCB wt %	EPOXY wt %	E-Glass wt %
1	60	25	15
2	40	40	20
3	40	20	40

V. MATERIAL TESTING

The material has been tested for various mechanical properties such as tensile, compression and hardness. Table 2 shows test results of the samples.

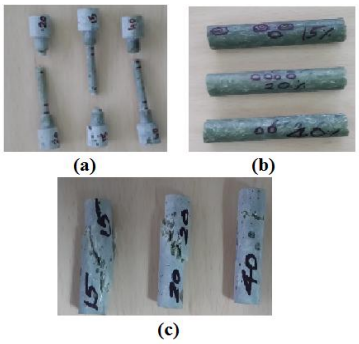

Fig.2 Tested Specimen (a) Tensile

(b) Hardness (c) Compression

Table 2 Test Results of prepared samples

Testing / Sample	Tensile N/mm^2	Compression N/mm^2	Hardness 'L' Scale
Sample 1	25	79	76.875
Sample 2	32	95	88.125
Sample 3	53	109	96.625

VI. MICRO STRUCTURE ANALYSIS

Micro structure analysis such as SEM and EDAX analysis for the prepared samples are carried out.

1.1 SEM Analysis.

The SEM analysis carried out for sample shows that it posses' flat surface morphology. Initially the sample was prepared by vacuum bag molding method and immediately after curing the SEM analysis for the material has

been carried out. The flat plates that are formed shows that the surface of the material has very smooth curvature.

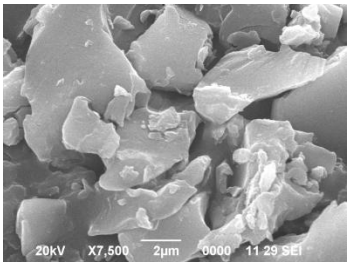

Fig.2 SEM Analysis of Specimen sample

1.2 EDAX Analysis.

The EDAX Analysis has been carried out to determine the composition of the prepared sample.

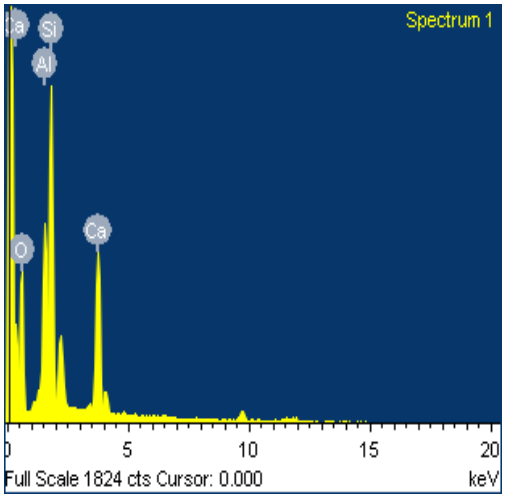

Fig.2 EDAX Analysis of Specimen sample

Table 3 material composition and their concentration

Element	App concentration	Intensity correction	Weight %	Weight % sigma	Atomic%
O K	43.16	0.6662	54.05	0.82	69.29
Al K	10.02	0.8596	9.73	0.35	7.39
Si K	21.59	0.8253	21.83	0.50	15.94
Ca K	16.67	0.9663	14.40	0.40	7.37

VII. CONCLUSION

It is concluded that the recycling can be carried out by powdering it into granular sizes will reduce the influence of hazards on the earth. The results shows that it posses very good material strength and morphological structures. Hence it can be used as a replacement material for industrial applications.

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