Effect of E-waste Aluminium with Fly ash composite for environment safety

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Abstract- The aluminium is a matrix material and the reinforcements are E-glass fiber and fly ash with various weight fraction the E-glass fiber is constant and the fly ash is varied 0,3,6,9 wt. % fabricate by using stir casting method. After the composite sample are subjected to examine the mechanical properties such as tensile, compressive, yield, % of elongation, hardness and toughness strength. From the test result the tensile strength of the four different wt.% composite sample is increased gradually adding with increasing the fly ash wt.% gradually (0,3,6,9 wt.%), the 9 wt.% fly ash sample is get higher tensile strength 199.698 N/mm^2 compared with other samples. The yield strength of the four composite sample was analyzed during the tensile strength test the yield end point of the specimen is called yield strength it was increased adding with increasing the fly ash wt.% gradually, the 9 wt.% of fly ash sample is get higher yield strength 182.55 N/mm^2 compared with other samples. The compressive strength of the four composite sample are increased gradually adding with increasing of fly ash wt.%, the 9 wt.% fly ash sample was get higher compressive strength 432.678 N/mm^2 compared with other samples. The % of elongation of the four composite samples was increased adding with increasing the fly ash wt.%, the 9 wt.% fly ash sample was get higher elongation 3.4% compared with other samples. The hardness of the composite samples was also increased adding with increasing the fly ash wt.%, the 9 wt.% of fly ash samples is get higher hardness strength 79.3 HBN compared with other samples. But only the third sample is get decreased in both hardness and % of elongation compared with second sample the decreasing ratio is 12 % of hardness and 13.04 % of elongation. The toughness strength of the composite sample was studied in impact charpy test was get decreased adding with increasing the fly ash wt.%, the 3 wt.% fly ash sample was suddenly get decreased 1 joule compred with 0 and 6 wt.% fly ash sample. For the above result the 6 and 9 wt. % fly ash sample was subjected to examine the microstructure analysis using scanning electron microscope. From the SEM image of 6 and 9 wt. % fly ash samples the 9 % fly ash sample was having good reinforcement. For the 6 wt. % fly ash sample is less performance compared with 9 wt. % sample. In this work yield way to reduce the E-waste amount by making new material.

Index Terms- Environmental impact assessment, e-waste, Heat Sink, e-glass fiber, fly ash, stir casting process, mechanical testing, microstructure analysis.

NOMENCLATURE

WEEE	-	Waste Electrical and Electronic Equipment	SiC	-	Silicon Carbide
E-waste	-	Electronic waste	Fe2O3	-	Ferric Oxide
MMC	-	Metal Matrix Composite	NaCl	-	Sodium Chloride
Mpa	-	Mega Pascal	MgO	-	Magnesium Oxide
Gpa	-	Gega Pascal	B2O3	-	Boron Oxide
g/cm2	-	Gram per centimeter square	Na2O	-	Sodium Oxide
No.	-	Number	K2O	-	Potassium Oxide
Al	-	Aluminium	MPa	-	Mega Pascals
RHA	-	Rice Husk Ash	UTS	-	Ultimate Tensile Strength
TV	-	Television	UCS	-	Ultimate Compressive Strength
SEM	-	Scanning Electron Microscope	PT	-	Tensile load
Wt.%	-	Weight percentage	σT		Tensile Strength
ASTM	-	American Society for Testing and Materials	A	-	Cross sectional Area
E/D	-	Edge distance to diameter ratio	PY	-	Yeild load
W/D	-	Width to Diameter ratio	σY	-	Yeild Strength
PCB	-	Printed Circuit Board	ΔL	-	Final Length, mm

SiO2	-	Silicon dioxide
Mg	-	Magnesium
Al2O3	-	Aluminium Oxide
CaO	-	Calcium Oxide
ASTM	-	American Standard Testing Method
SEM	-	Scanning Electron Microscope
L	-	Initial Gauge length, mm
mm	-	Milli Meter
Kg	-	Kilo Gram
N	-	Newton
J	-	Joule

I. INTRODUCTION

In recent year there has been increasing concern about the growing volume of end-of-life (EOL).The electronic scraps and waste are enormous that couldn't be normally disposed in to the agricultural land or any land because this contains more valuable metals and non-metals. There are also large amount of toxic materials present in it. The electronic scrap is very important subject of concern. All over the world, large amount of e-waste has been generated, with china & Japan producing above 1000 million tons per year. At present the electronic wastes are subjected to recycling process adapting either mechanical process or chemical process. Recycling processes are carried out to recover the materials from e-waste and segregate the materials in to metals and non-metals. The chemical process yields high metal purity but involves high cost and need more safety. The mechanical process involves less cost, medium safety, but recovers high valuable metals, such as copper, aluminium, lead, cadmium, brominates and beryllium flame retardants. Aluminium alloy A356.2 matrix and reinforcement of rice husk ash and Silicon carbide added at equal ratio of 2,4,6,8 wt.% is fabricated by double stir casting process. While increasing of reinforcements wt.% the porosity, hardness, yield strength and ultimate strength was increased in the composite and the density is decreased[1]. Aluminium alloy (Al-Mg-Si), RHA and Alumina (Al_2O_3) reinforcement at used with various combinations to fabricate the composite such as 0:10, 2:8, 3:7, 4:6 wt.% by using double stir casting method. In this composite was investigated as showed percentage elongation and fracture toughness was increased of the 2:8 wt.% sample and it containing low hardness, ultimate tensile strength and yield strength while increasing the reinforcements. So that the single alumina reinforcement only got higher than others samples[2]. aluminium alloy (Al-Si-10Mg) and Rice Husk Ash reinforcement in ratio of 3,6,9,12 wt. % using stir casting method fabricate the composite material. The tensile strength, compression strength and hardness was increased and the ductility gets decreased with increase in RHA weight fraction reinforcements[3]. Aluminium alloy A359 and reinforcement with Al_2O_3 at different wt.% such as 2,4,6,8 wt.% was fabricated by electromagnetic stir casting method. The tensile and hardness strength of the composite was increased that increasing the reinforcement Al_2O_3% while comparing with unreinforcement alloys[4]. Waste e-glass fibre particles are utilized in cement concrete mixer inert fillers at different percentage and different ageing days such as 17, 27, 43 wt. % and 28, 91, 365 days. The e-glass fibre size is 38 to 300µm 40% of e-glass fibre is less then 150µm. Based on the properties the hardened concrete, optimum e-glass content was found to be 40-50 wt. % and having excellent chloride –ion penetration resistance[5]. Aluminium 7075 matrix and reinforced with Fly ash and E-glass Short fibres composite is fabricated by stir casting at various weight fraction like E-Glass fibre 1%,3%,5% constantly with each ratio of fly ash (2,4,6,8%). The test result the 8% of fly ash and 5% of e-glass fibre sample was get high tensile and compressive strength. So the reinforcement Wt. % is increasing the properties is increased[6]. Aluminium alloy 6061 and reinforced with flyash was fbricated the composite by using stir casting method at different particle size and different percentage in weight fraction such as (4-25, 45-50, 75-100 µm) and (10, 15, 20 wt.%). The particle size is increased the tenisle and compressive strength is decreased. The wt.% percentage of fly ash is increased the tensile and compressive strength is increased at the same time the ductility is decreased[7]. Aluminium 7075 matrix and reinforced with Fly ash and Magnesiun composite is fabricated by stir casting at four various weight fraction like S1,S2,S3,S4. The samples are subjected to mechanical testing the S2 sample was higher strength at toughness, tensile, hardness strength and the grain size was decreased. So the amount of fly ash is increased up to S2 weight, that properties is increased[8]. The effect of reinforcement (Zirconia + Flyash) with aluminium alloy 6061 matrix is fabricated at fixed percentage of flyash (10%) and varying percentage of Zirconia (5% and 10%) in weight fraction by using stir casting method. From the result (fly ash10% + zirconia 10%) containing sample was having high tensile and hardness strength and the percentage elongation was decreased while comparing unreinforced alloy[9]. The wastage of fly ash is utilized in MMCs at aluminium matrix is fabricated at stir casting method at different weight fraction (flyash 5%,10%,15%,20%). The 20% of flyash sample is got high hardness and decreased in frictional forces and wear rates. So they increasing of fly ash % that the hardness is increased[10]. Aluminium 6061 is a matrix and the reinforcements are e-glass fibre and fly ash is fabricated by liquid metallurgy method at various weight percentage such as the fly ash is 2,4,6,8 wt.% and the e-glass fibre as 2 and 4 wt.% is constant at all. This sample was prepared and machined as per the ASTM standards subject to evaluated the mechanical properties like tensile, compressive and hardness strength. Finally the fly ash wt. % increased significantly improved the tensile, compressive and hardness strength and it is compared with unreinforced matrix materials[11]. In the metal matrix composite Al 6061 and the reinforcements is fly ash and e – glass fibre by stir casting method at various wt. %. The e-glass fibre is 2, 4 and 6 wt.% and the fly ash is constant at 5, 10, 15 wt.% is fabricated and machined as per the ASTM standard and subjected to evaluated the mechanical properties such as tensile, compressive, hardness strength and microstructure of the sample was observed to study the bonding of reinforcements in the Al 6061 alloy finally the fly ash increased up to 10 % and e-glass fibre 6 % sample is improved the tensile and compressive strength compared with other sample. The hardness is increased from 47.53 BHN to 68.48 BHN with adding of fly ash and E-glass fibre[12].

II. MATERIALS AND METHODS

A.Heat Sinks:

In electronic systems, a heat sink is a passive heat exchanger that cools a device by dissipating heat into the surrounding medium. In computers, heat sinks are used to cool the PCB. Heat sinks are used with high-power semiconductor devices such as power transistors and optoelectronics such as lasers and light emitting diodes (LEDs), where the heat dissipation ability of the basic device is insufficient to moderate its temperature. The heat sinks are found in all electronic and automation systems (i.e.) TV, DVD Player, Washing Machine, CPU…etc. The electronic equipments and systems containing large size heat sink is made by aluminium alloy material using casting process. Heat sink is majorly placed in the PCB`s (PRINTED CIRCUIT BOARDS) to reduce heat and cool the circuit boards with the help of fans. Heat sinks are the heat exchangers such as those used in refrigeration and air conditioning systems.

Heat Sink Cutting process*:* The heat sinks are large sizes it is contains little amount in the crucible either it is cut a small pieces the crucible contains large amount of heat sinks.

Figure.1 Heat Sinks (Aluminium alloy)

Table.1 chemical composition of heatsink(aluminium alloy)

Si	**Fe**	**Cu**	**Mn**	**Mg**	**Zn**	**Ti**	**Cr**
0.29%	0.073%	0.0002%	0.006%	0.49%	0.015%	0.019%	0.0002%
Ni	**Pb & Sn**	**Na**	**Ca**	**B**	**Zr**	**V**	**Be**
0.0001%	0.002%	0.0002%	0.00003%	0.0005%	0.0003%	0.002%	0.00004%
Sr	**Co**	**Cd**	**Sb**	**Ga**	**P**	**Li**	**Al**
0.00003%	0.006%	0.0003%	0.002%	0.008%	0.002%	0.00002%	**99.0%**

Figure.2 Heat Sink cutting Process

B.E-glass fiber:

Fiber reinforced composite materials consist of fibers of high strength and modulus embedded in or bonded to a matrix with distinct interfaces between them. In this form, both fibers and matrix retain their physical and chemical identities, yet they produce a combination of properties that cannot be achieved with either of the constituents acting alone. E-Glass or electrical grade glass was originally developed for standoff insulators for electrical wiring. It was later found to have excellent fiber forming capabilities and is now used almost exclusively as the reinforcing phase in the material commonly known as e-glass fiber. It was low cost, high strength, good reinforcement and easily available in the market.

Figure.3 E-glass fiber

C. Fly ash:

Fly ash is a waste product from the combustion of pulverized coal in electricity power plants. Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Here are two classes of fly ash are defined by ASTM C618: Class F fly ash and Class C fly ash. The main difference between the class types is the amount of calcium Oxide, silica, alumina, and iron content in the ash. The CaO wt. % is less than 20% ash is called class F type fly ash and more than 20% ash is called class C type fly ash. The below 63 micron grain size fly ash was only used in the composite preparation.

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F Class type **C Class type**

Figure.4 Class F type and class C type fly ash

Table. 2 Chemical composition of Fly ash

SiO_2	31.0%	MgO	2.8%
Al_2O_3	9.0%	Fe	5.7%
Fe_2O_3	8.15%	Na_2O	0.30%
CaO	**6.0%**	K_2O	0.20%

D. Stir Casting:

Stir casting is a liquid metallurgy method of composite material fabrication, in which a dispersed phase (ceramic particles, short fibers) is mixed with a molten matrix metal by means of mechanical stirring. The stir casting arrangements is shown in figure 5. It is effectively mixing the reinforcements with the matrix material (Al alloy) and doesn't damaged the reinforcements while stirring.

Figure.5 Stir casting arrangements

E. Composite Fabrication Procedure:

This project focused on how to reduce the e-waste in earth and save the environment in this work the e-waste devices are collected and remove the materials, devices, equipments separately. The removed devices are segregated metals, non-metals and plastics. From this non-metals the aluminum, copper, brass are recovered. The recovered materials are selected based on the literature this project was used the aluminum. The aluminiumas placed in this e-waste mostly in the heat sink it was collected and cutted to the small pieces. These materials as a matrix material it is melted at liquid state at 750ºC to 800ºC in the stir casting method after that the selected reinforcements are E-glass fiber and fly ash mixture added with preheating of 400ºC at 30 minutes at required wt.% after the stirrer is drop down and stirring for 930 rpm at 5-7 mins. After stirring the composite mixture was pouring in to the die and preparing the composite sample. The prepared samples are machining as per the ASTM standards convert the test specimen. The specimens are induced the mechanical properties examination. This process is continued at all specimens. Based on the test result the optimum strength composite was used to fabricate machine components.

F. Composite Material composition:

The composite material composition was constructed based on the literature study. In this project work focused the e-waste aluminiumis a matrix material and the reinforcements are e-glass fiber and fly ash. The existing works the reinforcements rice husk ash and SiC both 2,4,6,8 wt.% remaining aluminium 356[1], Aluminium alloy (Al-Mg-Si), RHA and Alumina (Al_2O_3) reinforcement at used with various combinations to fabricate the composite such as 0:10, 2:8, 3:7, 4:6 wt.%[2], aluminium alloy (Al-Si-10Mg) and Rice Husk Ash reinforcement in ratio of 3,6,9,12 wt. %[3], the effect of reinforcement (Zirconia + Flyash) with aluminium alloy 6061 matrix is fabricated at fixed percentage of flyash (10%) and varying percentage of Zirconia (5% and 10%) in weight fraction[9], the wastage of fly ash is utilized in MMCs at aluminium matrix is fabricated at stir casting method at different weight fraction (flyash 5%,10%,15%,20%)[10]. According to the following literature studies we prepared the composite materials samples at various wt. %. The composite material composition is shown in the table.3

Table (3) composition of composite materials

Sample	Aluminium alloy (wt %)	E-glass Fibre (wt %)	Fly ash (Wt %)
1	97%	3%	0%
2	94%	3%	3%
3	91%	3%	6%
4	88%	3%	9%

III. SAMPLE PREPARATION

The e-wasted heat sinks is collected at require amount in Kg and segregation, cutting, is a primary process of the experimental work. The secondary process of the project is the small pieces of heat sink is melted in stir casting furnace at 750ºC to 800ºC at 1 hr by crucible and the stirrer is set inside the melted aluminium and add the reinforcements e-glass fiber and fly ash was preheated in pre-heating furnace at 400ºC for 30 minutes. After adding the reinforcements with the degassing tablet powder (HEXACHLORA ETHANE TBLET) and stirrer is switch on rotated at 800 to 900 rpm at 5-7 minutes. After stirring it is lifted in to the furnace and crucible is take out in to the furnace and pouring in to the die and fabricate the composite materials samples this process is followed at remaining samples.

Figure.6 Composite Materials Fabrication Process

IV. RESULTS AND DISCUSSIONS

Mechanical properties testing:

A. Tensile Strength:

The tensile strength is an ability of the materials it is tested by Universal Testing Machine - 40 ton capacity machine modal TUE – C – 400. The test specimen is prepared by as per the ASTM E8M-13a dimension gauge length 30 mm, gauge diameter 6 mm fillet radius 6 mm, grip diameter 10mm and grip length 20 mm is conducted at room temperature 28ºC. The tensile strength of the composite materials samples results is shown in figure 11.

Figure . (7) Tensile test specimen Sample 1 - (Aluminium 97%, E-glass fibre 3%)

Figure . (8) Tensile test specimen Sample 2 - (Aluminium 94%, E-glass fibre 3%, Fly ash 3%)

Figure . (9) Tensile test specimen Sample 3 - (Aluminium 91%, E-glass fibre 3%, Fly ash 6%)

Figure . (10) Tensile test specimen Sample 4 - (Aluminium 88%, E-glass fibre 3%, Fly ash 9%)

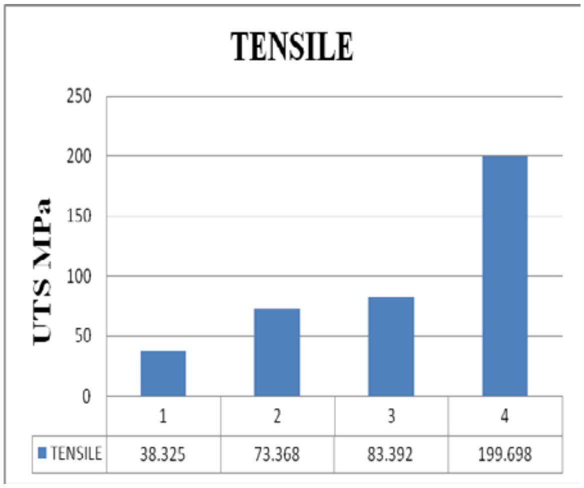

Figure. (11) Tensile Strength test result

The ASTM standard dimensions are Specimen diameter is D = 6 mm, Initial Gauge length G = 30 mm, Radius of fillet R = 6 mm, Grip diameter d = 10 mm , Grip length L = 20mm, Cross sectional area = 28 mm.

Tensile Strength (σ_T) = [Tensile Load / Cross sectional Area] (or) [P_T / A] N/mm^2

Difference between samples in % = [(Maximum strength – Minimum strength) / Maximum Strength] x 100

The fly ash wt. % is increased the tensile strength was increased gradually at all the four samples. In the first sample is reduced from the second sample at 47.76% and it compared with third sample which increased 12.02%, the third sample was decreased then fourth sample at 58.24%. From this above result the tensile strength was identified and compared with theoretical value of the composite is shown in the table. (4) it's come nearest strength.

B. Yield Strength and % of elongation:

The yield strength is an ability of the materials it is tested during the tensile test the yield load was applied on the specimen the yield point or before breaking point is a yield load is used to calculate the yield strength of the composite materials. The yield strength of the all four samples results are shown in figure 12. From the result the yield strength was increased which increasing of the fly ash wt. % in the second sample in increased at 53.837 %, the third sample is increased then second sample at 12.699 % and the fourth sample also increased then the third sample is 60.73%.

Yeild Strength (σ_Y) = [Yeild Load / Cross sectional Area] (or) [P_Y / A] N/mm^2

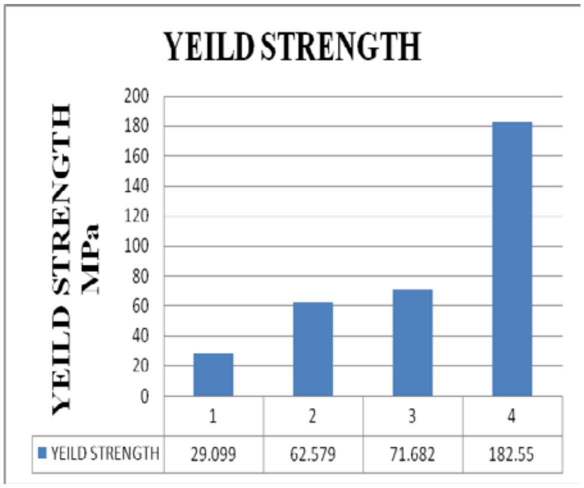

Figure. 12 Yield Strength test results

The % of the elongation is a enlarging length of the specimen for applying tensile load it is used to calculated % of elongation. The % elongation of the all four samples results are shown in figure 13. The % of elongation also increasing from first sample to second sample at 56.52% and the fourth sample is increased then the third sample is 39.29% only the third sample is get decreased then the second sample

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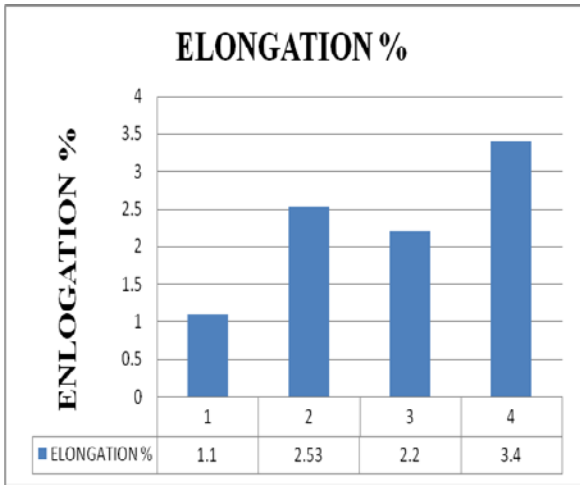

Figure.13 % of Elongation test results

Percentage of elongation in length= ΔL / L

C. Compressive Strength:

The compressive strength is an ability of the materials it is used to analyze the compressibility of the materials. It is conducted in UTM – Universal Testing Machine the machine model was TUE – C – 400. The compressive load was applied on the specimen the specimen is deformed is called compressive strength of the materials. The deformation stage load is a compressive load is used to calculate the compressive strength and the test specimen is prepared as per the ASTM-E9 standards. The compressive strength of the composite materials samples are shown in figure 18. From the compressive strength result is increased for increasing the fly ash wt. %. The second sample was increased 1.685 %, the third sample is increased then the second sample yet 10.56 % and the fourth sample also increased then the third sample at 9.646%.

Figure.14 Compressive test specimen Sample 1 - (Aluminium 97%, E-glass fiber 3%)

Figure.15 Compressive test specimen Sample 2 - (Aluminium 94%, E-glass fiber 3%, Fly ash 3%)

Figure.16 Compressive test specimen Sample 3 - (Aluminium 91%, E-glass fiber 3%, Fly ash 6%)

Figure.17 Compressive test specimen Sample 4 - (Aluminium 88%, E-glass fiber 3%, Fly ash 9%)

Compressive Strength σ_C = Compressive Load / Cross Sectional Area (or) P_C / A
$A = \pi r^2$
Here d = Diameter of the specimen = 9 mm, r = Radius of the specimen = 4.5 mm

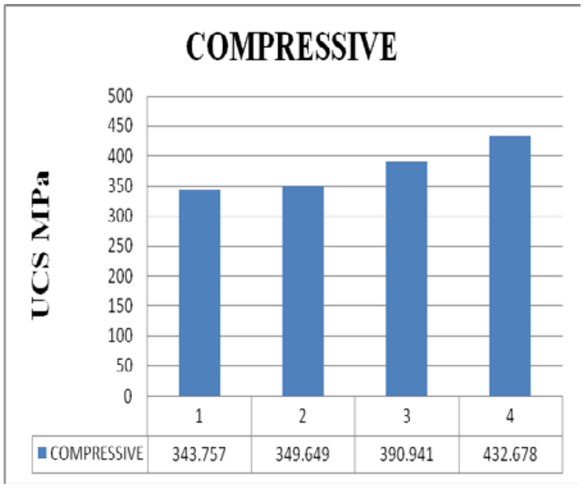

Figure.18 Compressive Strength test results

D. Hardness strength:

The hardness strength is an ability of the materials it is tested by hardness testing machine there are three types of hardness tester such as Brinell, Rockwell, and Vickers hardness. The test specimen is prepared as per the ASTM standard. In this project the Brinell hardness testing machine is used to analyze the hardness strength the ball type indenter tool was used. The hardness strength of composite materials result is shown in figure 23. The hardness strength of the second sample was increased then the first sample at 19.3% and the fourth sample is increased then the third sample at 20.80 % only the third sample is decreased then the second sample.

Figure.19 Hardness test specimen Sample 1 - (Aluminium 97%, E-glass fibre 3%)

Figure.20 Hardness test specimen Sample 2 - (Aluminium 94%, E-glass fibre 3%, Fly ash 3%)

Figure .21 Hardness test specimen Sample 3 - (Aluminium 91%, E-glass fibre 3%, Fly ash 6%)

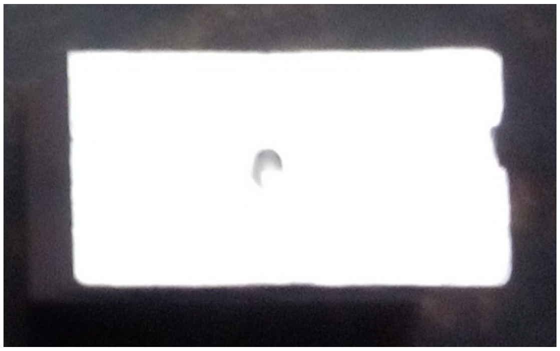

Figure.22 Hardness test specimen Sample 4 - (Aluminium 88%, E-glass fibre 3%, Fly ash 9%)

BHN = Load Applied (P) (kgf.)/ Spherical surface area indentation (A)
Area of indentation $A= \pi \times D /2(D-\sqrt{D^2 - d^{2)}}$

D = Diameter of the ball,

d = Indentation diameter

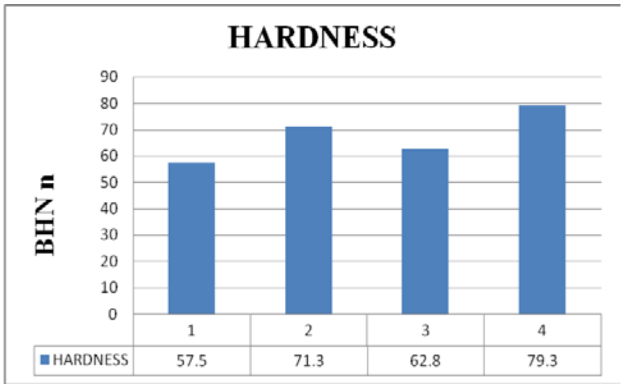

Figure.23 Hardness Strength test results

E. Impact Strength:

The Impact strength is an ability of the materials it is used to analyze the toughness of the materials it is tested two types Charpy and Izard test. By this project the Charpy test is carried out in the impact testing machine with V-notch. The test specimen was prepared as per the standard dimensions 10x55x7.5 mm. The impact strength of the composite materials samples result is shown in figure 28. From the test result the second sample is decreased then the first sample and the third sample was increased then the fourth sample here having some error in the impact strength of the composite.

Figure. 24 Impact charpy test specimen Sample 1 - (Aluminium 97%, E-glass fibre 3%)

Figure.25 Impact charpy test specimen Sample 2 - (Aluminium 94%, E-glass fibre 3%, Fly ash 3%)

Figure.26 Impact charpy test specimen Sample 3 - (Aluminium 91%, E-glass fibre 3%, Fly ash 6%)

Impact strength (Charpy) = Absorb energy / Effective cross section area (J/mm^2)
Absorb Energy = $E_2 - E_1$

Figure. 27 Impact charpy test specimen Sample 4 - (Aluminium 88%, E-glass fibre 3%, Fly ash 9%)

Table.4 Specifications of the impact test

S.NO	DESCRIPTION	VALUES
1	Impact capacity	300joule
2	Least count of capacity (dial) scale	2joule
3	Weight of striking hammer	18.7 kg.
4	Swing diameter of hammer	1600mm.
5	Angle of hammer before striking	160°
6	Distance between supports	40mm.
7	Striking velocity of hammer.	5.6m/sec
8	Specimen size	55x7.5x10 mm
9	Type of notch	V-notch
10	Angle of notch	45°

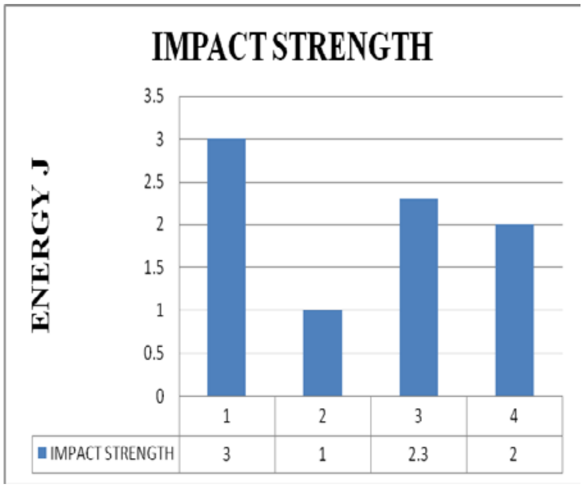

Figure.28 Charpy test results

SAMPLES	*1*		*2*		*3*		*4*	
PROPERTIES	Practical value	Theoretical value	Practical value	Theoretical value	Practical value	Theoretical value	Practical value	Theoretical value
Tensile, (N/mm^2)	38.325	39.425	73.368	74.354	83.392	94.03	199.698	210.08
Yield, (N/mm^2)	29.099	29.88	62.579	65.567	71.682	73.56	182.55	187.56
Elongation (%)	1.10	-	2.53	-	2.20	-	3.40	-
Compressive(N/mm^2)	343.757	347.76	349.649	350.65	390.941	395.69	432.678	435.676
Hardness	57.5	58	71.3	73	62.8	65	79.3	82
Impact (J)	3.0	-	1.0	-	2.3	-	2.0	-

Table 5 Test results of the MMCs sample

V. Micro Structure Analysis

Micro structural examination is carried out only at third sample (Al – 91%, E-glass fibre – 3%, fly ash – 6%) and fourth sample (Al – 88%, E-glass fibre – 3%, fly ash – 9%) composite was subjected to scanning electron microscope. Because in the third sample only was get low hardness strength and % of elongation while increasing the fly ash wt%. The micro structure image magnification was taken at 1500X (10µm) in both samples. From the fourth sample microstructure image the e-glass fibers and fly ash are effectively located at most of them places in the composite sample. Become a third sample the both fly ash and e-glass fibers are located at one are two places in the corresponded composite sample.

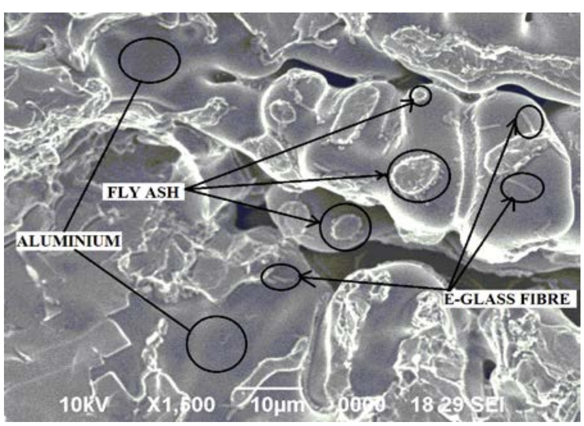

Figure.29 Microstructure image of sample 4 (Aluminium - 88%, E-glass fiber – 3%, Fly ash – 9%)

The microstructure of 9 wt. % sample is clearly shown how the reinforcements are bonded in the aluminium composite such as fly ash and e-glass fiber in the composite sample it was shown in the microstructure image of the 10 µm size is shown in the figure 29. This sample the fly ash wt. % is improved the mechanical properties tensile, yield, % elongation, compressive and hardness strength only the impact strength is decreased. Figure.(30) Micro structure image of sample 3 (Aluminium–91%, E-glass Fiber – 3%, Fly ash – 6%) sample microstructure image the reinforcement E-glass fiber and fly ash are less than the 9 wt. % sample it is shown in the figure 30. So the 6 wt. % sample mechanical properties are tensile, compressive, yield strength and charpoy test (impact strength) increased and the hardness strength and % of elongation only decreased. From the 6 wt. %

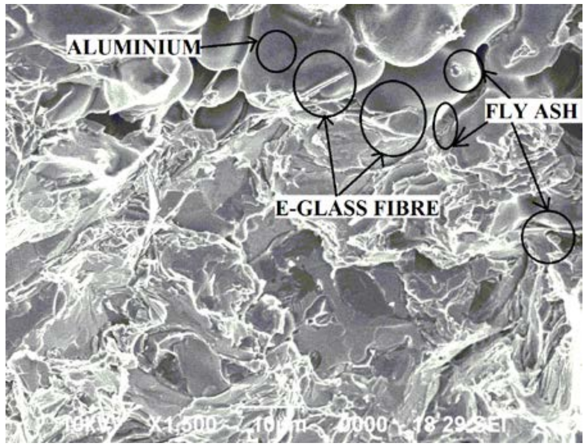

Fig ure. (30) Micro structure image of sample 3 (Aluminium – 91%, E-glass Fibre – 3%, Fly ash – 6%)

VI. CONCLUSION

The amount of E-waste production is globally challenged. In this work the new metal matrix composite was developed by using e-waste aluminium collected from the heat sink. The E-waste contains most valuable metals, non-metals and other particles. The e-waste materials are not recycled properly in the industry during any heating process the E-waste are produces the toxic gasses it was dangerous to the living things. Now the project work focused a innovative think the e-waste materials are added with composite with selected reinforcements for useful work. The e-waste aluminium is used in this as a matrix materials adding with selected reinforcements such as fly ash and e-glass fiber with various weight fraction was successfully fabricated using stir casting method. After the composite sample are subjected to examine the mechanical properties such as tensile, compressive, yield, % of elongation, hardness and toughness strength. From the test result the tensile strength of the four different wt.% composite sample is increased gradually adding with increasing the fly ash wt.% gradually (0,3,6,9 wt.%), the 9 wt.% fly ash sample is get higher tensile strength 199.698 N/mm^2 compared with other samples. The yield strength of the four composite sample was analyzed during the tensile strength test the yield end point of the specimen is called yield strength it was increased adding with increasing the fly ash wt. % gradually, the 9 wt.% of fly ash sample is get higher yield strength 182.55 N/mm^2 compared with other samples. The compressive strength of the four composite sample are increased gradually adding with increasing of fly ash wt.%, the 9 wt.% fly ash sample was get higher compressive strength 432.678 N/mm^2 compared with other samples. The % of elongation of the four composite samples was increased adding with increasing the fly ash wt.%, the 9 wt.% fly ash sample was get higher elongation 3.4% compared with other samples. The hardness of the composite samples was also increased adding with increasing the fly ash wt.%, the 9 wt.% of fly ash samples is get higher hardness strength 79.3 HBN compared with other samples. But only the third sample is get decreased in both hardness and % of elongation compared with second sample the decreasing ratio is 12 % of hardness and 13.04 % of elongation. The toughness strength of the composite sample was studied in impact charpy test was get decreased adding with increasing the fly ash wt.%, the 3 wt.% fly ash sample was suddenly get decreased 1 joule compared with 0 and 6 wt.% fly ash sample. For the above result the 6 and 9 wt. % fly ash sample was subjected to examine the microstructure analysis using scanning electron microscope. From the SEM image of 6 and 9 wt. % fly ash samples the 9 % fly ash sample was having good reinforcement performance in the composite sample. For the 6 wt. % sample is less performance of e-glass fiber and fly ash compared with 9 wt.% fly ash sample. This work is developing the new materials and save earth from the E-waste.

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