

BEHAVIOUR OF HIGH STRENGTH AI 7005 REINFORCED WITH WASTE BASED FLY ASH AND GLASS FIBER

Submitted in partial fulfilment of the requirements for the award of Bachelor of
Engineering Degree in Mechanical Engineering

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SATHYABAMA

**Institute of science and technology
(DEEMED TO BE A UNIVERSITY)**

Accredited with grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of S MARIO NITHYAN (REG.NO 38150095) and PRITHIVIRAJ (REG.NO 38150083) who carried out the project entitled ” **BEHAVIOUR OF HIGH STRENGTH AI 7005 AND ITS COMPOSITES REINFORCED WITH WASTE BASED FLY ASH AND GLASS FIBER**” under our supervision from September 2021 to May 2022.

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ABSTRACT

The interest to foster lightweight materials with upgraded properties reasonable for different designing applications is the focal point of this exploration work. Modern squanders like Fly ash (FA) and S-Glass fiber (GF) where utilised as reinforcement materials for high strength alloy, that is i.e, Al7005. Stir casting courses were utilised for manufacturing the four samples

(as cast Al7005/3%FA/3%GF,

Al7005/1%GF/5%FA ,

Al7005/2%GF/4%FA

Al7005/4%GF/2%FA

The test test go through Tensile, hardness, Impact, Wear test and morphological investigation Metal Matrix composites (MMCs) are most able in achieving worked on mechanical properties and wear properties because of the presence of supported particles. Aluminium is utilised in different applications on account of its light weight and high strength and wear resistance. In the current work, Al7005 MMC alloy is supported with various weight percentages of S-glass and Fly ash were ready through mix casting procedure and hot casted. The casted Al7005 cross breed MMCs were subsequently exposed to tensile test (ASTM B 557M) the properties of casted cross breed MMCs were viewed as better compared to other mixture MMCs. It is seen that ultimate tensile strength of casted Al7005 3%FA /3%GF half and half (Fly ash) MMCs worked on by 7.43% and extreme rigidity of casted Al7005 3%FA and 3%GF Fly ash mixture MMCs worked on by 7.43 percentage. Where level of extension is reduced to 14% than the mixture casted. The MMCs were tested with Brinells hardness test with ASTM principles ASTM-E18 (56.8, 58.4, 57.4). The highest hardness value found in sample no 4. Then the MMCs tested with an impact test to test the impact strength of the metals with the ASTM E23. The most highest impact value found is Sample 3-2 values is 13.6. The MMCs were tested with a wear test with Pin-On -Disk Apparatus with ASTM G99. The least wear value is found in sample number 3 (-17). The sample that goes through the four tests in particular tensile, Hardness, Impact and Wear tests and morphological review utilising SEM (Scanning Electron Microscope). This SEM Test is utilised to guarantee the uniform dispersion of these reinforcements and to deal with the blending of unfamiliar pollutants, inside the continuous phase

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LIST OF SYMBOLS AND ABBREVIATIONS

Al	Aluminium
Zn	Zinc
FA	Fly ash
GF	Glass fibre
SEM	Scanning Electron Microscope
Cu	copper
Mg	Magnesium
MMCs	Metal Matrix Composites
UTS	Ultimate Tensile strength.
MRR	Material Removal Rate
TMP	Turbo Molecular Pump
CNT	Carbon Nanotubes
SiC	Silicon Carbide
ASTM	American society for testing Materials

Wt%

Weight percentage

Mn

Manganese

Zr

Zirconium

Cr

Chromium

Al_2O_3

Aluminium Oxide

K_2O

Potassium Oxide

CHAPTER 1

INTRODUCTION

MMCs (modified metal matrix composites) are at the top when creating planned parts due to their super properties (physical, mechanical and electrical) even at extreme temperatures. Metal matrix composites, choosing the liquid metallurgy course (fluid state handling, casting cycles, powder metallurgical: squeezing, sintering, casting, fashioning, or joining) to manufacture leaves behind improved properties is of modern pertinence. Morphology, type, and size of fortifications are more critical to MMC properties, as well as the strategy used during creation. Aluminium and magnesium based composites delivered high rigidity and refined microstructure properties compared to casted parts. Huge consideration is consequently expected for the improvement novel lightweight composites through casting course, reasonable for designing applications 7XXX series Al7005 alloy has natural properties like high solidarity to thickness proportion, High explicit firmness and durability attributes making it an optimal up and comer material for underline parts in car and aviation applications. The expansion support (Natural, Inorganic, Modern and horticulture squander, Nitrides, Oxides, Carbon Nanotubes, Compounds, Carbides) to aluminium grid brought about (composite materials) multi phase materials which work on the particular properties and draw in designing applications. MMC fortifications added volumes and enormous sizes to Aluminium-Copper-Magnesium compounds that brought about better strength in composite parts. Looking for materials replaceable, the utilisation of tons of agro- industries (Fly ash) and combined or composite waste based (Glass fibres) could bring about decreased annulling natural effect and cost of support material. The fly ash age is 300 million tons was found by service of india in 2017. Wind turbine cutting edges manufactured through glass fibre supported plastics have a normal life expectancy of twenty years. The audit guessed that by 2035, around 1 lakh tons/year will be collected with wind turbine sharp edges. The use of glass fibres in composites generates 27.5 to 45.50 6wt% of glass fibres of which six percent are recycled and reused. The remainder is treated waste, which ends up in landfills. Quick advancement in the improvement of polymer composites prompted. The rapid improvement of polymer composites prompted the development of different design applications that enable the reuse of glass fibre and fly ash as potential reinforcement

materials for manufacturing parts for applications. Supporting glass fibre to a metal matrix (Aluminium, zinc- Aluminium) brought about upgraded strength and hardness in the manufactured MMCs. Al7005 built with glass fibre further developed the damping conduct of composites industry squanders for examples, Glass fibre and Fly ash particles were built upto Al6061 and Al6063 compounds to manufacture composites through the mix casting course. The above writing survey affirms that restricted examinations have been done with modern squanders as potential support materials for creating composites in spite of the fact that supporting particles offer gainful properties.

The underlying application of aeroplane uses 70% of Al 7XXX because of its high strength. 5% of underlying parts are manufactured by casting courses, 7% by producing, 28% by rolling and 60% by casting. In any case, cutting edge materials need to improve the hardenability, harm resilience and erosion resistance in Al 7XXX compounds. Although Aluminum material has great mechanical properties, it becomes consumed quickly. The stress erosion is seen to have a very high imperfection in underlying Al7XXX composites that creates aeroplane mishaps. The casting system refines the grain structure because of expanded plastic distortion because of break of support particles to better shaes which invigorates dynamic recrystallization and nucleation. The microstructural change impacts the consumption conduct of the compounds. An expansion in SiC fortifications with diminished molecule size further develops the erosion resistance in Aluminum alloy, because of the change in microstructure. The polarisation opposition assumes an indispensable part in metallic consumption exposed to test tests presented to a destructive temperature. Note that, consumption energy in dynamic metal is more prevalent than inactive metals under destructive conditions. This is on the grounds that pitting activity breaks the defensive latent movies bringing about the inception of consumption on ingot(metal) surfaces. The microstructure brings about a diminished consumption rate in casted magnesium-based MMCs. Although a ton of exploration endeavours are being made on further developing Al 7XXX compound properties, less consideration is paid to improving erosion resistance properties.

Al 7005 alloy has inborn characteristics like high strength, pliancy, mouldability, with light weight qualities guarantees generally applied in aeroplane, marine ships, and rail transportation parts. High velocity trains, aeroplanes and marine boats require load-bearing properties to limit the frequency of parts disappointment against stress

erosion breaking and are exposed to a destructive temperature . S-containing species are typically produced. In marine air, there are substance reactions between sulphur dioxide and water. As of now, crossover composite materials are frequently utilised for different design applications, due to enhanced properties obtained from the use of double fortifications, which could eliminate the aloof film of Aluminum alloy and fermentation of electrolyte on the materials. With short glass filaments and fly ash reinforcements, there is increased hardness and pressure. Most crossbreed composites are composed of $n > 2$ mutually working stages because they confer high strength. Erosion resistance property for high strength Aluminium compounds is effective and essential and could enhance their applications.

1.1 PROCEDURE OF THE WORK :

Using industrial wastes as reinforcement materials for making hybrid Al 7005 composites, the present study aims to limit the corrosion rate of Al 7005 in a corrosive environment with the following objectives: (a) using fly ash, and (b) using S-glass fibres as cost-effective reinforcement materials for fabricating hybrid Al 7005 composites. (b) Microstructural analysis of four samples (Al70005, Al7005 + 3% GF + 3% FA, Al7005 + 1% GF + 5% FA). (c) Tensile and Ductility Tests for Casted Samples (ASTM B 557M) (d) Study of hardness of the casted samples with Brinell's Hardness test(ASTM-E18). (e) Study of Impactability of the casted MMCs with Impact test(IZOD)(ASTM E23) . (f) Study the wear rate of the Casted MMCs with Wear Test using Pin-On -Disk apparatus.(ASTM G99) (g) Microstructural study of the tested MMcs with Scanning Electron Microscope(SEM)

1.1 Aluminium

An outline of the new advancements in Aluminium application in the auto business is introduced and drifts in normal and explicit Aluminium utilises for traveller vehicles are inspected. A discussion is provided on the selection of material and innovative concepts of car construction using Aluminium that meet both economic and environmental demands and enhance driving comfort as well. In the most advanced and competitive market, Aluminium alloys designed for strong strength, better formability, and light

weighting are presented and illustrated by examples of successful Aluminium solutions in the most advanced and competitive market.

The European car industry is referred to overall as in fact generally progressing and creative. In view of affordable and political strain to decrease fuel utilisation and CO₂ outflow the endeavours for light weighting in auto plan and developments have expanded altogether and explicit arrangements in light of the escalated utilisation of Aluminium as changed or new composites have been Aluminium combinations created for the rising prerequisites in higher strength and better formability for lighter loads, as well as the particular improvements of semi-completed Aluminium items, for example, castings and sheets are introduced and represented alongside models from the most exceptional and cutthroat business sectors. applications and 5kg for body-in-white (21 kg others) . In light of current advancements in new model ages with imaginative Aluminum ideas it very well may be assessed that the utilisation of this material in European traveller vehicles will beyond twofold in the following ten years.

1.2 Aluminium used in sheets

Aluminium sheets for car body-in-white application have been utilised since the beginning of vehicle and Aluminium creation. In the hour of expanding large scale manufacturing and minimal expense needs, notwithstanding, steel has assumed control over the lead. Yet, expanding fuel costs, CO₂ guidelines and extra solace and hardware loads lead to a solid propensity for light weighting. Yet additionally parts of solace and playful driving assists with advancing advancements in light weight plan and designing, transcendently in Western Europe. Figure 1.1

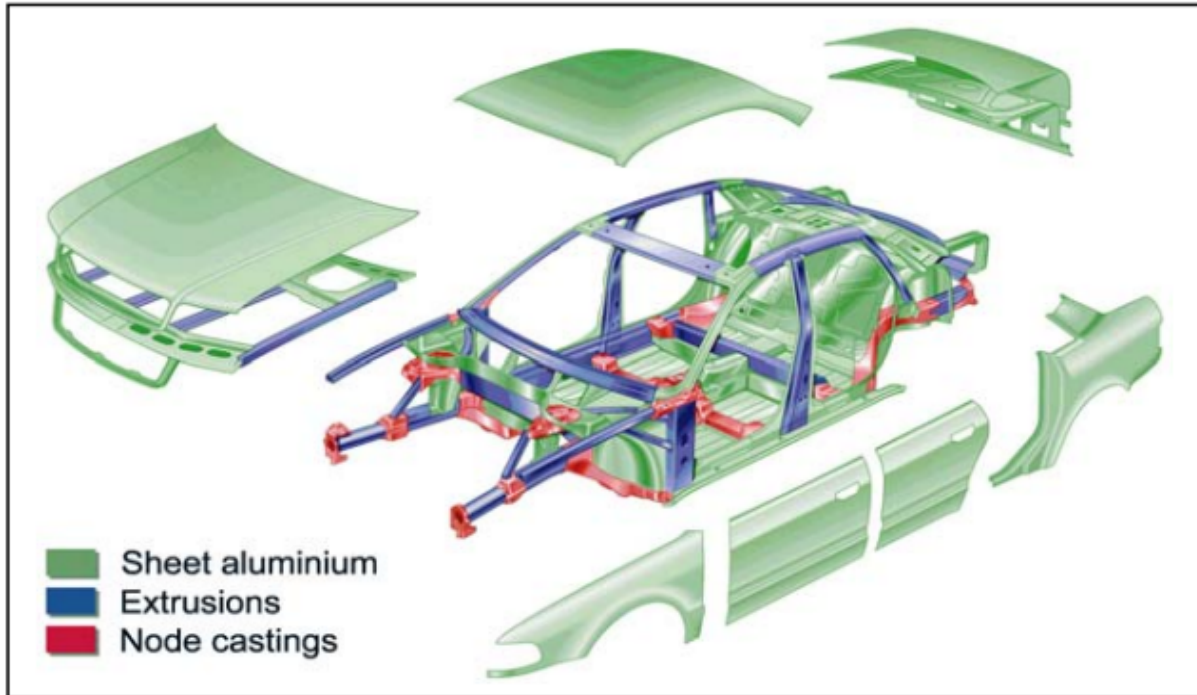


Figure 1.1 :Al Space Frame and semi material distribution(Ref: Radu Bercan)

1.3 ALUMINIUM ALLOYS

The improvement of high strength, lightweight, and consumption safe materials is basic to fulfil this need for lightweight and sturdy parts for designing applications prompting expanded eco-friendliness and diminished fossil fuel byproduct. Aluminium (Al) composites offer fantastic solidarity-to-weight proportion and in this manner are utilised generally in auto, aviation, and marine applications. Notwithstanding, the utilisation of Al-composites is obliged in numerous applications because of their restricted erosion opposition and a decay of the consumption execution with endeavours to build the strength.¹⁻³ If Al alloys with high erosion resistance, similar with that of hardened steel, could be ready, they could be future lightweight and harmless to the ecosystem compounds. For planning such alloys, erosion of Al combinations and its relationship with the creation and microstructure at different length scales should be perceived. Basics of consumption of Al and its combinations and job of handling, microstructure, and piece on Al composites can be found.

1.4 Advantages of Aluminium

Benefits of Aluminium combinations

- ❖ Aluminium is an incredibly adaptable metal with various advantages, it is perceived for being both lightweight and adaptable.
- ❖ Light Weight
- ❖ Consumption Resistance
- ❖ Electrical and warm conductivity
- ❖ Reflectivity and Ductility
- ❖ Unscented and Impermeable
- ❖ Recyclability

1.5 Disadvantages of Aluminium combinations

- ❖ Costly Raw material .
- ❖ Costly Fabrication. Requires extraordinary strategies to weld.
- ❖ Combustible.
- ❖ Consumes quickly in Salt water.
- ❖ It is gentler than steel.

1.6 AI7005 ALUMINIUM ALLOY

Al 7005 alloy has inherent properties like high strength, versatility, weldability, with lightweight qualities that are generally applicable in railway transportation parts and. High velocity rails, aeroplane and marine boats require load-bearing characteristics to limit its occurrence of parts disappointment opposing stress consumption breaking and exposed to a destructive temperature. By and large, S-containing species are produced viz. compound responses occur between sulphur dioxide and water in the marine environment. This could destroy the latent film of Aluminum combination and fermentation of electrolyte film (if any) on the material surfaces. As of now, hybrid composite materials are frequently being utilised for different designing applications, because of upgraded properties with the utilisation of double fortifications. There is expanded hardness with short glass filaments and pressure and flexibility with supporting fly ash reinforcements. As a general rule, hybrid or hybrid composites comprise of ($n > 2$) mutually working stages, since they give high strength coming about because of various stages. Upgrading consumption opposition property for high strength Aluminium alloy is for sure fundamental and could enlarge the applications.

1.7 OBJECTIVES OF THIS RESEARCH WORK

In the present discovery, an exploration on the Stir casting samples of Aluminium Al7005 with GF+FA based on Tensile, Impact, Hardness and wear test and corrosion test. The primary targets of this examination are:

(a) use of industry squander based (fly ash and S-glass fibers) as a financially savvy support material for creating Al 7005 hybrid composites.

(b) Four test samples for Microstructural study (as cast Al 7005, casted: Al7005 + 3% GF + 3% FA, Al7005 + 1% GF + 5% FA).

(c) Study of Tensile and Ductility of the casted samples with Tensile Test(UTS)(AST B 557M)

(d) Study of hardness of the casted samples with Brinell's Hardness test(ASTM-E18).

(e) Study of Impactability of the casted MMCs with Impact test(IZOD)(ASTM E23) .

(f) Study the wear rate of the Casted MMCs with Wear Test using Pin-On -Disk apparatus.(ASTM G99)

(g) Microstructural study of the tested MMCs with Scanning Electron Microscope(SEM)

Figure 1.2 labelled the automotive components made of Aluminium alloy.

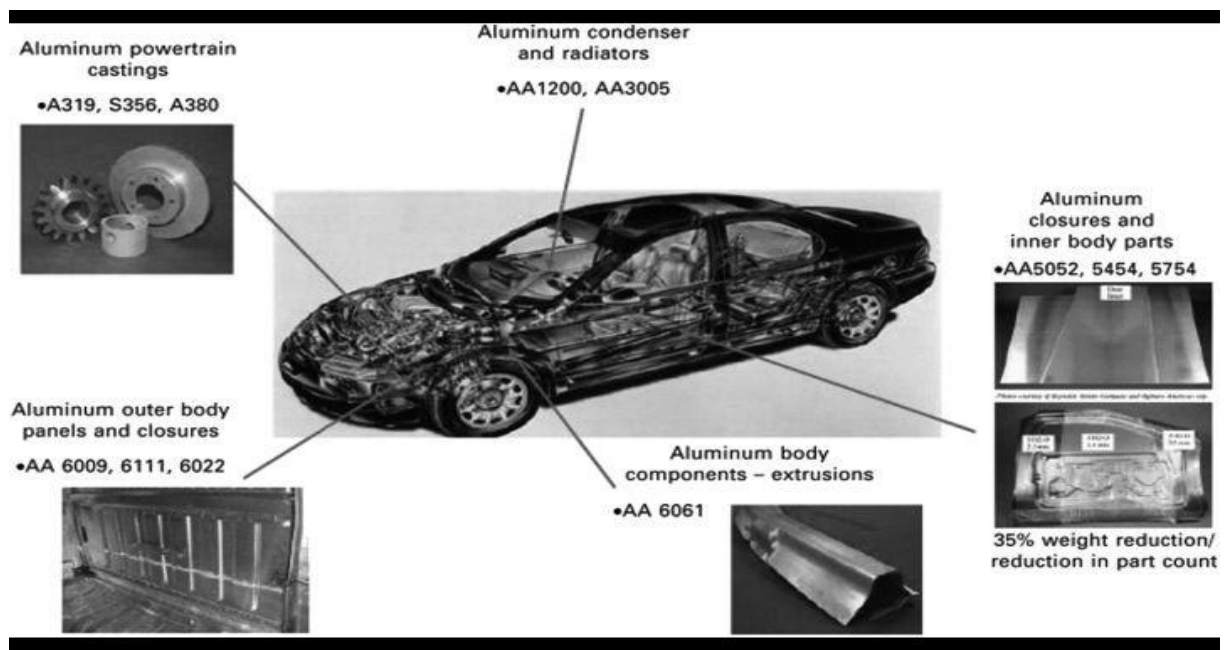


Fig 1.2 Automotive components made of Al alloy (Ref: J.C. Benedyk)

1.8 AI 7005 ALUMINIUM ALLOY

Al 7005 combination has inborn properties like high strength, plasticity, weldability, with lightweight attributes guarantees broadly applied in aeroplane, marine ships, and rail transportation parts . Rapid trains, airplane and marine boats require load-bearing properties to limit the occurrence of parts disappointment against stress erosion breaking and are exposed to a destructive temperature . As a general rule, glass fibre-containing species are produced viz. synthetic responses occur between SO₂ and water in marine air . This could eradicate the latent film of Aluminum compound and fermentation of electrolyte film on the material surfaces .for differently designed applications hybrid composites are used, because of upgraded characteristics with the utilisation of double reinforcement. Increasing hardness is there with short glass filaments and pressure and flexibility with supporting fly ash fortifications. As a rule, crossover composites comprise of ($n > 2$) mutually working stages, since they grant high strength coming about because of various stages. Improving consumption opposition property for high strength Aluminium composite is for sure fundamental and could augment the applications.

CHAPTER 2

LITERATURE SURVEY

Praveen kumar, et al (Behaviour of High Strength Aluminium combination and its built up MMCs") 2021: Al 7005 compound has inherent properties like top strength, pliancy, mouldability, with lightweight attributes guarantees generally applicable in airplane, rail and ship transport. High velocity trains, aeroplane and marine boats require load-bearing characteristics to limit the frequency of parts disappointment against stress consumption breaking and are exposed to a destructive climate[1]. Shantaraja M(et al 2021)("Impact of casting on Tensile approach to acting of S glass and Fly ash upheld composites ") 2021 The ductile test was coordinated by ASTM B 557M principles. The casted examples were machined and cut and the test was driven by ASTM principles. Three instances of each creation are attempted and the typical of three characteristics are recorded. A cautious report on versatile properties has been done on the Al 7005 composite developed with Glass fibre with 6% Fly ash. Connection studies have been done on casted mixture MMCs. It will in general be assumed that the pliable characteristics for instance Yield strength (YS) and Ultimate rigidity (UTS) of casted Al 7005 blend MMCs shows better improvement stood out from as-casted composites[2]. Availability of Al 6061Al-Al203 by Cicero, S., et al. In spite of the way that powder metallurgy makes better mechanical properties in MMCs, liquid state taking care of has some critical advantages[3]. They are as: better lattice atom holding, easier control of organisation structure, straightforwardness, insignificant cost of taking care of, closer net shape and the wide selection of materials Pal, Debabrata, et al. (2022)[4] . Fluid state manufacture of MMC's incorporates two techniques which rely upon the temperature .An exploratory investigation of hardness, ductile and wear properties of Aluminum metal matrix composites through mix casting interaction by James, Johny, et al created AA356 composite utilising shifting wt% of SiC nanoparticles as support by means of Stir Casting. They found that tribological properties were upgraded with expanding wt% of SiCn, and glue wear was the significant wear mechanism[5]. They additionally performed relapse investigation and effectively fostered a numerical capacity for the equivalent. Rao et al. tracked down that Al/SiC composite had altogether lesser wear coefficient than the compound and it repressed further because

of strain applied and SiC particulate expansion. Jo et al. created a cross breed metal grid composite of Aluminum - SiC-B₄C, ballistic effect tests and different compressive test were performed. Crossover composite was found to perform better in every one of the performed tests. [7] Rasaee, Sajad, and AmirHossein Mirzaei 2021. (SiC) Silicon carbide fortifications with various shapes and volumes, added to Aluminium-Copper-Magnesium combination, achieved better strength in composite parts addresses the extension of reinforcement to Aluminium and its alloy brought about superior characteristics (hardness, strength, and wear resistance) in casted parts. The casting system guarantees uniform and steady scattering of supported nanoparticles in the lattice and subsequently brings about upgraded characteristics with refined grain pattern in Metal Aluminium framework composites. The utilisation of hard help particles, exst carbides, brought about casting pass on wear. Supporting hard materials into the network brought about many assembling issues (device wear in machining, protection from distortion in the framing system). The casting boundaries (like temperature and casting proportion) influence the microstructure and mechanical qualities in casted parts]. represents that there are different casting proportions utilized by recognized specialists, which directs there exists a huge degree to lead an extreme exploratory study[8]Akkoyun, Fatih, and Ali Ercetin et al 2020. An expansion in casting proportion brings about a decrease in cross-area, though an expansion in casting temperature brings about a corresponding reduction in the power expected to manufacture the parts[9]Varna, K., et al.2021. The coalescent breaks will generally develop quickly by interfacing with one another which brings about lower strength past the basic casting ratio[10]Gugulothu, Bhiksha, et al 2021. Consequently, the investigation of casting boundaries and substitute supporting materials that outcome in simplicity of creation of casted leaves behind improved properties at decreased costs is of modern importance.

2.2 REVIEWED AND MODIFIED

Based on the survey, most of the research observed stir casting by liquid metallurgy route is cost effective. And Tensile, Hardness, Impact, Wear test are taken to determine the hardness and wear and tear ability of the composites. Fly ash and glass fiber are the cost effective materials to be used as Metal Reinforcement material.

CHAPTER 3

AIM AND SCOPE OF THE PROJECT

3.1 AIM OF THE PROJECT

The aim of this project is to test the Tensile ,impact ,hardness and wear rate of the Aluminium Al7005 alloy reinforced with cost efficient Fly ash and S- Glass fiber and study the about microstructure of the samples with the SEM(Scanning Electron Microscope).

3.2 SCOPE OF THE PROJECT

Stir casting is an appropriate handling method to manufacture Aluminum lattice composites and cross breed Aluminium network composites as it is a practical interaction and liked for large scale manufacturing. Aluminium manufacture is utilized in this task of molding Aluminium into a completed item. To work on the strength and pliability of cast Aluminium compounds ,it is important to concentrate on their crack properties by leading a progression of tests . The designing pressure - strain bend examples utilised in a pliable test are ready as indicated by standard determinations .The test pieces can be barrel shaped or level. The Brinnell hardness test strategy is ordinarily used to test materials that have a surface that is too rough to possibly be tried utilising another test technique . As numerous materials bomb out of nowhere under impact, at defects ,breaks, or scores. The Impact test is utilised to test the capacity of the material to test impact, utilised by designers to anticipate its way of behaving under certain circumstances. The Pin-on - disk wear test unit was utilised to decide the contact and wear attributes of the composites.

CHAPTER 4

MATERIALS AND METHODS

4.1 Components involved

4.1.1 Al 7005 Aluminium alloy

Al7005 is an Aluminium fashioned composite utilised in bike outlines , because of its general simplicity of welding it doesn't need costly hotness treating - it is anyway more enthusiastic to shape fabricate seriously testing. It has a Ultimate Tensile Strength of 350 MPa, a Fatigue Strength of 150 MPa and a thickness of 2.78 g/cm³. It needn't bother with precipitation solidified , however it can be cooled in air.

7005 Aluminium composite

Table no: 4.1 Chemical Composition of Aluminium alloy

No	Component	Percentage
1	Aluminium	91.0% - 94.7%
2	copper	<=0.10%
3	Chromium	0.06 - 0.20%
4	Iron	<=0.40%
5	Manganese	1.0% - 1.80%
6	Magnesium	0.20 - 0.70%
7	Titanium	0.010% - 0.060%
8	silicon	<=0.35%
9	Zirconium	0.080% - 0.20%
10	Zinc	4.0%-5.0%
11	other	<=0.15%

Table 4.1 listed the chemical composition of Al 7005. Al 7005 contains 91 to 94.7% of pure aluminium, contains 0.06% to 0.20% chromium, contains less than equal to 0.10%, iron less than equal to 0.40%, magnesium contains 1.0% to 1.80%, manganese contains 0.20% to 0.70%, silicon contains less than equal to 0.35%, Titanium contains 0.010% to 0.060%, zinc contains 4.0% to 5.0%, Zirconium contains 0.080% to 0.20%, Other total contains less than equal to 0.15%

4.1.2 Fly ash and glass fiber :

Chemical composition:

Chemical composition of matrix and reinforcement materials.

Table no :4.2 Chemical compositions of Fly ash, Glass fiber

Glass Fibre		Fly ash	
Components	wt%	Components	wt%
Al_2O_3	26	Al_2O_3	29.6
SiO_2	64	Fe_2O_3	0.72
MgO	10	CaO	0.10
-	-	MgO	0.34
-	-	K_2O	3.53
-	-	SiO_2	64.6
-	-	-	-

Table 4 shows the chemical compositions of fly ash and glass fiber. Glass fiber consists of 26% of Alumina, and 10% of Magnesium Oxide, and 64% silicon dioxide. Fly ash consists of 29.6% Alumina, Calcium Oxide 0.10%, Iron (III) oxide, 0.72%, Potassium oxide 3.53%, Magnesium Oxide 0.34%, Silicon dioxide 64.6%

4.1.3 STIR CASTING :

The interaction of stir casting includes blending of dissolve, in which the soften is blended consistently which uncovered the liquefy surface to the temperature which keeps an eye on ceaseless oxidation of Aluminum liquefy. Because of ceaseless decomposition, the saturation or wettability of the Aluminum decreases and the composite particles are not mixed .The Furnace used to liquefy the Metals like Magnesium, Aluminum, Copper, Zinc) for Casting, making into Metal Alloys and MMCs(Metal with Oxide Ceramics) . Among the different strategies, the mix casting course is straightforward, more affordable, and utilized for large scale manufacturing.The primary limits of stir cast Al-Si-Cu MMC are inappropriate circulation of SiC support in lattice and less permeability of SiC support particles with liquid Al.The significant blending process boundaries are mixing speed, stirrer math, stirrer position, and blending time.Stir Casting is a fluid state technique for composite materials creation, where a scattered stage (earthenware particles, short filaments) is blended in with a liquid network metal through mechanical blending. Mix Casting(Figure 4.1) is the easiest and the most practical technique for fluid state manufacture.



Fig no 4.1 Stir casting machine

4.1.4 MACHINING USING EDM (ELECTRICAL DISCHARGE MACHINING)

Electrical discharge machining (EDM) Fig 4.2, generally called spark machining, spark crumpling, fail miserably sinking, wire replicating or wire breaking down, is a metal assembling process by which an ideal shape is gained by using electrical deliveries shimmers. Material is taken out from the workpiece by a movement of rapidly rehashing stream discharges between two terminals, confined by a dielectric liquid and rely upon an electric voltage. One of the terminals is known as the device cathode, or basically the instrument or anode, while the other is known as the workpiece-cathode, or work piece. The cycle relies on the instrument and workpiece not connecting.

At Whenever the voltage between the two cathodes is expanded, the force of the electric field in the volume between the anodes is more noteworthy, resulting in dielectric, separation of the fluid, and the delivery of an electric bend. Thus, material is taken out from the terminals. The fluid dielectric is pumped into the space between the cathodes when the flow stops (or is halted, depending on the generator type), empowering the strong particles (garbage) to be out of hand and the protecting properties of the dielectric to be reestablished. Adding new fluid dielectric in the between cathode volume is normally alluded to as flushing. After a flow stream, the voltage between the anodes is reestablished to what it was before the breakdown, so another fluid dielectric breakdown can happen to rehash the cycle.

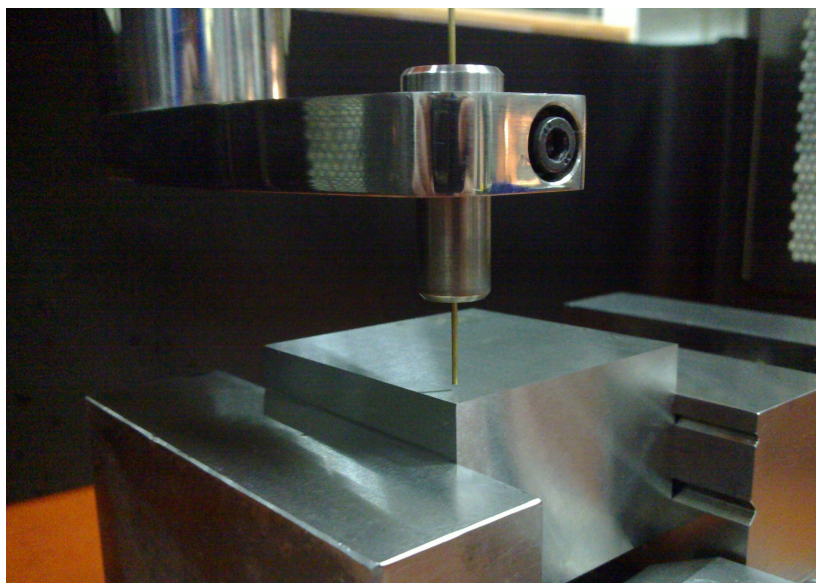


Fig no 4.2 Electrical discharge machining with the given samples

4.1.5 TENSILE TEST :

Ultimate tensile strength (UTS) is the greatest pressure that a material can endure while being extended or pulled.

a) the rigidity, otherwise called a definitive elasticity, the heap at disappointment isolated by the first cross sectional region where a definitive rigidity

(U.T.S). $\sigma_{max} = P_{max}/A_0$, where P_{max} = most extreme burden, A_0 = unique cross



Fig no.4.3 Tensile testing machine

Figure 4.3 shows a Tensile testing machine which is used to measure ultimate tensile strength, percentage Elongation ,Young's modulus ,etc..

4.1.6 BRINELL HARDNESS TESTING MACHINE :

According to ASTM E10, Brinell hardness is determined by a Brinell hardness test. In most cases, materials that are used to test have a design that is too rough or have a surface that is too harsh to ever be tested using another method. Fig 4.4 shows a Brinnels hardness testing machine.



Fig no.4.4 Hardness testing Machine

4.1.7 IMPACT TESTING MACHINE :

In Turning arms are held at a particular altitude (steady expected power) and delivered afterwards. By swinging down, the arm breaks the jagged sample. The energy consumed by the sample is determined from the altitude the arm swings to subsequent to hitting the sample. Figure 4.5 shows Impact Testing machine (IZOD).



Fig no 4.5 : Impact testing machine(IZOD)

4.1.8 WEAR TESTING WITH PIN-ON-DISK APPARATUS:

Pin on Disk testing(Figure 4.6) gives a technique for portraying the wear between two materials. Engineers often utilize this technique to assess the exhibition of a "wear couple" or to portray the presentation of various materials against a standard surface.

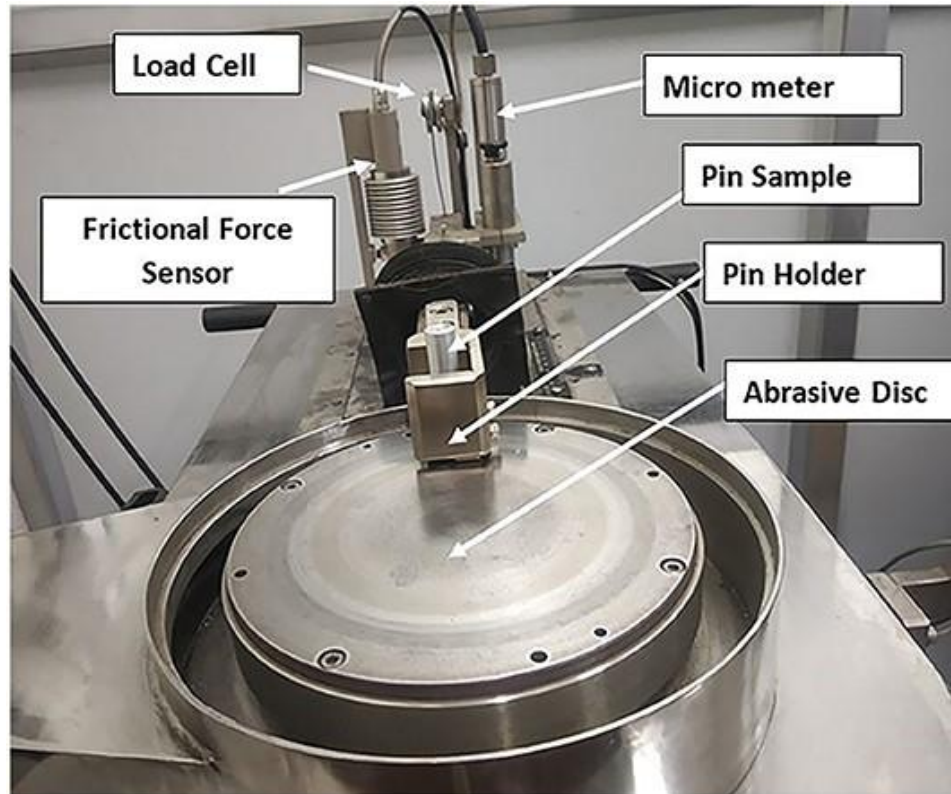


Fig no 4.6 : Pin on Disk apparatus

Table no : 4.3 Specification of Pin on Disk apparatus

Type	Specification
Disc size	160 mm(Diameter)
Pin size	3-10 mm
Normal load	0-100N
Disc rotation	100 - 1500 RPM

Table 4.3 specifications of the parts of Pin on Disk apparatus .The Pin size of the apparatus is 3-10mm and the disk size is 160mm(Diameter),the disk rotation speed is 100 to 1500 RPM and Normal load is 0-100 N.

4.1.9 SCANNING ELECTRON MICROSCOPE :

Specialised determinations for Scanning Electron Microscope (SEM) . Highlights Specifications: Objective 3nm at 30KV with tungsten fiber in High Vacuum e2 [r4tgm mode and 4.0 nm or better at 30KV in Variable strain or low vacuum mode. The importance of objective and the strategy used to conclude the comparable still up in the air. Objective ensured ought to be maintained by printed composition. .

Amplification Up to 3,00,000X or better. Least amplification ought to be indicated

Accelerating voltage Variable up to 30 kV or better.

Test current Suitable for all applications, and should truly rely upon 1 μ A or better.

Electron gun Thermionic transmission type - Tungsten source Detectors In-chamber SED (Everhart-Thornley). Submitted and separate SE finder for low vacuum/variable strain mode. Back Scattered Electron Detector for using both in high vacuum and variable strain. Pointer should have the limit of high mindfulness for low kV assessment. Decide worked in customized/manual control for distinction and quality

. Chamber Large chamber with no less than at least 6 embellishment ports. Chamber configuration ought to permit changing of the examples rapidly. Chamber ought to be furnished with a CCD camera or any reasonable gadget to see the example and stage inside the examination chamber without slowing down EM locators. Vacuum System Fully programmed chip controlled vacuum framework comprising of Turbo-Molecular Pump (TMP) (alongside water chiller if water-cooled TMP) supported by Rotary pumps (or) particle getter vacuum pumps, alongside pneumatic valves. (Explain assuming any in-constructed legitimate wellbeing measures against disappointment of force supply, vacuum, water-stream, and so on are given). This framework ought to be viable for firearms and fiber to safeguard both Gun/fiber against air-openness of example chamber during example stacking/dumping. It ought to have ability to accomplish a low vacuum of 500 Pascal or better.

The checking electron magnifying lens (SEM) Four produces pictures by filtering the example with a high-energy light emission. As the electrons interface with the example, they produce auxiliary electrons, backscattered electrons, and trademark X-beams.

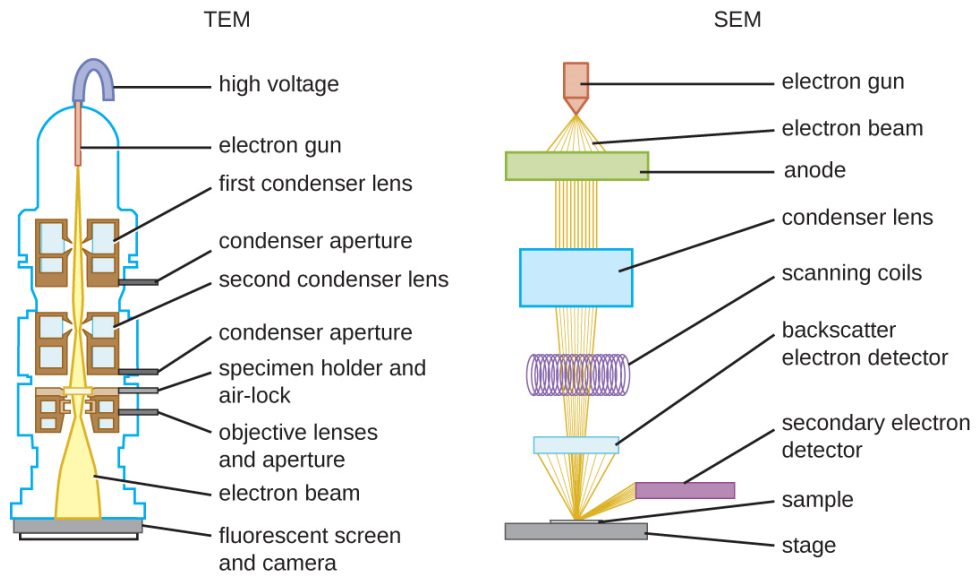


Fig no : 4.7 Parts of Scanning electron Microscope

CHAPTER 5

METHODOLOGY

5.1 PROJECT METHODOLOGY

In accomplishing this point of this work ,portions of the machines were intended for different plan conditions .The plan result used to choose materials for different parts.The Al7005 were bought from Perungudi ,Chennai. The Fly ash were bought from Ennore Thermal Power station .The glass fiber from Parish corner glass industries. The methodology is to stir cast the specimens with

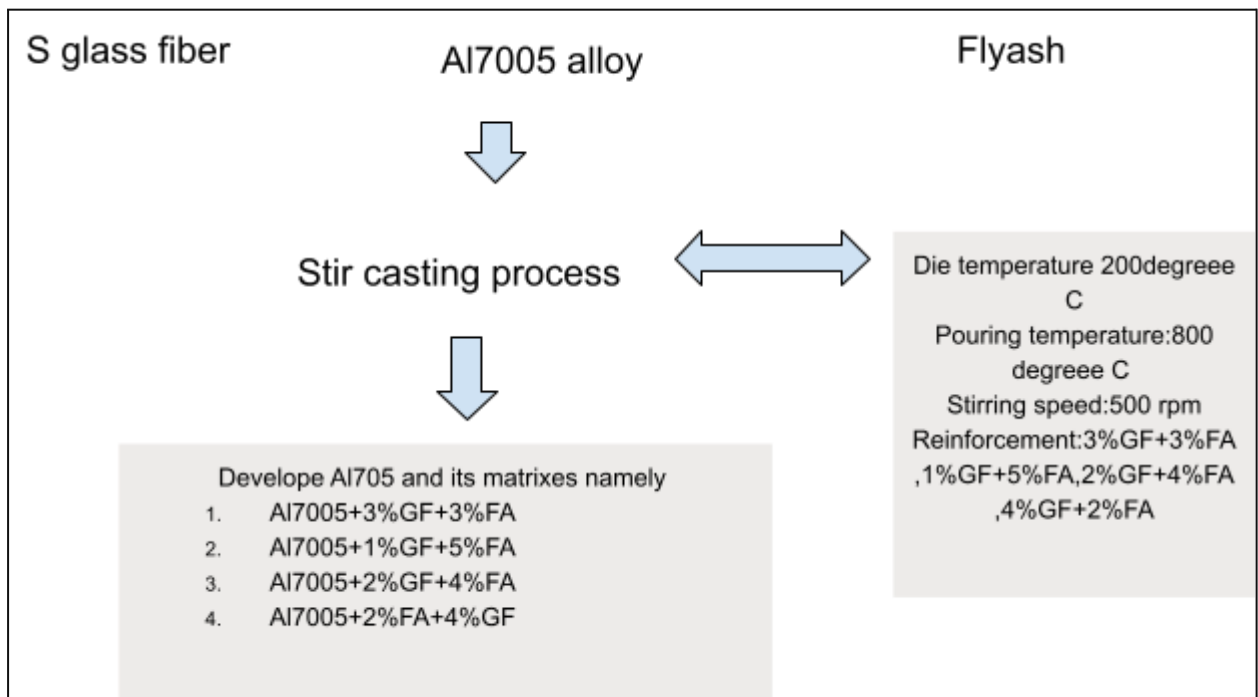
Al7005 + 3%FA+3%GF,

Al7005 + 1%GF+5%FA,

Al7005 + 2%GF+4%FA

Al7005 + 4%GF+2%FA.

They were mixed with stir casting techniques. The outcome was sent to Cutting and Machining. After the machined samples were taken for testing of Tensile, impact, Hardness ,Wear, and analysed by SEM(Structured electron Microscope). Figure 5.1 shows the Project methodology.



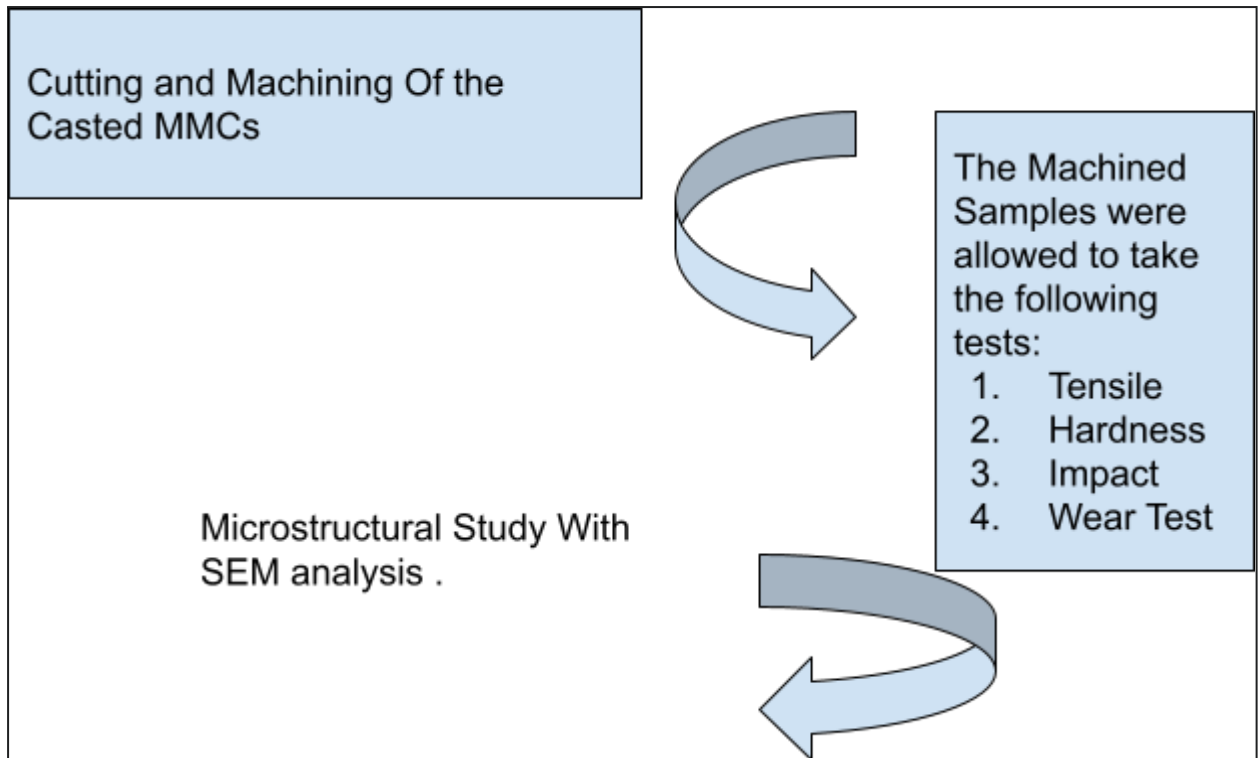


Figure no 5.1 Methodology of the Project

5.2 STIR CASTING :

Stir casting is a kind of casting cycle where a mechanical stirrer is familiar with structure a vortex to mix support in the grid material. It is a proper cycle for making of metal organization composites on account of its cost reasonability, tangibility to enormous scope producing, ease, essentially net trim and more straightforward control of composite development. Out of various warmers, base pouring radiator is sensible for production of metal cross section composites in blend projecting course, this kind of radiator contains modified base pouring technique which gives second pouring of the relax mix (structure and backing). Modified base pouring is for the most part used in the hypothesis projecting industry. In this system, an opening is made in the groundwork of the melting cauldron to give base pouring and is safeguarded by a chamber shaped shell of metals . In the blend projecting cycle, the organisation material is melted and stayed aware of at a particular temperature for 2-3 h in this radiator. Meanwhile, fortresses are preheated in a substitute radiator. Resulting to dissolving of the matrix material, the mixing framework has started to approach the vortex. Mixing expects a basic part over the last microstructure and mechanical properties of the gave composites a job as it controls the dissemination of fortresses inside the matrix. Ideal mechanical properties can be achieved by the uniform dissemination of help and this

issue is ordinary to most handling procedures, including mix casting This issue can be tackled by ideal choice of blending parameters.the examples utilised for blending are:

1.AI7005 + 3%FA+3%GF,

2.AI7005 + 1%GF+5%FA,

3.AI7005 + 2%GF+4%FA

4.AI7005 + 4%GF+2%FA. Figure 5.2, 5.3 and 5.4 so the casted parts obtained from stir casting process.



Fig no :5.2 Example of cast sample1 and 2



Fig no 5.3: Example of cast sample 3



Fig no 5.4 : Example of cast sample 4

5.2.1 CUTTING AND MACHINING OF THE MATERIAL :

The vitally certified work to give a genuine explanation of the material departure during electric delivery machining is perhaps that of Van Dijck. Van Dijck presented a warm model alongside a computational multiplication to figure out the eccentricities between the cathodes during electric delivery machining. In any case, as Van Dijck himself surrendered in his survey, the amount of assumptions made to beat the shortfall of exploratory data around then was exceptionally gigantic.

Extra instances of what occurs during electric delivery machining to the extent that hotness move were made in the piece of the eighties and mid nineties. It gave around three papers: the first presenting a warm model of material departure on the cathode, the second presenting a warm model for the deterioration occurring on the anode and the third introducing a model depicting the plasma satisfactory outlined during the segment of the delivery move through the dielectric liquid. These models give the most genuine assistance for the case that EDM is a warm connection, taking out material from the two cathodes considering melting or dispersal, close by pressure components spread out in the glimmer opening by the collapsing of the plasma channel. In any case, for little delivery energies the models are deficient to sort out the exploratory data. This large number of models rely upon different notions from such unique assessment locales as submarine impacts, discharges in gases, and disillusionment of transformers, so it isn't is truly normal that elective models have been proposed even more actually in the composing endeavouring to sort out the EDM connection. Among these, the model from Singh and Ghosh reconnects the expulsion of material from the anode to the presence of an electrical power on the outer layer of the cathode that could precisely eliminate material and make the cavities. This would be conceivable in light of the fact that the material on a superficial level has modified mechanical properties because of an expanded temperature brought about by the section of electric flow. The creators' reproductions showed the way that they could make sense of EDM better than a warm model (liquefying or dissipation), particularly for little release energies, which are regularly utilized in μ -EDM and in completing tasks.

Given the numerous accessible models, apparently the material expulsion system in EDM isn't yet surely known and that further examination is important to explain it,

particularly considering the absence of exploratory logical proof to construct and approve this EDM models. This makes sense of an expanded ebb and flow research exertion in related trial methods

In this end, there are following main considerations are accomplished during machining activities:

Coming about first resolutions can be expressed from survey of work in this space that EDM execution is for the most part assessed based on TWR, MRR, Ra and hardness.

In material expulsion rate (MRR) from every chose boundary, flash current (I) is the main information factor influencing the machining of workpiece.

The exhibition is impacted by release current, pulse on schedule, pulse off time, obligation cycle, voltage for EDM.

For instrument wear rate (TWR) from the every chose boundary, flash current (I) is the main info factor influencing the machining of workpiece followed by flash time and voltage.

Inventive innovation in the EDM is continuously advancing to make this strategy further fitting for the Machining. In the field of assembling extra consideration is on the enhancement of the technique by dropping the quantity of Electrodes.

5.3 TENSILE TEST :

One material property that is for the most part used and seen is the strength of a material. However, what's the significance here?" "Strength" can have various ramifications, so let us explore what is suggested by the strength of a material. We will look at an extraordinarily straightforward examination that gives lots of information about the strength or the mechanical approach to acting of a material, called the moldable test.

The crucial thought about a flexible test is to put an illustration of a material between two mechanical assemblies called "handles" which snap the material.

The material has known perspectives, like length and cross-sectional district. We then, begin to apply weight to the material got a handle on toward one side while the far edge is fixed. We keep on building the weight (as often as possible called the pile or power) while at the same time assessing the change of length of the model.

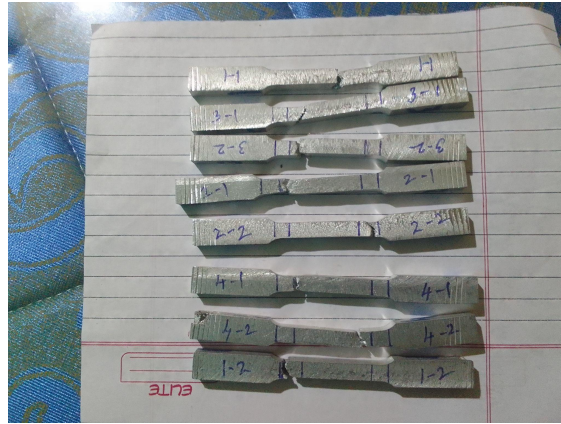


Fig no 5.5 :Tensile test Specimen

Fig 5.5 shows the example gone through malleable test. One can do a particularly chipped away at test at home. Expecting you have a strategy for hanging one completion of some material from a solid point that doesn't move, then you can adjust loads on the far edge. Measure the change of length while adding weight until the part begins to expand in conclusion breaks. The outcome of this test is an outline of weight (proportion of weight) versus migration (sum it broadened). Since how much weight expected to broaden the material depends upon the size of the material (and clearly the properties of the material), assessment between materials can very test. The ability to make a proper relationship can be indispensable to someone getting ready for essential applications where the material ought to persevere through unambiguous powers

5.4 BRINELL'S HARDNESS TEST :

The four as cast tests were tried with elastic test Based on the likelihood that a material's response to a load set at one little guide is associated with its ability toward twist forever (yield), the hardness test is performed by crushing a set steel ball (Brinell test) into the external layer of the test piece. Most hardness tests are performed on business machines that register conflicting characteristics in reverse association with the significance of entry of the ball or cone. Practically identical space tests are performed on wood. Hardness preliminary of materials, for instance, flexible or plastic don't have comparable ramifications as those performed on metals. Entrance is assessed, clearly, but misshapening achieved by testing such materials may be out and out temporary.

Ball Dia : 2.5 mm

Load : 187.5



Fig 5.6 Brinell's hardness test Specimen

The four casted samples were taken to Brinell's hardness test (Fig 5.6). With 2.5 ball diameter and Load 187.5. It is observed that the fourth sample (2% fly ash and 4% Glass fiber) withstand high hardness in Brinell hardness test.

5.5 IMPACT TEST:

The effect resistance of the materials not entirely settled by the IZOD impact trial of ASTM norms. The turning arm is raised to a specific height (steady) and a while later conveyed. The arm swings down hitting a scored test, breaking the example. The energy consumed by the not set in stone from the height the arm swings to resulting to hitting the model. A scored test is generally used to choose impact energy and indent responsiveness.

This test uses an other strategy of the model under test. The Izod impact test changes from the Charpy impact test in that the model is held in a cantilevered bar game plan as opposed to a three-point twisting arrangement

impact, by definition, is a huge power applied for a very short period of time, achieving an unforeseen trade of power and energy, and its effect is different when a comparative proportion of energy is moved even more dynamically. Standard planning developments are presented to it and may encourage breaks that, for a really long time, spread to where unpleasant dissatisfaction would result. Influence tests are used in taking a gander at the shear break durability of various materials under a comparative test conditions, or of one material versus temperature to choose its pliable to-delicate advancement temperature where a grandiose dive in impact strength with reducing temperature is seen. A material's toughness is a variable of its ability to absorb energy during by and large drowsy plastic distortion, but the rate at which strain happens matters. Delicate materials have low solidness in view of the unassuming amount of plastic bending they can drive forward at any rate. In any case, pliant materials could carry on like delicate materials under high-energy impact, subsequently the prerequisite for this kind of test. The test conditions are regulated by various variables, specifically: the components of the regularly rectangular cross section of the model under the score; the height of the hammer around the starting position, choosing its speed at impact; the mass of the sledge which along with the speed decides its motor energy at impact; the sharpness, or tip bend, of the indent; the temperature of the example.

The fig 5.7 four MMCs were tried and the outcomes are:



Fig 5.7 Impact testing Specimen

5.6 IMPACT VALUES :

The four samples were taken to the Impact testing .The result shows that the third sample (Al7005,4% fly ash + 2% Glass fiber) shows high impact resistance during the test(13 .6, 13.0).The Fig 5.7 shows specimen undergoing impact test.

5.7 WEAR TEST :

Test Parameters includes:

Load-Values of the power in Newtons at the wearing contact. Speed-The by and large sliding speed between the arriving at surfaces in meters each second. Distance-The collected sliding distance in meters. Temperature-The temperature of one or the two models at regions close to the wearing contact. Environment The air (lab air, relative sogginess, argon, oil, etc) incorporating the wearing contact Procedure 8.1 Immediately prior to testing, and going before assessing or measuring, awesome and dry the models. Take care to eliminate all soil and unfamiliar matter from examples.Use non chlorinated, non-film-molding cleaning trained professionals and solvents. Dry materials with open grains to wipe out all traces of the cleaning fluids that may be trapped in the material. Steel (ferromagnetic) models having extra fascination should be demagnetized. Report the procedures used for cleaning. Measure fitting model viewpoints to the nearest 2.5 μm or check the guides to the nearest 0.0001 g.

Implant the circle securely in the holding device so the plate is fixed inverse (61°) to the pivot of the objective Insert the pin model securely in its holder and, if major, change so the model is inverse (61°) to the plate surface when in contact, to stay in contact conditions.

Add the authentic mass to the framework switch or bundle to cultivate the picked force pressing the pin against the plate. Start the motor and change the speed to the best worth while holding the pin model distant of the circle. Stop the motor. Set the transformation counter (or same) to the best number of disturbances. Begin the test with the models in contact under load. The test is stopped when the ideal number of disturbances is achieved. Tests should not be disrupted or restarted. Fig 5.8 shows the wear test model. Wipe out the models and clear off any free wear debris. Note the presence of features on or near the wear scar, for instance, distensions, removed metal, staining, microcracking, or spotting. Remeasure the model angles to the nearest 2.5 μm or review the guides to the nearest 0.0001 g, as fitting. Proceed with the test with additional guides to obtain satisfactory data for quantifiably enormous results.



Fig 5.8 Wear test specimen

5.8 SEM ANALYSIS WITH THE TESTED SAMPLES :

(SEM) assignments and results a drew in stream of electrons over a surface to make an image. The electrons in the support point speak with the model, thusly conveying various signs that can be used to secure information about the surface's topography and design.

The standard SEM parts include:

base of electrons

Area down which electrons travel with electromagnetic focal points

Electron indicator

Test chamber

PC and show to see the photos

Electrons are conveyed at the most extreme mark of the part, accelerated down, and went through a mix of central places and openings to make a connected light emanation which then strikes the external layer of the example. The genuine example is mounted on a stage in the chamber area and (with the exception of assuming that the amplifying instrument is planned to work at low vacuums) both the portion and the chamber are cleared by a mix of cylinders. The level of the vacuum will depend upon the arrangement of the amplifying instrument.

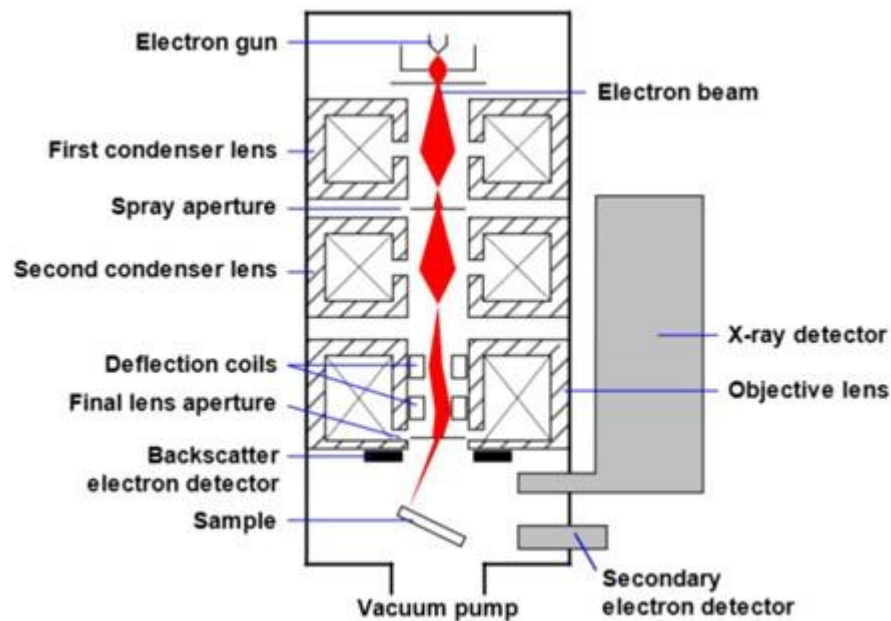


Fig 5.9 Parts of (SEM) scanning Electron Microscope

The put of the electron shaft on the example is compelled by examine circles organized over the objective focal point. These twists licence the shaft to be investigated the external layer of the model. This shaft reevaluated or inspecting enables information about a portrayed locale on the guide to be accumulated. Due to the electron-test correspondence, different signs are conveyed. These signs are then recognized by fitting finders.

5.9 Sample-Electron Interaction

The Scanning electron magnifying instrument focal point (SEM) produces pictures by sifting the model with a high-energy light emanation. As the electrons team up with the example, they produce auxiliary electrons, backscattered electrons, and brand name X-radiates. These signs are assembled by something like one pointers to approach pictures which are then displayed on the PC screen. Right when the electron point of support hits the external layer of the model, it enters the guide to a significance of two or three microns, dependent upon the accelerating voltage and the thickness of the model. Many signs like assistant electrons and X-radiates are conveyed in view of this coordinated effort inside the model.

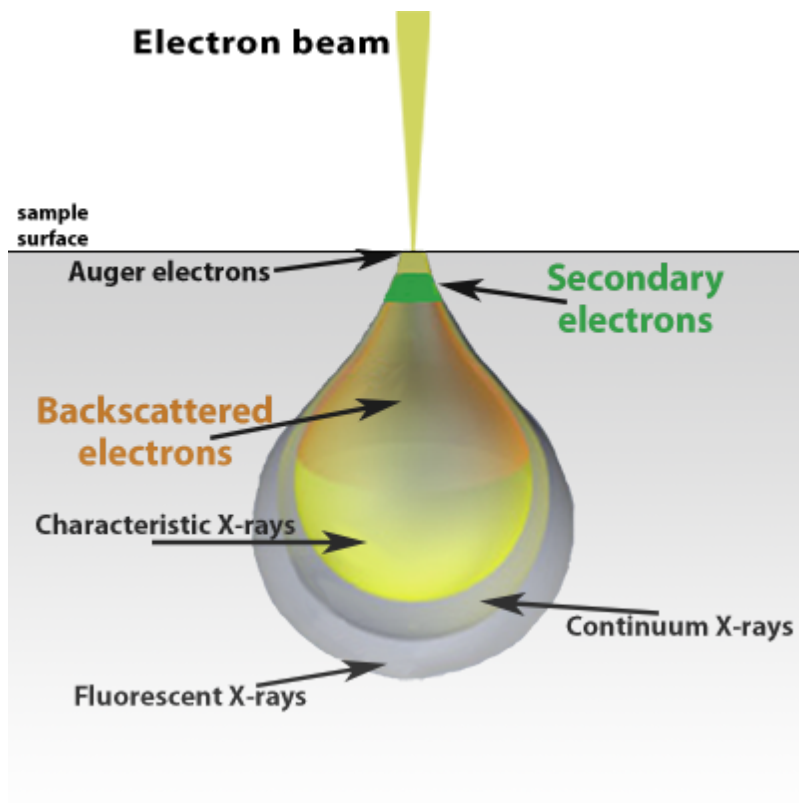


Fig 5.9 Electron beam of SEM

The best objective accomplished in a SEM depends upon different variables like the electron spot size and association volume of the electron shaft with the example. While it can't give an atomic objective, some SEMs can achieve an objective under 1 nm. Normally, current standard SEMs give an objective between 1-20 nm, while workspace systems can give an objective of 20 nm or more.

CHAPTER 6

RESULT AND DISCUSSION

6.1 SEM (SCANNING ELECTRON MICROSCOPE) SAMPLE1

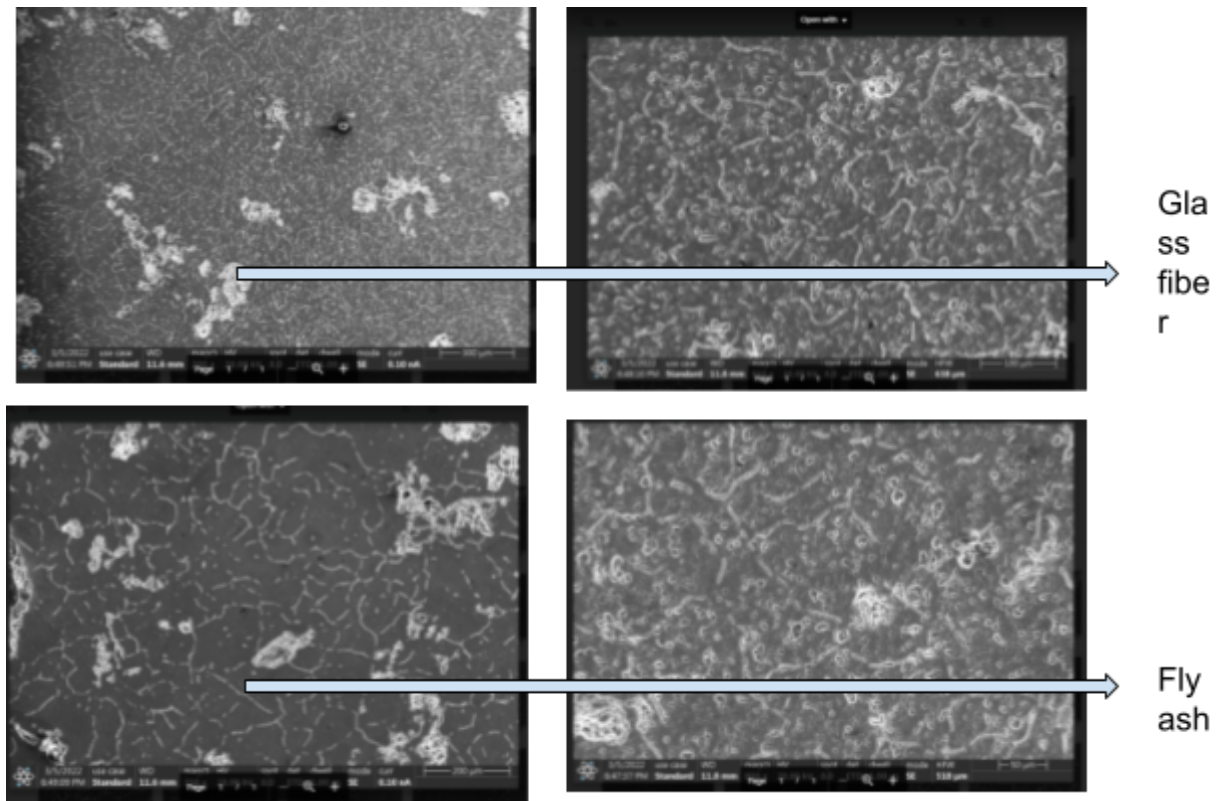


Figure 6.1 : Morphology of sample 1

Fig 6.1 shows morphological view for sample 1 with 100μm ,200μm, 300μm,50μm.In this figure dispersion of fly ash and glass fiber are visible.

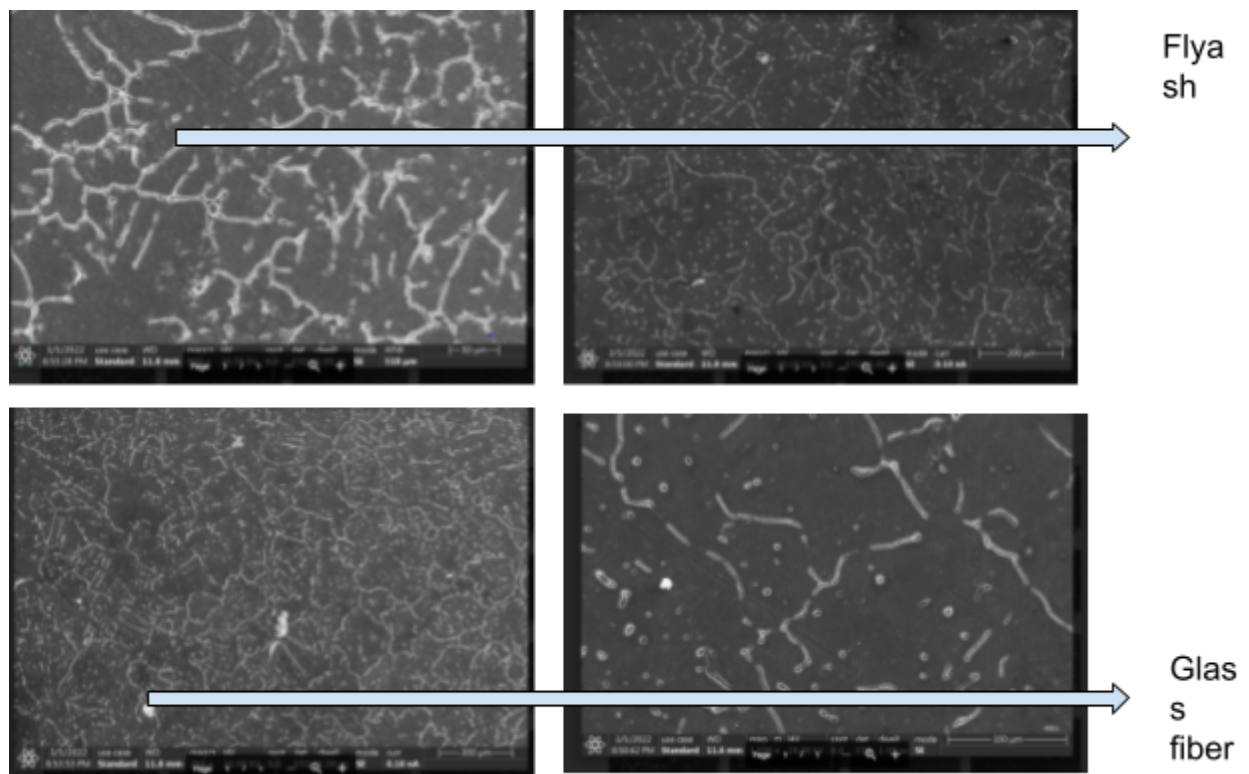


Figure 6.2 Morphology of Sample 2

Fig 6.2 shows morphological view for sample 2 with 100μm, 200μm, 300μm,50μm.In this figure the dispersion of fly ash and glass fiber. are shown.

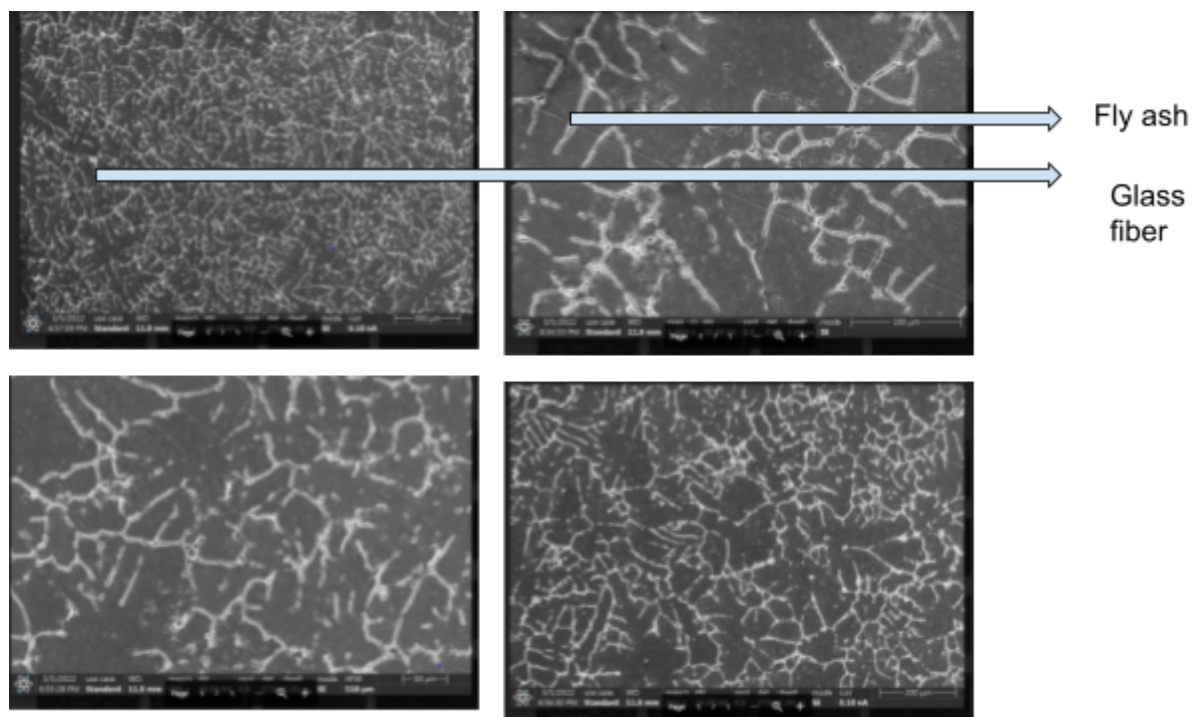


Figure 6.3: Morphology of sample 3

The fig 6.3 shows a morphological view for sample 3 with 100μm,200μm,300μm,50μm. In this morphology study there is equal dispersion of fly ash and glass fiber are seen

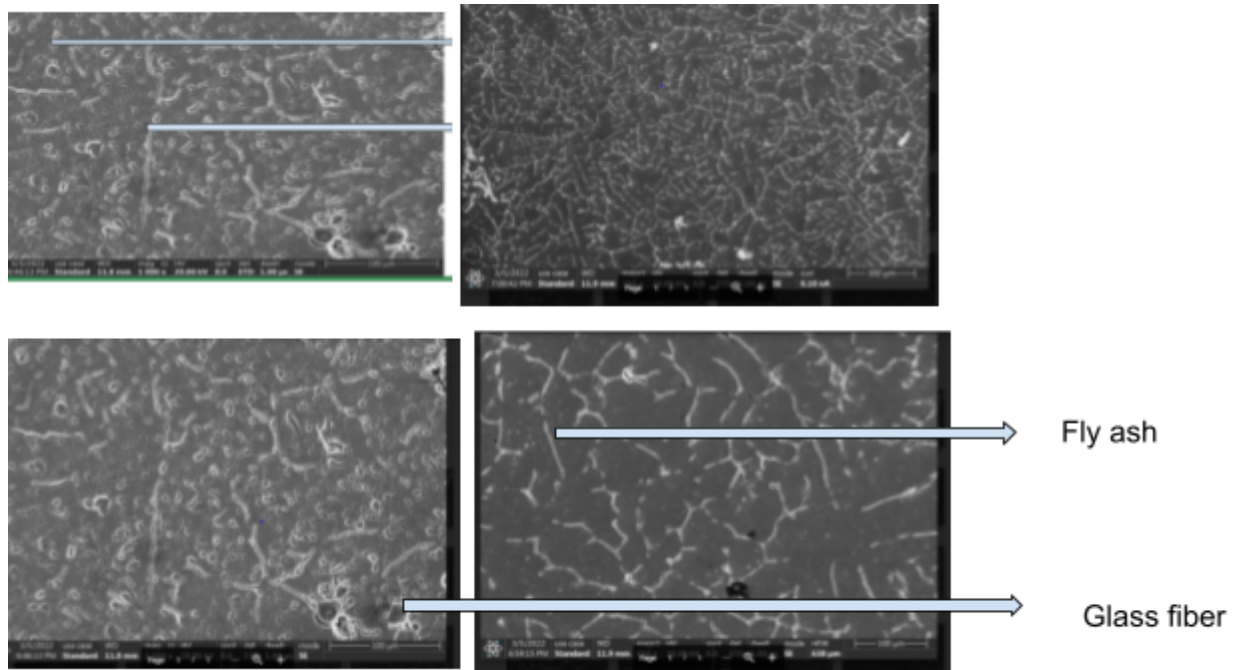


Figure 6.4 Morphology of Sample 4

Figure 6.4 shows morphological view for sample 4 with 100μm,200μm,300μm,and 50μm,

The equal dispersion of fly ash and glass fiber can be seen in the sample 3 (Al7005 /4%Fly ash /2% Glass fiber)

6.2 BRINELL HARDNESS

Ball Dia: 2.5 mm

Load: 187.5

Table 6.1 : Hardness value for 4 samples(three trials)

Sample I.D	Location-1	Location-2	Location-1
1	52.0	52.4	51.1
2	55.3	56.1	55.8
3	54.5	53.4	54.6
4	56.8	58.4	57.4

Table 6.1 displays the hardness values for 4 samples in three trials.The fourth sample shows the highest hardness value of 58.4 BHN(Brinell hardness number)

6.3 IMPACT TEST

Table 6.2 : Impact value for 4 samples(two trials)

sample I.D	Joules
1-1	5.4
1-2	6.4
2-1	12.7
2-2	12.8
3-1	13.6
3-2	13.0
4-1	10.5
4-2	10.4

.The table 6.2 shows the list of impact values for the fabricated samples in two trials.Sample 3 shows the highest impact value compared to other samples

6.4 WEAR TEST RESULT:

Table no 6.3 Wear test result for SAMPLE 1

TIME	WEAR	FF	TEMP
0.98	-0.95	0.44	1329.71
2.394	-2.05	1.34	1329.61
3.374	-3.03	3.03	1329.62
4.354	-2.93	4.21	1329.9
5.335	-2.43	4.99	1329.66
6.317	-1.47	5.27	1329.86
7.295	0.57	5.56	1330.21
8.277	3.92	5.8	1330.07
9.473	7.62	5.93	1330.13
10.456	11.39	5.93	1330.02
1.522	8.54	1.59	1330.7

2.503	41.19	5.04	1330.63
3.483	68.75	7.8	1330.45
4.466	93.73	8.95	1330.36
5.444	112.25	8.96	1330.55
6.424	152.49	8.87	1330.7
7.406	180.37	8.86	1330.78
9.04	194.71	8.84	1330.76
10.018	208.39	9.14	1330.61
0.98	12.37	2.14	1329.04
1.96	27.92	5.93	1329.22
3.049	48.31	9.01	1329.11
4.029	84.69	12.47	1329.13
5.009	114.46	13.23	1329.1
5.99	145.32	13.28	1329.34
7.081	167.93	13.36	1329.47
8.059	191.66	13.57	1329.6
9.039	222.55	13.66	1329.75
10.021	232.79	13.69	1329.89

Tables

Table no :6.4 Wear results for Sample 2

1.418	0.63	0.53	1329.14
2.396	4.8	2.63	1329.2
3.378	9.49	4.02	1329.23
4.358	15.76	4.58	1329.36
5.339	20.02	4.46	1329.42
6.317	27.88	4.23	1329.34
7.299	34.83	4.08	1329.06
8.605	40.9	4.02	1328.92
9.585	47.37	3.95	1329.25
10.564	50.28	3.93	1328.99
0.981	0.45	1.61	1330.09
1.963	6.88	4.65	1330.42
3.052	14.57	8.24	1330.49

4.033	19.4	10.12	1330.39
5.013	26.14	11.63	1330.47
1330.47	31.56	11.35	1330.76
7.08	36.81	10.76	1330.84
8.061	41.9	10.28	1330.66
9.041	43.96	10.16	1330.3
0.98	13.01	2.2	1331.17
2.069	36.86	4.66	1331.15
3.049	96.3	12.5	1331.02
4.029	141.09	17.28	1330.7
5.118	188.71	18.29	1330.74
6.101	230.28	17.79	1330.79
7.081	287.51	17.04	1330.29
8.059	314.52	16.22	1330.26
9.475	316.53	15.32	1330.07

Table 6.5 Wear results for Sample 3

TIME	WEAR	FF	TEMP
0.981	-3.89	0.86	1330.64
2.725	-9.24	2.69	1330.67
3.703	-14.72	5.03	1330.7
4.686	-17.6	5.65	1330.67
6.208	-19.71	5.73	1330.7
7.189	-21.44	5.68	1330.81
8.169	-17.2	5.54	1330.76
9.15	-12.85	5.51	1330.76
10.241	-10.55	5.51	1330.43
0.978	13.93	2.27	1330.16
1.961	55.61	7.07	1329.96
3.05	94.42	12.16	1329.93
4.03	123.24	14.62	1329.98
5.009	166.77	16.55	1330.13

5.988	209.59	16.33	1330.16
7.406	234.29	15.91	1330.16
8.385	233.5	14.7	1330.49
9.365	212.56	13.61	1330.53
10.456	187.22	12.76	1330.72
0.978	13.93	2.27	1330.16
1.961	55.61	7.07	1329.96
3.05	94.42	12.16	1329.93
4.03	123.24	14.62	1329.98
5.009	166.77	16.55	1330.13
5.988	209.59	16.33	1330.16
7.406	234.29	15.91	1330.16
8.385	233.5	14.7	1330.49
9.365	212.56	13.61	1330.53
10.456	187.22	12.76	1330.72

Table 6.6 : Wear results for Sample 4

TIME	WEAR	FF	TEMP
0.979	0.43	0.21	1330.46
1.961	1.49	0.44	1330.67
2.942	3.89	0.71	1330.48
3.922	6.03	0.69	1330.31
4.9	11.82	0.7	1329.92
5.882	17.87	0.83	1329.56
7.079	24.85	0.87	1329.71
8.061	32.13	0.64	1329.82
9.04	39.66	0.58	1329.69
10.02	46.19	0.76	1329.49
0.98	1.41	1.49	1330.54
2.394	5.31	5.17	1330.29
3.375	14.23	9.94	1329.91
4.354	23.91	12.68	1329.78

5.334	34.45	12.99	1329.62
6.315	41.93	13.16	1329.86
7.295	57.17	13.48	1330.34
8.276	70.27	13.88	1330.45
9.909	80.32	14.06	1330.01
10.889	90.82	14.04	1330.1
0.978	13.62	1.14	1330.76
1.959	29.22	3.04	1330.71
3.812	47.92	5.26	1330
4.791	76.81	6.9	1329.8
5.771	103.08	7.45	1329.91
7.295	128.4	7.84	1329.84
8.275	152.29	8.41	1329.83
9.255	177.43	8.78	1329.73
10.236	192.11	9.01	1329.21
11.218	201.42	9	1329.37

Tables 6.3 , 6.4, 6.5 and 6.6 show the wear result for samples 1 to 4 .The sample 3 shows the lowest wear value .

6.5 TENSILE TEST REPORT :

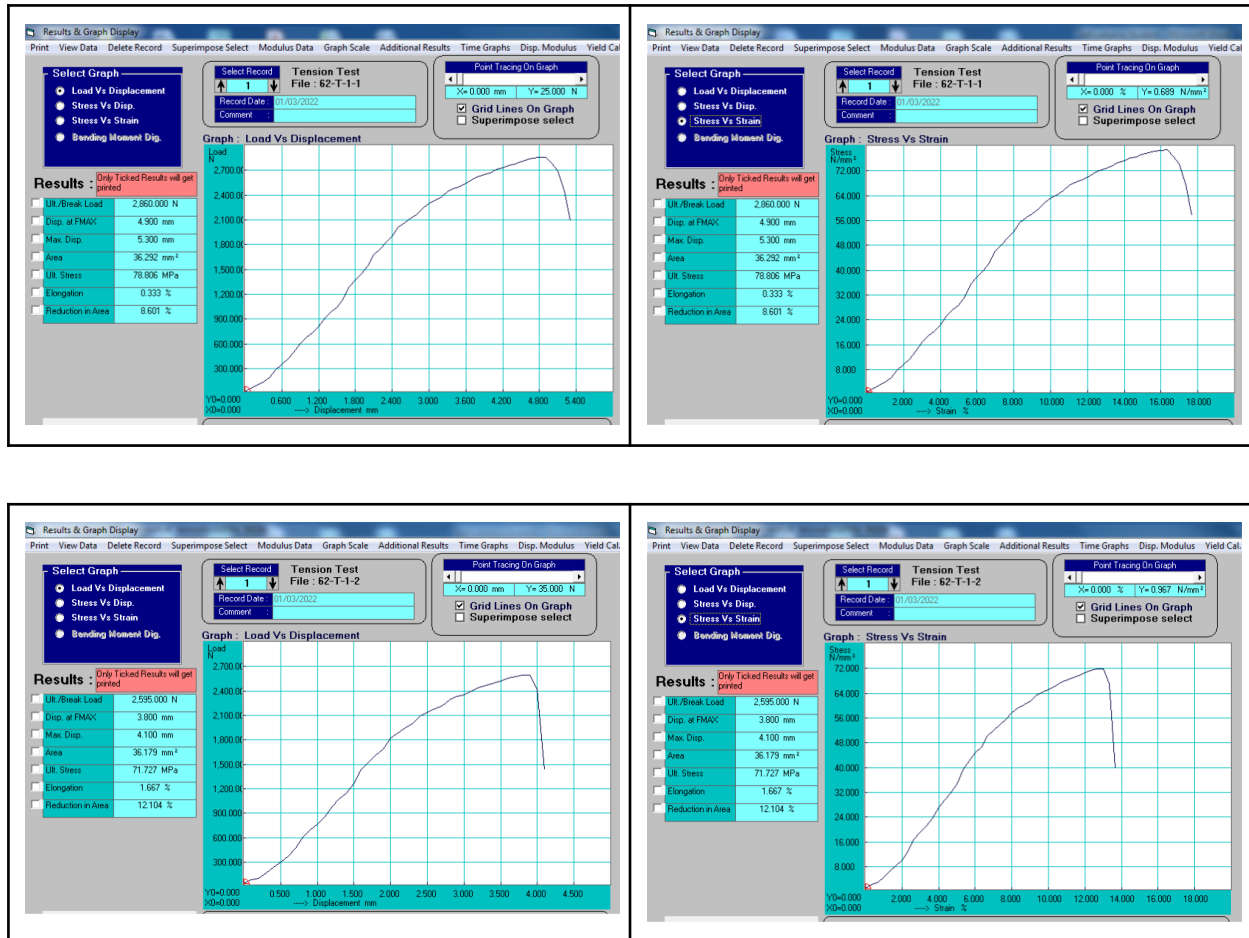


Fig no 6.5 Load vs displacement figure for sample 1

This Figure shows the relation between load and displacement where load is plotted along Y axis and Displacement along X axis high yield strength ,elongation and their corresponding break load for 1-1 , 1-2 ,1-3, 1-4(four trials) is 2860N , 2860N , 2595N , 2595 N and displacement at F_{max} 4900mm, 4900mm, 3800mm, 3800mm and maximum displacement is 5300mm, 5300mm and 4100mm, 4100mm.The ultimate stress is 78.806MPa, 78.806MPa, 71.727MPa, 71.727MPa.The Elongation of the sample is 0.33%,0.333%,1.667%,1.667%.Reduction in area is 8.601%,8.601%,12.104%,12.104%

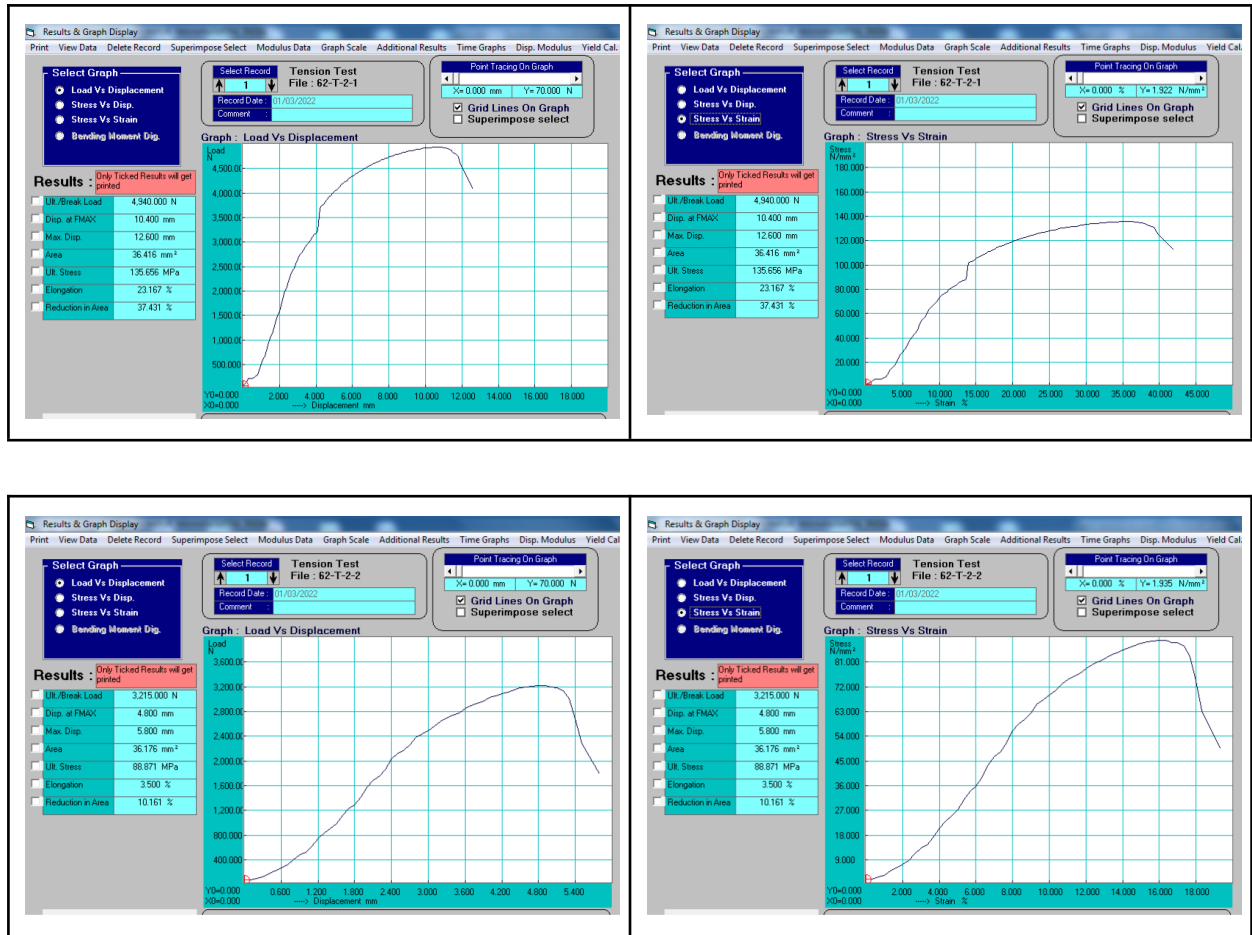


Fig no 6.6 Load vs displacement graph for sample 2

This figure shows the relation between load and displacement where load is plotted along Y axis and Displacement along X axis high yield strength, elongation and their corresponding break load for 2-1, 2-2, 2-3, 2-4 (four trials) (is 4940N, 4940N, 3215N, 3215N and displacement at Fmax 10400mm, 10400mm, 5800mm, 5800mm and maximum displacement is 12800mm, 12800mm and 4100mm, 4100mm. The ultimate stress is 135.656 MPa, 135.656 MPa, 88.871 MPa, 88.871 MPa. The Elongation of the sample is 23.167%, 23.167%, 3.500%, 3.500%. Reduction in area is 37.431%, 37.431%, 12.104%, 12.104%, 10.161%, 10.161%

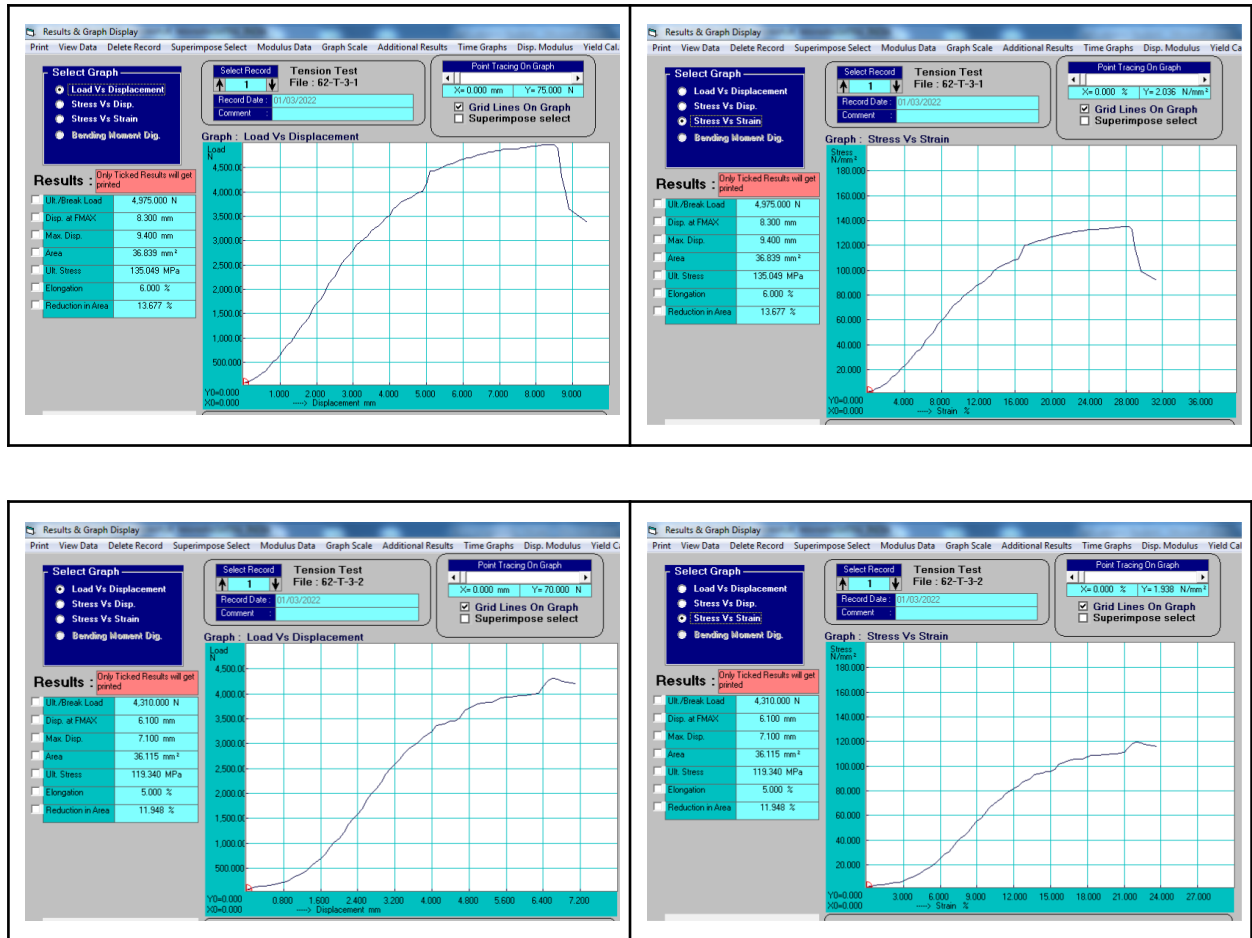


Fig no 6.7 Load vs displacement figure for sample 3

This graph shows the relation between load and displacement where load is plotted along Y axis and Displacement along X axis high yield strength ,elongation and their corresponding break load for 3-1 , 3-2 ,3-3, 3-4(four trials) is 4975N, 4975N, 4310N, 4310N and displacement at Fmax 8300mm, 8300mm, 6100mm, 6100mm and maximum displacement is 9400mm, 9400mm and 7100mm, 7100mm.The ultimate stress is 135.049MPa, 135.049MPa, 119.340MPa, 119.340MPa.The Elongation of the sample is 6000%, 6000%, 5000%, 5000%. Reduction in area is 13.677%, 13.677%, 11.948%, 11.948%.

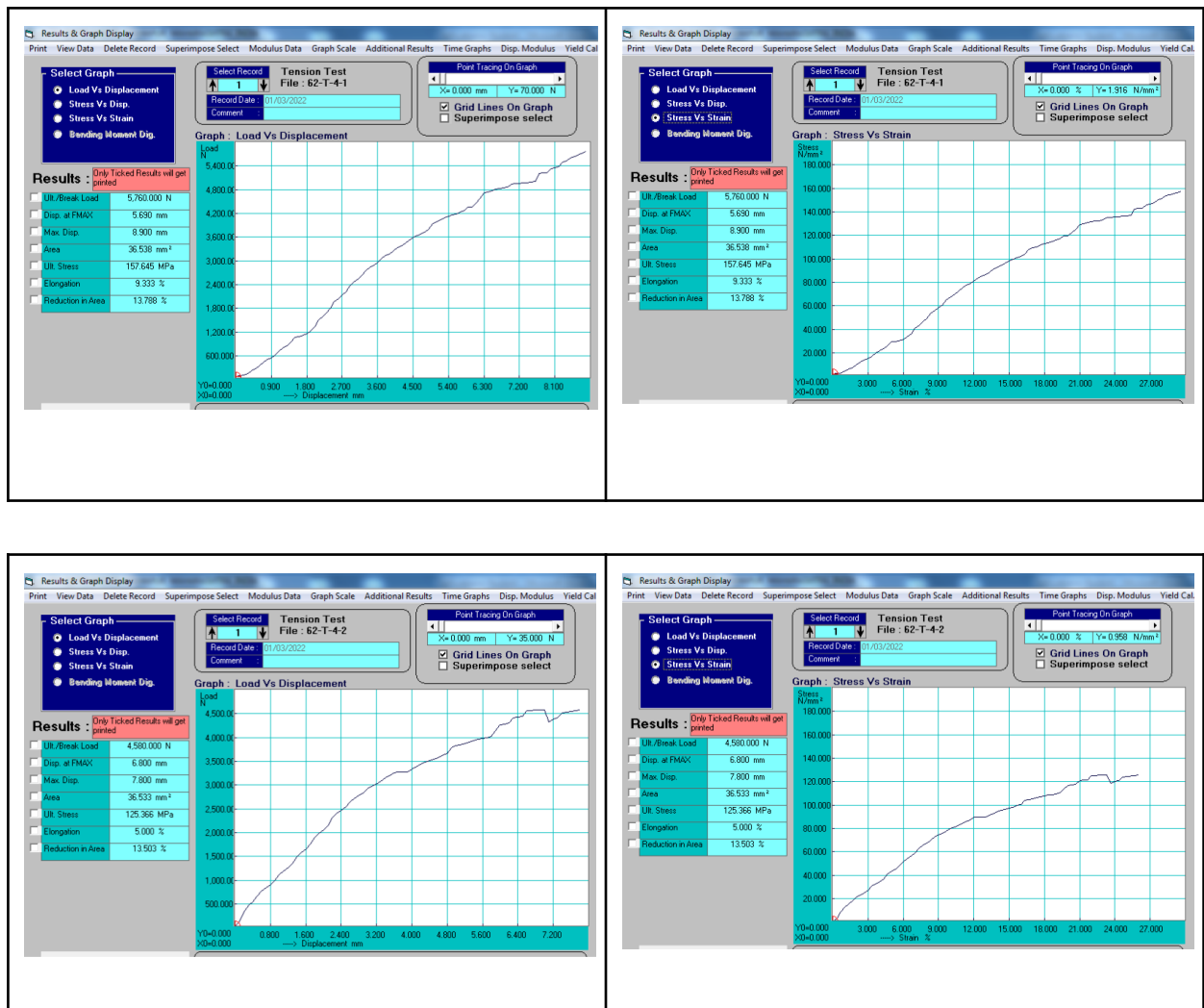


Fig no 6.6 Load vs displacement figure for sample 4

This fig 6.4 shows the relation between load and displacement where load is plotted along Y axis and Displacement along X axis high yield strength ,elongation and their corresponding break load for 4-1 , 4-2 ,4-3, 4-4(four trials) is 4975N, 4975N, 4310N, 4310N and displacement at Fmax 8300mm, 8300mm, 6100mm, 6100mm and maximum displacement is 9400mm, 9400mm and 7100mm, 7100mm.The ultimate stress is 157.645MPa,157.645MPa 125..366MPa,125.366MPa.The Elongation of the sample is 6000%, 6000%, 5000%, 5000%. Reduction in area is 13.677%, 13.677%, 11.948%, 11.948%

CHAPTER 7

CONCLUSION

7.1 CONCLUSION

In the fabricated specimen Sample 4 with 4% of Glass fiber and 2% of Fly ash shows higher mechanical properties with maximum tensile strength 157.6MPa .Sample 3 with 2% glass fiber and 4%fly ash has maximum Impact strength of 13.6 Joule and maximum hardness of 58.4 obtained for sample 4, In Morphological study fourth sample shows equal distribution of reinforced material . In wear Sample no 4 shows lowest wear.

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