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Effect of Hybrid Reinforcements on the Mechanical and Micro structural Properties of AA6061 Nano-Composites

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Abstract: ***Now-a-days we are widely using aluminum based metal matrix composites. To overcome the problems faced in conventional materials, lots of studies are going on replace them with composites/alloys. In these metal matrix composites are heavily used in structural, aerospace, weapons, machinery parts, marine and automobile applications for its light weight, high strength and low production cost. As developments of light weight materials has provided numerous possibilities for weight reduction. In this project we are casting aluminum based (AA6061) composites with magnesium and fly ash as reinforcements, fly ash is one of the inexpensive and low density material and it is easily available as the product during coal combustion and then casted components are machined specimen dimension and different materials testing had been conducted to the obtain material properties, characteristics and micro structures. We are varying mass fraction of fly ash (0%, 5%, 10%, 15%, and 20%) and keeping 4% of magnesium as constant. We had got well advancements in mechanical properties like tensile, hardness and impact strength with increase in wt% of reinforcement.***
Keywords: Metal matrix composites, Mg – Fly ash, Stir casting and mechanical properties.

I. INTRODUCTION

Traditional solid materials have confinements in accomplishing great mix of solidarity, solidness, sturdiness and thickness. To beat these deficiencies and to fulfill the consistently expanding need of advanced innovation, composites are most encouraging materials of ongoing interest. Metal lattice composites (MMCs) have essentially improved properties including high explicit quality; explicit modulus, damping limit and great wear obstruction contrasted with unreinforced compounds. There has been an expanding enthusiasm for composites containing low thickness and minimal effort fortifications. At the plainly visible level at least two materials join to give helpful material which is named as composite. An inhomogeneous material made by the engineered get together of at least two materials at the naturally visible level, to get explicit attributes and properties, is named as composites.
The greater part of the composite materials are made out of two stages one is named as lattice, which is ceaseless and encompasses the other stage, frequently called the scattered stage. Composites are partitioned into the accompanying classes based on the type of the basic constituents:

A. CHARECTERISTICS OF THE COMPOSITE:

- These are falsely made (consequently, barring normal material, for example, wood).
- These comprise of at any rate two unique species with a very much characterized interface.
- Their properties are affected by the volume level of fixings.
- These have at any rate one property not controlled by the individual constituents.

The Composite Performance Depends On The Following Factors:

- Properties of lattice and fortification.
- Size and dissemination of constituents.
- State of constituents.
- Nature of interface between constituents.

B. CLASSIFICATION OF THE COMPOSITES

Composite materials are characterized

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(a). Based on framework material.
(b). Based on filler material.

1) Based on Matrix:

- Metal Matrix Composites (MMC)

Metal Matrix Composites are made out of a metallic lattice (aluminium, magnesium, iron, and cobalt, copper) and scattered clay (oxides, carbides) or metallic (lead, tungsten, molybdenum) stages.

- Artistic Matrix Composites (CMC)

Artistic Matrix Composites are made out of a clay network and imbedded filaments of other earthenware material (scattered stage).

- Polymer Matrix Composites (PMC)

Polymer Matrix Composites are made out of a grid from thermoset (Unsaturated polyester (UP), Epoxy) or thermoplastic (PVC, Nylon, Polystyrene) and implanted glass, carbon, steel or Kevlar filaments (scattered stage).

2) On The Basis Of Material Structure:

- Particulate Composites

Particulate Composites comprise of a grid strengthened by a scattered stage in type of Particles.

- Composites with irregular direction of particles.
- Composites with favoured direction of particles. Scattered period of these materials comprises of two-dimensional level platelets (drops), laid corresponding to one another.

- Sinewy Composites

Short-fiber fortified composites. Short-fiber strengthened composites comprise Of a lattice strengthened by a scattered stage in type of intermittent filaments (Length< 100*diameter).

- Composites with arbitrary direction of filaments.
- Composites with favored direction of strands.

- Long-fiber strengthened composites.

Long-fiber fortified composites comprise of a network fortified by a scattered stage in type of constant strands.

- Unidirectional direction of strands.
- Bidirectional direction of strands (woven).
- Overlay Composites

C. ALUMINIUM AND ITS ALLOYS:

General Characteristics of aluminum: The exceptional blends of properties gave by aluminum and its compounds make aluminum one of the most flexible, practical, and alluring metallic materials for a wide scope of employments from delicate, profoundly pliable wrapping foil to the most requesting designing applications. Aluminum compounds are second just to prepares being used as basic metals.

Aluminum opposes the sort of dynamic oxidization that makes steel rust away. The uncovered surface of aluminum consolidates with oxygen to shape an idle aluminum oxide film just a couple ten-millionths of an inch thick, which squares further oxidation. What's more, not normal for iron rust, the aluminum oxide film doesn't chip off to uncover a new surface to facilitate oxidation. In the event that the defensive layer of aluminum is damaged, it will in a flash reseal itself. The flimsy oxide layer itself sticks firmly to the metal and is dreary and straightforward imperceptible to the unaided eye. The staining and chipping of iron and steel rust don't happen on aluminum. Aluminum normally shows brilliant electrical and warm conductivity, yet explicit amalgams have been created with high degrees of electrical resistivity. These composites are helpful, for instance, in high-force electric engines. Aluminum is regularly chosen for its electrical conductivity, which is about twice that of copper on an identical weight premise. The necessities of high conductivity and mechanical quality can be met by utilization of long-line, high-voltage, aluminum steel-cored strengthened transmission link. The warm conductivity of aluminum composites, around 50 to 60% that of copper, is profitable in heat exchangers, evaporators, electrically warmed machines and utensils, and car chamber heads and radiators. Aluminum is non-ferromagnetic, a property of significance in the electrical and hardware enterprises. It is non-pyrophoric, which is significant in applications including inflammable or dangerous materials dealing with or introduction. Aluminum is likewise non-harmful and is routinely utilized in holders for food and drinks. It has an appealing appearance in its characteristic completion, which can be delicate and brilliant or splendid and gleaming. It tends to be for all intents and purposes any shading or surface.

Aluminium composites are chiefly 2 unique sorts as indicated by dependent on the primary characterizations

- Cast composites
- Wrought composites

Both composites are further sub-separated into 2 classifications they are

- Heat treatable composites
- Non – heat treatable composites

II. LITERATURE REVIEW

Prof.N.RDamere, atal [1] proposed the utilization of nano particles created bybase up approach for the manufacture of the nano composites considering malleability maintenance with uniform increment in pliable properties. Top down is additionally passable to use in creation of MMNC. In their work they has accepted network material as A356 and fortification material as nano silicon carbide particles at 0.1 to 5 weight rate by ultrasonic cavitation , and the outcomes are contrasted and A356 lattice composite strengthened with small scale particles at 5wt% by mix throwing additionally arranged. They demonstrated that 1kw force ultrasonic transducer and 6 min as sonication time 0.1wt% of fortification is adequate to scatter nano materials in 500gmsof AL metal. In this work he reasoned that with the expansion in the fortification proportion, rigidity, hardness of nano-Fly Ash critical change in flexibility. While for small scale composite, slight increment in quality, hardness and abatement in malleability were watched.J.David Raja Selvam, D.S.Robinson Smart [2]; has taken AA6061 as networkmaterial and they took fortification material fly debris. This examination demonstrates that 1kw force ultrasonic transducer with 30min sonication time for 12wt% support is adequate to scatter nano materials in 500gms of Al metal. They contrasted the outcomes and the unadulterated A356 composite and they reasoned that utilization of nano materials indicated improvement in elastic properties and hardness with decline in malleability. 12wt% of the CNTs displays the best return and elasticity and great maintenance of pliability, and among Fly Ash and B4c the fly debris shows preferable ductile properties over the other. Ass.ProfSatyanarayana. Ch [3]atal; has accepted network material as A356 and CNTs as the fortification materials and determined the cavitation pressure[6] produced in the ultrasonic handling by utilizing the general Lenard-Jones "6-12" potentials and through effects found that the cavitation pressures is far more noteworthy than tookinterior weight and can ready to scatter mtrix carbon nano tubes in the framework efficiently. Ass.ProfRamaniahNallu ,atal [5] have taken AA6061 as lattice composite and nano Fly Ash particles as the fortification are casted and rubbing mix welded. FSW brought about noteworthy grain refinement and homogeneous appropriation of nano Fly Ash particles. The smaller scale auxiliary examination is done utilizing optical tiny (OM) and filtering electron magnifyinglens (SEM. Thejointqualityis expandedcontrastedwiththe regular combination welding strategies. a significant improvement in the mechanical properties are watched.JieLan, Yong Yang,Xiaochun Li [6], has taken AZ91D magnesium and Fly Ash particles as fortification and the composite was created , the ultrasonic nonlinear impactswere utilized to scatter nano measured particles in the liquid metal SEM pictures show the uniform dissemination ofthe support inthe networkmaterial and albeit afew agglomerations were watched . also, the Eds investigation study sees that the exceptionally little degrees of oxygen content that demonstrates that the liquid metal was very much shielded from oxidation. Hai Su, WenliGao, ZhaohuiFeng,Zheng Lu [7], proposed Nano estimated clay particles strengthened Al framework composites created utilizing ordinary mix throwing methods typically present helpless conveyance of nano particles inside the lattice and high porosity. In this examination ,nano Al203/2024 composities were set up by strong – fluid blended throwing , joined with ultrasonic treatment. The got composite showed fine grain microstructure , sensible All2o3 nano molecule conveyance in the lattice , and low porosity. Strong fluid blended throwing method was viable in hindering the agglomeration of nano particles in the framework .the utilization of ultrasonic vibration on the composite liquefy during the hardening not just characterized the grain microstructure of the network , yet in addition improved the circulation of nano estimated fortification . contrasted and the m,atrix , a definitive tensiule quality and yield quality of 1wt% nano Al2o3/2024 composite were upgraded by 37% and 810% successfully. The better pliable properties were ascribed to the uniform dispersion of fortification and grain refinement of alluminium lattice. Yong Yang, Xiaochun Li[8]: suggested that light weight metal grid nano composite MMNCs(metalframeworkwithnano estimatedearthenwareparticles) can beof essentialness for car, aviation and various different applications. It is invaluable to create successful nano producing techniques for manufacture of mass parts of alluminium based MMNCs careful cementing handling. Anyway it is amazingly hard to scatter nano measured clay particles consistentlyinliquidaluminum. Inthispaper,ahighforceultrasonictest isutilizedtoscatter nano measured Fly Ash particles into liquid aluminum compound A356.

Exploratory outcomes show that the ultrasonic cavitation based scattering of nano particles in liquid aluminum composite is viable. the uniform nano molecule scattering in the Al combination grid came about in altogether improved mechanical properties.

V.Giridhar, R.S.Arunraj, R.Dhisondhar[9], recommended that it is amazingly hard to scatter nano estimated fired particles,uniformly in liquid metal. So as to research the impactof choice nano materials (CNTs) on the microstructure and mechanical properties of composite , another technique is utilized to maintain a strategic distance from agglomeration and isolation of the particles. The microstruct5ure of the composite is researched by filtering electron microscope(SEM). Test results demonstrated an almost uniform dissemination and great scattering of the nano particles inside the Al grid , albeit some of little agglomerations are found. Hardness, flexural quality and rigidity are upgraded by joining of nano materials into the grid. The upgrade in estimations of hardness, flexural quality and pliable strengt5h saw in the trial is because of little molecule size and great appropriation of the particles, which was affirmed by SEM pictures. R.S.Rana, RajeshPurohit,S.Das[10] recommended that AA5083 compound micron and nano Fly Ash composites has been manufactured by ultrasonic helped mix throwing process. Diverse weight percent of Fly Ash particles micron(10wt%) and nano (1,2,3and 4wt%) were utilized for the union of Al framework composites.SEM diagrams demonstrated uniform conveyance of Fly Ash particles anyway with agglomeration at certain spots. An endeavor has been made to contemplate the impact of wear boundaries like applied burden , sliding pace , sliding separation a nd level of fortification on the dry sliding wear conduct of Al network micron and nano Fly Ash composites . Results uncovered that a low burden and littler sliding separation composite with nano Fly Ash demonstrated higher wear opposition. Anyway at high burden and longer sliding separation composites with smaller scale Fly Ash shows higher wear opposition among all composites tried.

III. FABRICATION OF COMPOSITE

Despite the fact that there are a few strategies for the arrangement of the composite, giving developed a role as the one of the best techniques to deliver items with the unpredictable shapes. Anyway it is very hard to acquire uniform scattering of nano-sized particles in fluid metals because of high consistency, helpless wet capacity, and enormous surface to volume proportion in the metal grid. So to beat this difficult we utilize high force ultrasonic waves to have uniform scattering in the fluid stage as they produce the fundamental non - straight impacts required.

A. EQUIPMENT AND CONSUMABLES USED:

Matrix Alloy	AA6061.
Reinforcement	Fly ash Of Size 5µm-300 µm
Wetting agent	Magnesium (Mg)
Crucible	Graphite Material With 1.5 Kg Capacity
Dies	Mild Steel
Inert Gas	Argon.
Ultrasonic Transducer	20Khz, 2000W
Electrical Resistance Furnace	1200°C
Chamber Size	12×12×18

Table 1: Equipment and Consumables Used

Component	Wt%
Cu	6.00%max
Fe	0.7%max
Si	0.40%max
Zn	0.30%max
Bi	0.60%max
Pb	0.40%max
Al	Balance

Table 2: Composition of AA 6061

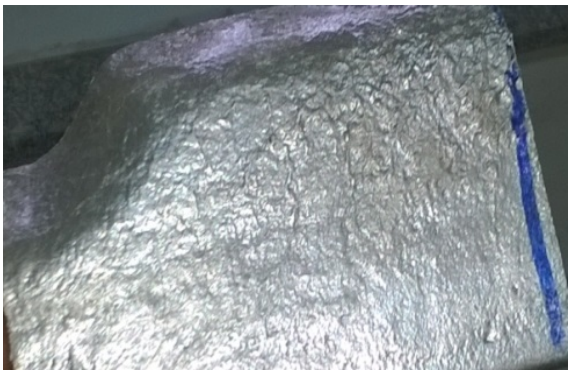


Fig 1: Aluminium Block

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B. CFLY-ASH:

Fly debris otherwise called "pummeled fuel debris" within the uk could be a coal burning item made out of fine particles that are driven out of the heater with the vent gases. Debris that falls within the base of the kettle is named base debris. In present day coal-terminated force plants, fly debris is by and huge caught by electrostatic precipitators or other molecule filtration hardware before the vent gases hit thesmokestacks.

Before, fly debris was by and huge discharged into the air, however air contamination control measures currently necessitate that it's caught preceding discharge by fitting contamination control hardware. In the US, fly debris is for the foremost part put away at coal power plants or set in landfills. About 43% is reused, frequently utilized as a pozzolan to deliver water driven concrete or pressure driven mortar and a swap or halfway substitution for Portland concrete in solid creation. Pozzolans guarantee the setting of cement and mortar and provides solid more assurance from wet conditions and compound assault. Fly debris material hardens while suspended within the fumes gases and is gathered by electrostatic precipitators or channel sacks. Since the particles set quickly while suspended within the fumes gases, fly debris particles are commonly circular fit as a fiddle and target size from 5 µm to 300 µm. the many results of the fast cooling is that number of minerals have the chance to require shape, which fundamentally formless, extinguished glass remains. By the by, some hard-headed stages within the pounded coal don't dissolve (totally), and stay crystalline. In outcome, fly debris could be a heterogeneous material. SiO_2, Al_2O_3, Fe_2O_3 and sporadically CaO are the principle synthetic segments present in fly remains. The mineralogy of fly cinders is differing.The centralizations of other follow components change too as per the kind of coal combusted to border it. Indeed, on account of soft coal, with the remarkable special case of boron, follow component fixations are commonly like follow component focuses in unpolluted soils.Two classes of fly debris are characterized by ASTM C618: Class F fly ash and sophistication C fly debris. the most contrast between these classes is that the measure of calcium, silica, alumina, and iron substance within the debris.



Fig 2: Fly Ash

C. MAGNESIUM

Mix throwing in addition to cooling plate procedure has been utilized for the manufacture of Al network composites dependent on compound 356. Improvement of the wettability of Fly Ash particles was done, utilizing the oxidization of Fly Ash particles, the utilization of wetting operators by including Magnesium(Mg) into the grid and the covering of Fly Ash particles utilizing a sol–gel procedure. The presentation of Fly Ash particles into incompletely cemented amalgam with high thickness keeps the particles from skimming and agglomerating. Unoxidised Fly Ash particles are for the most part isolates from the Al lattice during the crushing recommending helpless grip and helpless wettability between the framework and the particles. Oxidized Fly Ash particles and sol–gel silica covered Fly Ash particles demonstrate great authoritative among composite and network.



Fig 3: Magnesium Turnings

D. Procedure of Stir Casting:

Mix throwing process begins with putting void cauldron inside the mute. at first radiator temperature is going to 450°C so it's bit by bit expanded up to 900°C. extraordinary temperature of the stifle assists with liquefying Aluminum composite rapidly, lessens oxidation level, upgrade the wettability of the support particles inside the network metal.

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Aluminum compound AA6061 is utilized as Matrix material. Required amount of Aluminum composite is cut from the staple which is inside such a round bar. Aluminum combination is cleaned to dispose of residue particles, gauged then poured inside the pot for softening. During dissolving nitrogen gas is utilized as concoction component to shape the latent air round the liquid framework. debris is utilized as support. 4% by weight of unadulterated magnesium turnings are utilized as substance operator. At a time all out 500 gram of liquid composite was prepared inside the pot. Required amounts of fortification powder and magnesium turnings are burdened the equalization. Fortifications are warmed for 30 minutes and at temperature of 500°C. At the point when lattice was inside the completely liquid condition, Stirring is begun following 2 minutes. Stirrer rpm is step by step expanded from 0 to 300 RPM with the help of speed controller. Temperature of the warmer is going to 630°C which is underneath the softening temperature of the lattice. an even semisolid phase of the liquid grid was accomplished by blending it at 630°C. Pouring of preheated fortifications at the semisolid phase of the lattice upgrade the wettability of the support, decreases the molecule settling at the underside of the pot. Fortifications are poured physically with the help of tapered container. The pace of stream of fortifications estimated was 5 gram for every second.



Fig 4 stir casting process

Scattering time was taken as 5 minutes. In the wake of mixing 5 minutes at semisolid stage slurry was warmed and hold at a temperature 900°C to shape sure slurry was completely fluid. Stirrer RPM was then step by step brought down to the zero. The mix throwing contraption is physically kept side thus liquid composite slurry is poured inside the metallic Mold. Shape is preheated at temperature 500°C before pouring of the liquid slurry inside the Mold. This ensures slurry is in liquid condition all through the pouring. While pouring the slurry inside the Mold the progression of the slurry is kept uniform to abstain from catching of gas. At that point it's fast extinguished with the help of air to downsize the settling time of the particles inside the grid.

IV. MICROSTRUCTURES

A. JMICROSTRUCTURES OF AA6061, 4%Mg, 0%, 5%, 10%, 15%, 20% FA:

Microstructure is characterized because the structure of a readied surface or slender foil of fabric as uncovered by a magnifying instrument above 25X amplification. The microstructure of a fabric (which may be comprehensively grouped into metallic, polymeric, fired and composite) can emphatically impact ash properties, as an example, quality, strength, malleability, hardness, erosion obstruction, high/low temperature conduct, wear opposition, etc, which thusly administer the employment of those materials in modern practice.The material example is ready up by cleaning, scratching, cutting, fume affidavit so on. The techniques are said by and enormous as metallographic as applied to metals and combinations, and may be utilized in adjusted structure for a few other material, for instance, pottery, glasses, composites, and polymers. Two varieties of optical magnifying lens are commonly wont to inspect level, cleaned and scratched examples: a mirrored image magnifying lens and a reversed magnifying lens. Recording the image is accomplished utilizing a complicated camera working through the eyepiece. Here we are utilizing an altered magnifying lens of amplification 10x to 60x. We acquire the photographs ofJtheLninePexamplesOasPfollows:
a). The figure underneath shows the miniaturized scale auxiliary investigation for the cast aluminum combination without fly debris particles and ultrasonic preparing. It o.k. is also watched unmistakably that the dendritic grains are obviously uncovered.

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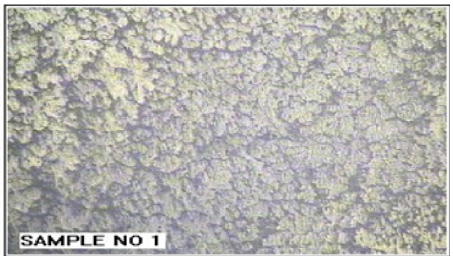


Fig 5:MicrostructureGofFRawHAA6061

b). The figure beneath shows the little scale auxiliary examination for the instance containing framework material as AA6061 and also the support material as fly debris for the load percent of fifty. From the underneath picture we are able to watch the dissemination of the fly debris particles within the AA6061. The grain sizes watched are littler than that of the cast aluminum compound without fly debris particles and ultrasonic handling.c). The figure underneath shows the little scale auxiliary examination for the instance containing framework material as AA6061 and therefore the support material as fly debris for the burden percent of 10 %. From the beneath picture we will watch the dispersion of the fly debris particles within the AA6061. The grain sizes watched are littler than that of the cast aluminum combination without fly debris particles and ultrasonic preparing.

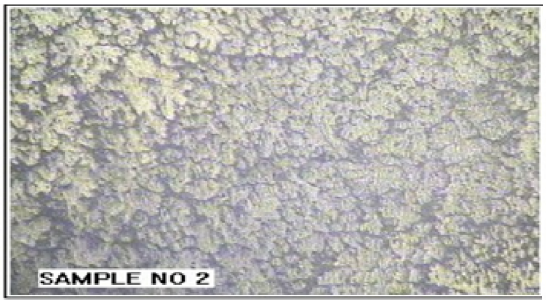
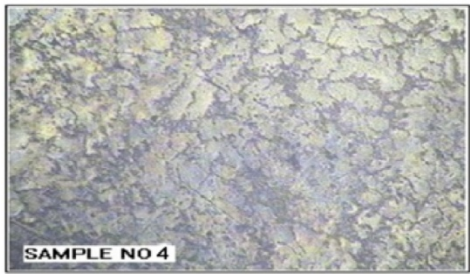


Fig 6:MicrostructureHofHAA6061HwithH5%WtGof flyhash



Fig 7:MicrostructureJofHAA6061KwithJ10%WtjofhFlyash

d).The figure underneath shows the tiny scale basic investigation for the instance containing framework material as AA6061 and also the fortification material as fly debris for the burden percent of quarter-hour. From the beneath picture we are able to watch the dispersion of the fly debris particles within the AA6061. The grain sizes watched are littler than that of the cast aluminum composite without fly debris particles and ultrasonic handling.



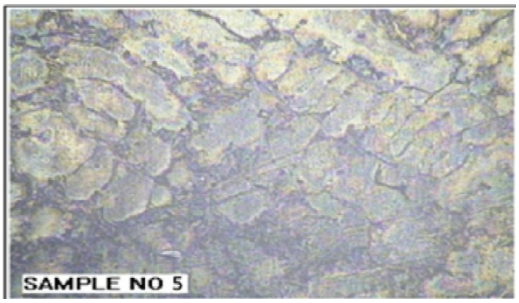


Fig 8:MicrostructureHofHAA6061HwithH15%Wt.HofHFlyAsh Fig 9:MicrostructureHofHAA6061HwithH20%WtHofH Flyjash

e). The figure underneath shows the miniaturized scale basic investigation for the instance containing grid material as AA6061 and therefore the fortification material as fly debris for the burden percent of 20%. From the beneath picture we will watch the dissemination of the fly debris particles within the AA6061. The grain sizes watched are littler than that of the cast aluminum compound without fly debris particles and ultrasonic preparing.From the above miniaturized scale auxiliary pictures the conveyance of the ash particles within the lattice compound is watched and also the distinction within the dissemination of the particles is unmistakably watched with in the crude cast aluminum amalgam, Fig 9 the dimensions of the dendritic grains is big and no ultrasonic preparing is completed and no fly debris particles are available.

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Test (4) shows the microstructure of the cast aluminum amalgam test with 20 wt.% Fly Ash particles with ultrasonic handling. The grain sizes from the examples with fly debris particles and ultrasonic handling are plenty littler. From the above pictures it's seen that the fly debris particles are disseminated and now SEM diagrams are taken.

B. SEM IMAGES

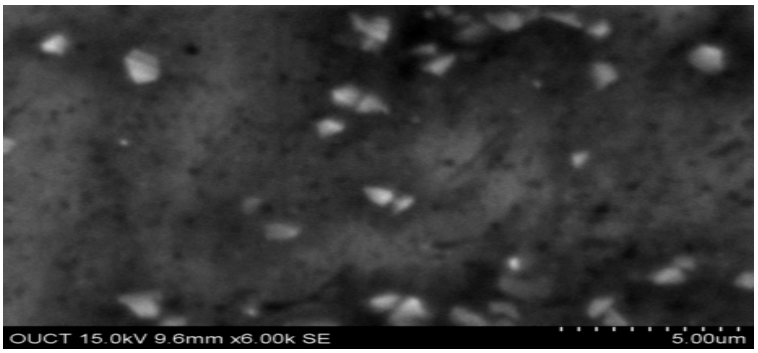


Fig 10: SEM Image OF AA6061 with 5% Wt. of Fly Ash

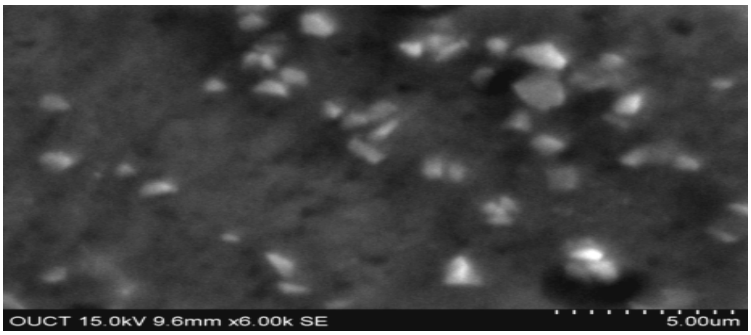


Fig 11: SEM Image of AA6061 with 10% Wt. of Fly Ash

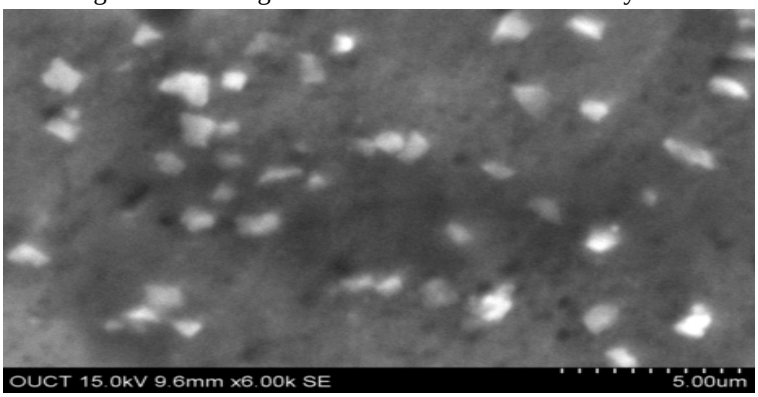


Fig 12:.SEM Image of AA6061 with 15% Wt. of Fly Ash

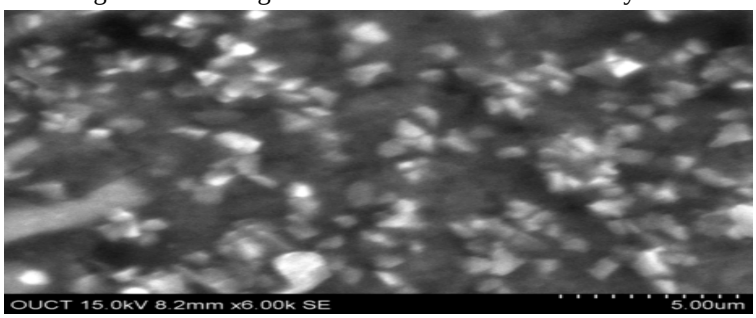


Fig 13: SEM Image of AA6061 with 20% Wt. of Fly Ash

The above pictures show the dispersing of the Nano debris particles inside the AA6061 organizes mix. From the pictures doubtlessly the Nano-sized debris particles (from 5 to twenty wt. you take care of size 5µm) were all around dissipated inside the AA6061 system, as showed up. Infinitesimal scratches/breaks because of cleaning are appeared. High power ultrasonic waves have delivered strong cavitations and acoustic spilling impacts during mixing. Transient cavitations have made a careless impact adequately ready to isolate the gathered particles and disperse even more reliably inside the liquid.

C. QUALITATIVE ANALYSIS:

1. Line ID:

The article of examination is to look out what components are available in an 'obscure' example by recognizing the lines inside the X-beam range utilizing tables of energies or frequencies. Ambiguities are uncommon and may perpetually be settled by thinking about extra lines in like manner in light of the fact that the primary one.

2. Qualitative ED analysis:

The ED spectrometer is helpful for investigation on the grounds that an entire Spectrum might be gotten rapidly. Helps to ID are given, similar to offices for superimposing the places of the lines of a given component for correlation with the recorded range. In order to confirm the creation of the nano-composite, EDS investigation was utilized. The regular outcome's appeared in Fig underneath.

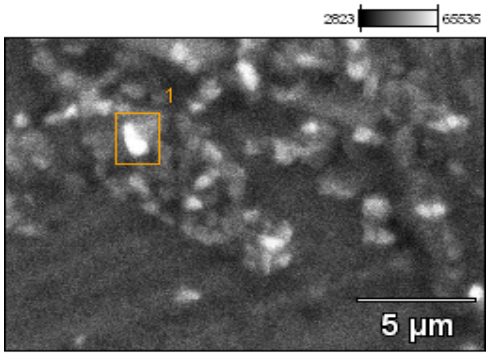


Fig 14: Electron Dispersion Microscope Image

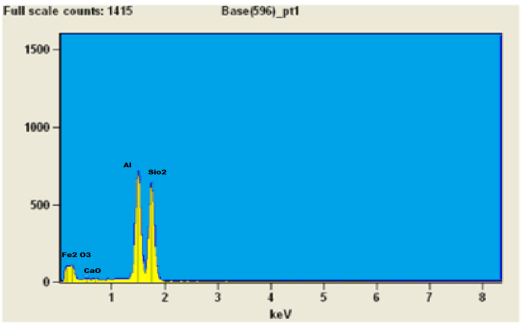


Fig 15: Electron Dispersion Microscope Image

It appears that the composite was ensured well during creation since the oxidation level is somewhat low. Since the normal size of the debris molecule is 5µm, it's hard to utilize EDS spot examination because of the restriction of the e-bar goal inside the instrument. In this manner, planning checking was utilized. Shows the dissemination of the climate aluminium (Al), fly debris, individually. The outcomes show that C is conveyed consistently, which demonstrates a fair scattering of debris particles in lattice. From the planning of Si component, there are a few fixations from the eutectic Si of the amalgam.

V. MECHANICAL CHARACTERISTICS

A. ASTM Standards:

The ASTM gauges alluded to as the American Society for Testing and Materials is a world standards' association that creates and distributes intentional accord specialized measures for large choice of materials items frameworks and administrations. ASTM E8 standard test methods for strain testing of metallic materials The above figure shows the ASTM E8 standard testing for the metallic testing of the materials. According to these standards' the picture of the specimen are as appeared above and furthermore the qualities in like manner are:

- The general length be 210mm
- Gauge length 90mm
- Width 15mm
- Width of held territory 25mm.

The mass Al cast composite was cut predictable with the above standards in Wire Edm process.

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Fig 16: Al Cast Alloy in sync with ASTME8 Standards



Fig 17: Tensile Tested Pieces



Fig 18: Piece before breaking in UTM



Fig 19: Piece in the wake of breaking in UTM

As saw from the above figures the examples were exposed to disappointment nearly at the indistinguishable area. This breaking of the examples at the indistinguishable area demonstrates the uniform dispersion of the composite particles inside the examples the type strain bends were taken as demonstrated as follows:

By taking the debris molecule weight rate on the X pivot and in this manner a definitive sturdiness on the Y hub the resulting perceptions were watched.

Wt (%)	UTS
0	335 MPa
5	348 MPa
10	360 MPa

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15	330 MPa
20	310 MPa

Table 3: Ultimate enduringness Values

- The last word lastingness estimation of the crude AL cast composite was referred to be as 335MPa.
- On expansion of the debris for weight percent 5% the UTS esteem expanded to 348MPa.
- On expansion of the debris for weight percent 10% the UTS esteem expanded to 360MPa.
- On expansion of the debris for weight percent 15% the UTS esteem expanded to 330MPa.
- On expansion of the debris for weight percent 20% the UTS esteem expanded to 310MPa.

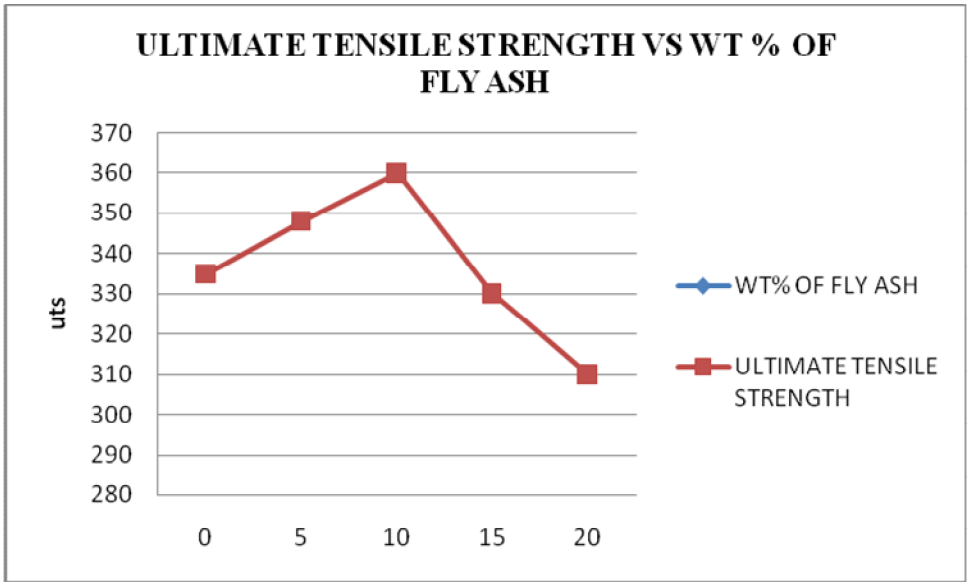


Fig 20: Graph Showing UTS Vs Wt. (%) of FA

The above recognitions clearly scatters that in light of the fact that the weight level of the nano-particles increase a complete inflexibility in like manner augmentations and it's a positive sign to be viewed.

1) YieldPoint:

The Yield point is the place the adaptable deformation stops and along these lines the plastic twisting starts. From the weight strain charts gained the going with discernments are made:

Wt. (%)	**Y.S**
0	260 MPa
5	302 MPa
10	325 MPa
15	280 MPa
20	240 MPa

Fig 4: Showing Values of Yield Points

- 260MPa is the place the yielding beginnings by virtue of the plain AA6061.
- On development of the fly flotsam and jetsam for weight percent 5% the yield quality extended to 302MPa.
- On development of the fly flotsam and jetsam for weight percent 10% the yield quality worth extended to 325MPa.
- On development of the fly flotsam and jetsam for weight percent 15% the yield quality worth extended to 280MPa.
- On extension of the fly flotsam and jetsam for weight percent 20% the yield quality worth extended to 240MPa.

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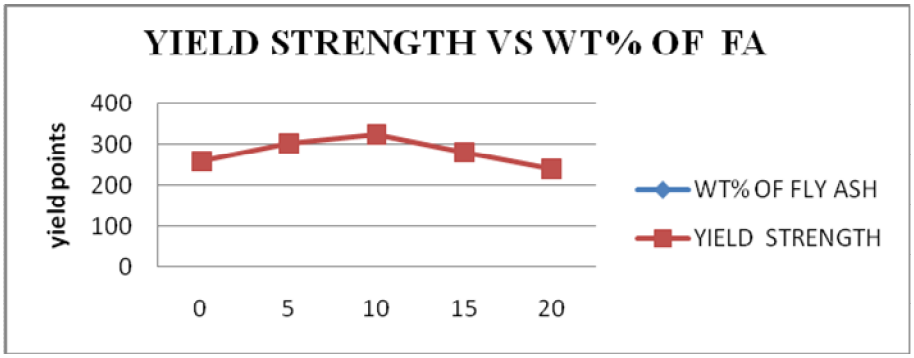


Fig 22: Graph Showing Yield Strength Vs Wt% FA

From the Fig 22 recognitions it will in general be clearly understood that the in light of the fact that the degree of the nano particles inside the composite addition the yield quality worth forms which might be a positive miracle to be viewed.

2) Ductility:

Malleability is evaluated inside the subtleties of the speed augmentation. The extending rate for the rough AL cast amalgam is intended to be 2.6%. The going with discernments is seen in light of the fact that the degree of the debris particles increase.

Wt. (%)	5(nm)
0	9.5%
5	9.0%
10	8.3%
15	8.0%
20	7.5%

Table 5: Showing Values of % Elongation

- Ductility regard on extension of the fly trash for weight percent 5% is 9.0%.
- ii. Ductility regard on extension of the fly trash for weight percent 10% is 8.3%.
- iii. Ductility regard on extension of the fly trash for weight percent 15% is 8.0%.
- iv. Ductility regard on extension of the fly trash for weight percent 20% is 7.5%.

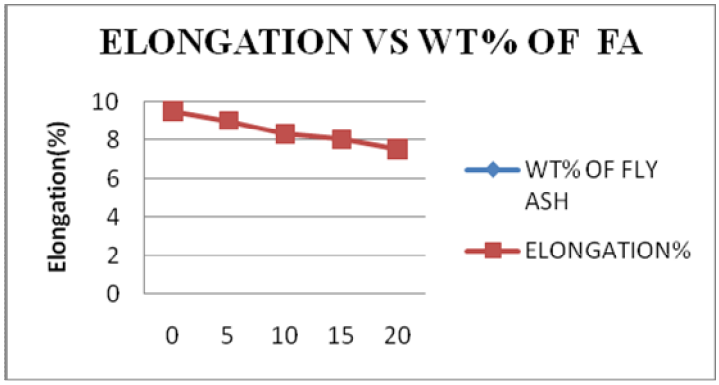


Fig 23: Graph Showing Elongation% Vs Wt% FA

The degree of augmentation followed the a little bit at a time lessened example on the development of debris content even the slightest bit the sizes and percentages.The reason can be because of the effect of Embrittlement of the composite because of the origin of limited split at the Fly Ash-AA6061 interface. the speed augmentation of the extensive number of collections of the nano composites is hardly lesser than that of the base mix.

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3) Hardness

Hardness is that the property of a texture that engages it to restrict plastic deformation, generally speaking by invasion. Be that since it might, the term hardness may similarly insinuate assurance from winding, scratching, scratched region or cutting. Hardness isn't an understudy debris material property coordinated by accurate definitions to the extent vital units of mass, length and time.

A hardness property estimation is that the delayed consequence of a described estimation strategy. Hardness of materials has perhaps since very while back been reviewed by assurance from scratching or cutting. The hardness test methods fuse

- Rockwell hardness test.
- Brinell hardness test.
- Vickers hardness test.
- Micro hardness test.

B. ROCKWELL HARDNESS TEST:



Fig 24: Brinell and Rockwell Hardness Testing machine



Fig 25: Brinell hardness tested pieces

The results Obtained are

Wt. (%)	5 (nm)
0	60 BHN
5	74 BHN
10	80 BHN

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15	70 BHN
20	56 BHN

Table 6: The Hardness Values Obtained

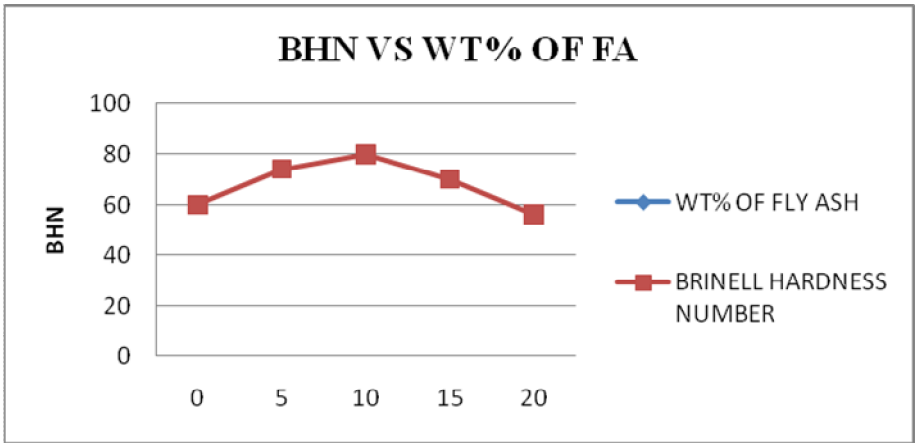


Fig 26: Graph Showing Hardness Vs Wt (%) FA

The values obtained show that as the composition and the percentage values are increased the hardness values also increased which is a good sign to be noticed.

C. *IMPACT STRENGTH:*

Both Charpy and Izod sway testing are famous strategies for deciding effect quality, or sturdiness, of a material. As such, these tests measure the aggregate sum of vitality that a material can ingest. This vitality ingestion is straightforwardly identified with the weakness of the material. Fragile materials, for example, pottery or glass, will in general have lower ingestion rates than flexible materials like copper or aluminum.

Understanding a material's vitality retention properties is basic, as it predicts how much plastic misshapening the material will have the option to withstand before calamitous disappointment.

1) Izod Impact Testing:

The Izod sway test was named for English designer Edwin Gilbert Izod, who initially portrayed the test technique in 1903. The test contraption and example configuration are fundamentally the same as Charpy sway, with some remarkable contrasts, including the direction of the example, which is clasped into the device vertically with the indent looking toward the pendulum. The pendulum at that point impacts the example at a predefined zone over the score. A test example having a V-formed score is fixed vertically, and the example is broken by striking it from a similar side as that of the indent by the utilization of the mallet. The crack vitality is resolved from the swing-up point of the sledge and its swing-down edge. The Izod sway esteem (J/m, kJ/m2) is determined by isolating the crack vitality by the width of the example. Effect test was done at room temperature utilizing Impact analyzer to compute the durability. The example is bolstered toward one side like a cantilever shaft in the test and perusing was taken by breaking the example because of the effect of the pendulum. It tends to be noticed that the strength expanded with an expansion in the weight level of magnesium and fly-debris.This is because of appropriate scattering of magnesium and fly-debris into the grid or solid Interfacial holding between aluminum composite 2011 and magnesium and fly-debris interfaces. As appeared by the diagram the durability of test 1 is 4.2 and it increment with increment percent of fly-debris and consistent pace of magnesium spans to a most extreme estimation of 6.8 for test 3 which has greatest estimation of Fly-Ash (15%) and magnesium (4%).To expanding the fly debris content at 20% then the material sturdiness is decreased.

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Fig 27: Fixing the specimen



Fig 28: Breaking the specimen



Fig 29: Before testing specimens

Fig 30: After tested specimens

The outcomes got are

Composition of AA6061	Impact Load (Nm)
AA6061 base alloy and 4% of magnesium	6.1Nm
AA6061+5%fly ash and 4% of magnesium	5.3Nm
AA6061+10%fly ash and 4% of magnesium	7.2Nm
AA6061+15%fly ash and 4% of magnesium	8.2Nm
AA6061+20%fly ash and 4% of magnesium	5.8Nm

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Table 7: Experimental values of toughness

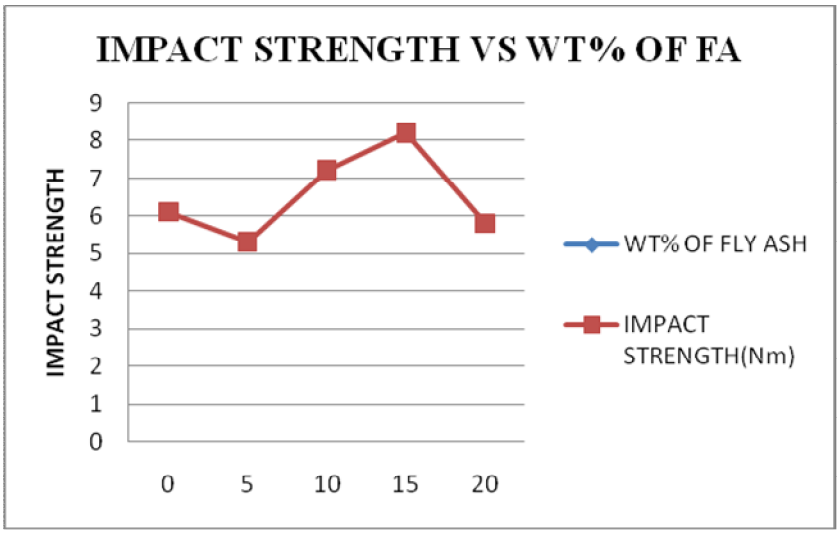


Fig 31: Variation of impact strengths with AA6061with constant Mg and Fly-Ash content.

The qualities acquired show that as the synthesis and the rate esteems are expanded the effect quality qualities likewise expanded which is a decent sign to be taken note.

VI. CONCLUSIONS

The conclusions drawn from the present investigation are as per the following:

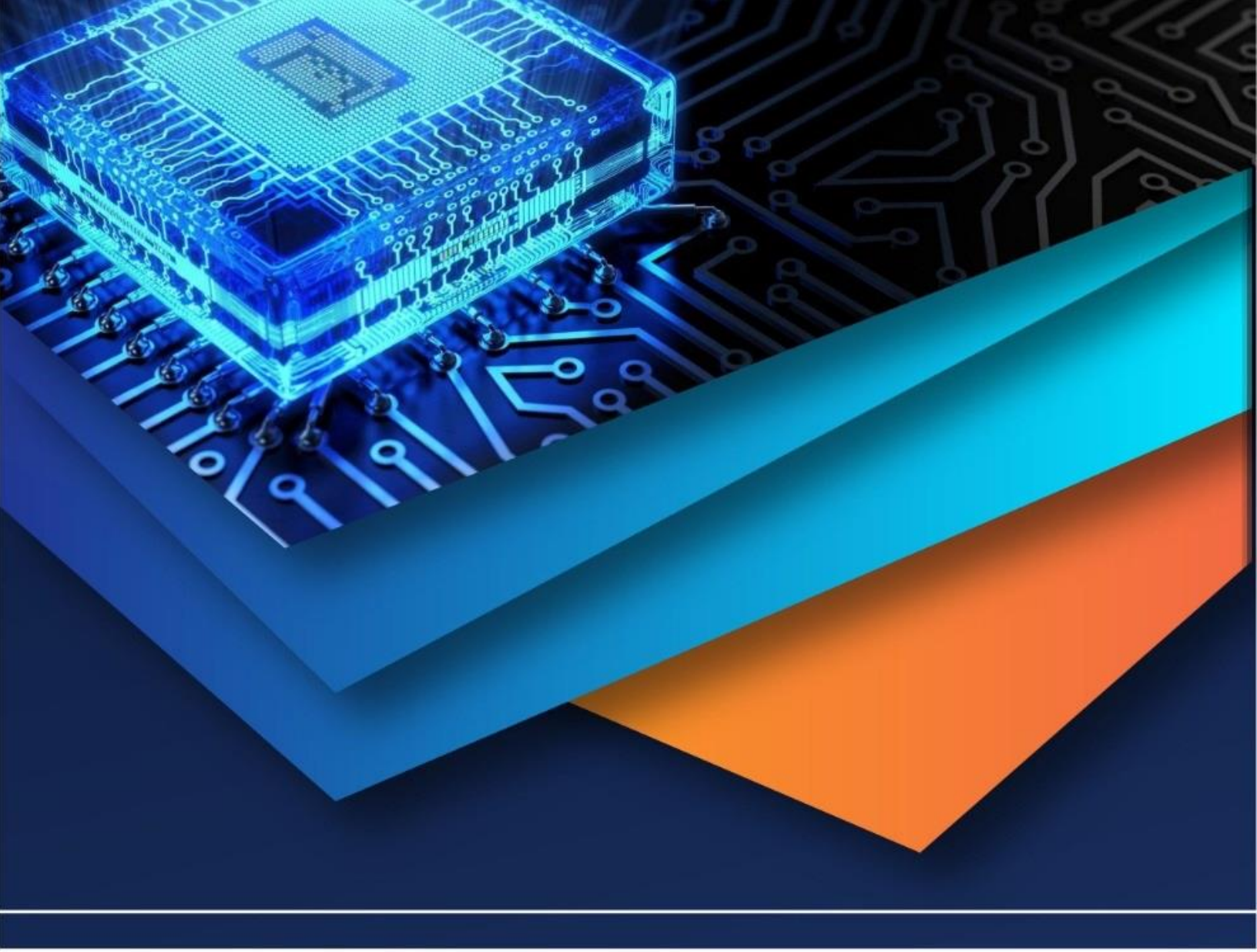
1) The result affirmed that mix framed AA6061 with Magnesium/Fly-Ash strengthened composites is plainly better than base AA6061 in the correlation of elasticity, hardness and effect quality.
2) It is discovered that prolongation will in general decline with expanding particles wt% which affirms that 4% magnesium and variety of Fly-Ash expansion builds weakness.
3) It appeares from this investigation that UTS and Yield Strength tend beginnings to increments with increment in weight level of magnesium and variety of fly debris.
4) Impact quality is expanded when 15% fly debris was included and same way sway quality is diminishes when fly debris is expanded by over 15%.
5) Hardness of aluminum (AA6061) is expanded from 60BHN to 80BHN with expansion of fly debris and magnesium.
6) It can be seen from the SEM pictures and EDS examination that the particles are all around dispersed in the base amalgam and agglomeration of the particles are extraordinarily diminished, and the dissolve pool is all around shielded from the barometrical conditions.
7) The extreme rigidity of the base amalgam is seen to be 335MPa.
8) On expansion of the fly debris for weight percent of 5% the UTS esteem expanded to 348MPa.
9) On expansion of the fly debris for weight percent of 10% the UTS esteem expanded to 360MPa.
10) On expansion of the fly debris for weight percent of 15% the UTS esteem expanded to 330MPa.
11) On expansion of the fly debris for weight percent of 20% the UTS esteem expanded to 310MPa.
12) 260MPa is where the yielding beginnings for the base combination.
13) On expansion of the fly debris for weight percent 5% the yield quality expanded to 302MPa.
14) On expansion of the fly debris for weight percent 10% the yield quality worth expanded to 325MPa.
15) On expansion of the fly debris for weight percent 15% the yield quality worth expanded to 280MPa.
16) On expansion of the fly debris for weight percent 20% the yield quality worth expanded to 240MPa.
17) Ductility esteem on expansion of the fly debris for weight percent 5% is 9.0%.
18) Ductility esteem on expansion of the fly debris for to weight percent 10% is 8.3%.
19) Ductility esteem on expansion of the fly debris for weight percent 15% is 8.0%.
20) Ductility esteem on expansion of the fly debris for weight percent 20% is 7.5%.

21) With up to 10% expansion of fly debris Mechanical properties are upgraded and with further expansion of fly ash the properties begins decreasing.

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