# A STRUCTURAL STUDY IN FINDING MECHANICAL PROPERTIES OF AL6062 REINFORCED WITH FLYASH/BRONZE/NICKEL

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**Abstract:** *This paper reviews the consequences of an experimental study of effect of particle size of fly ash particles on mechanical properties of fly ash reinforced aluminium alloy (Al6062) composites samples, processed by stir casting route reported. Fly ash is one of the most promising inexpensive and low density reinforcement available in large quantities among other reinforcement. Aluminium (Al) based metal matrix composite can be an efficient and effective compared to and matrix alloy. In the present investigation, Al6062 composites were fabricated by stir casting method by varying weight percentage of reinforcements for Sample (Al 2021 89% + Br 3% + 1% Ni + 8% flash) Chemical compositions, micro hardness, wear test and tensile test were performed to study the mechanical behaviour of all the test specimens. The surface morphology was studied using microscopic inspection to indicate the distribution of reinforcement particles and bonding between the matrixes. Composites containing hard oxides (like Br)are preferred for high wear resistance along with increased hardness and high temperature oxidation resistance. The result reveals that wear rates of the composite materials is lower than that of the matrix alloy and friction coefficient was minimum.*

***Keywords:*** *Al6062, Fly ash, Br, Ni, Mechanical properties, Metal Matrix Composites, Hardness*

## 1.0 Introduction:

Composite materials all in all are notable designing materials with the greater part of them having the remuneration of higher particular weight and particular modulus and furthermore better warm strength, exhaustion properties and wear protection contrasted with a few of the metals and combinations. It is seen that the higher cost of assembling of nonstop fiber fortified metal grid composites has prompted the utilization of molecule strengthened and bristle strengthened MMCs. In such manner, the filler material having lower thickness and cost, for example, fly fiery remains has been a solid support material for creating AMMCs. Wellbeing risks can be caused by the fly fiery remains produced from the power plant in India. It is evaluated that of the 90Mt of coal burning side-effects produced every year, just 25% is presently utilized, a lot of it is in type of extenders in concrete and in polymers; the rest of up in arrive filling or surface impoundments. It is thusly expected that the fly powder particles as support in aluminium would advance yet another utilization of this minimal effort squander side-effect. The blend throwing strategy is generally utilized among the diverse preparing procedures accessible. Blend throwing normally includes delayed fluid support contact, which can cause significant interface response. Matrix Composite (MMCs) has been assuming a noteworthy part in designing applications especially in lightweight material applications. Aluminum (Al) based metal framework composites can be a proficient and successful braking material contrasted with cast press. Al 6062 has the most elevated quality of the 6000 arrangement amalgams otherwise called an auxiliary composite has appealing properties as lightweight, wear safe, high firmness and high warm conductivity.

## 2.0 Literature review:

**Charles and Arunachalam[1**] directed examinations on property investigation and numerical displaying of machining properties of aluminium amalgam crossover (Al-compound/SiC/fly fiery debris) composites delivered by fluid metallurgy and powder metallurgy systems containing aluminium with dispreads silicon carbide included differing extents (10%, 15%, and 20% vol. %) and fly fiery remains kept up at 10 vol. %.They found that expansion of dispread particles brought about an expansion in hardness and wear protection. **Basavarajappa et al. [2]** examined mechanical properties of as cast aluminium combination composite strengthened with SiCp and graphite particles. Their outcome uncovered that as the support content expanded the mechanical properties, for example, extreme elasticity, yield quality, hardness and compressive quality of the composite expanded dominatingly however the thickness of the composite diminished. The expanded quality of aluminium 2024/SiCp-Graphite composite was credited to synergistic impact of the separation thickness produced due the distinctions in coefficient of warm extension between the constituents of the composite. **Massardier et al. [3]** explored the mechanical properties of aluminium based composite fortified with performs explained by Elf-Atochem. These performs comprised haphazardly arranged hexagonal and mono crystalline an alumina platelets. The volume part of the platelets in a perform was shifted in the vicinity of 15 and 35%.Two aluminium frameworks (either an A9 unadulterated aluminium network (99.9% Al) or a 6061 aluminium combination (1%Magnesium, 0.6% Silicon)) were utilized to get ready composites by the press throwing procedure. The impact of the variable parameters of the material on the tractable properties of composites was examined**.** **P.K. Rohatgi [4]** reports that with the expansion in volume rates of fly slag, hardness esteem increments Al– fly slag (precipitator sort) composites. He additionally reports that the ductile flexible modulus of the powder composite increments increment in volume percent (3– 10) of fly fiery remains. **J. Babu Rao [5]** thinks about that Metal grid composites (MMCs) have enhanced properties contrasted with unreinforced composites. There has been an expanding enthusiasm for composites low thickness and minimal effort fortifications. Among different dispersions utilized, fly cinder is a standout amongst the most and low thickness fortification accessible in substantial amounts as strong waste side-effect. In the present, unadulterated aluminium – 5 to 15% (by weight) fly cinder composites were made by mix throwing course. **P. Shanmughasundaram [6]** considered the Development of lightweight materials has given the car business various potential outcomes for vehicle weight lessening. Advance around there relies upon the improvement of materials, handling methods, surface and warmth medicines Aluminum lattice earthenware fortification composites have pulled in expanding consideration because of their consolidated properties, for example, high particular quality, high firmness, low warm extension coefficient and unrivalled dimensional solidness at hoisted temperatures when contrasted with the solid materials.

### 3.0 Methodology

In this work, fly ash reinforced aluminium alloy (Al6062) composites, processed by stir casting route was used. The three types of stir cast composites had a reinforcement particle sizes of follows 50-60µm are selected after the sieve analysis. The required quantities of fly ash (8%) were taken in a powder container. Then the fly ash was preheated to $400^0$C and maintained at that temperature for about 15 minutes. Weighed quantity of Al6062 was taken from the ingot and melted in a crucible at $775^0$C which is above its melting temperature ($675^0$C). Molten metal was stirred by mechanical stirrer to create a vortex and the weighed quantity of preheated fly ash particles were slowly added to the molten alloy. A small amount of Mg (0.5-0.6weight percent) was added to ensure good wet ability and to remove oxygen from fly ash particles with molten metal. After mixing, the melt will be poured into a mould for the preparation of specimens. The mechanical test will be conducted as per the ASTM standards. After mixing, the melt was poured into a prepared mould for the preparation of specimen. The composite which is from the mould was taken after cooling.

The present experimental investigation, Al alloy 6062 is used as a matrix material while SiC, basalt and fly ash are used as reinforcement material for the preparation of composite specimens. The chemical compositions of the fly ash are shown in table below.

**Table shows Chemical composition of the fly ash (wt. %)**

| Constituents | Composition (wt.%) |
|---|---|
| $Al_2O_3$ | 30.40 |
| $SiO_2$ | 58.41 |
| $Fe_2O_3$ | 8.44 |
| $TiO_2$ | 2.75 |
| Loss of ignitation | 1.43 |

**Table shows Chemical composition of Al6062**

| Aluminium | Bismuth | Chromium | Copper | Iron | Lead | Magnesium | Silicon | Titanium | Manganese | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|
| 94.7-97.8% | 0.4-0.7% | 0.04 - 0.14% | 0.15-0.40% | 0.7 % max | 0.4-0.7 % | 0.8-1.2% | 0.4 - 0.8% | 0.15% max | 0.15% | 0.25 % max |

### Hardness Test:

Hardness tests were performed on an UHL Vickers small scale hardness measuring machine in understanding to the ASTM test technique for metallic materials. For the connected heap of 500 gm and abide time of 10 seconds the miniaturized scale hardness esteems for tests were resolved.

### Tensile Test

The malleable tests are completed on an all inclusive testing machine in understanding to the ASTM test strategy E8 for metallic materials. The stacking rate is 2.0 mm/min.

### Microstructure Test

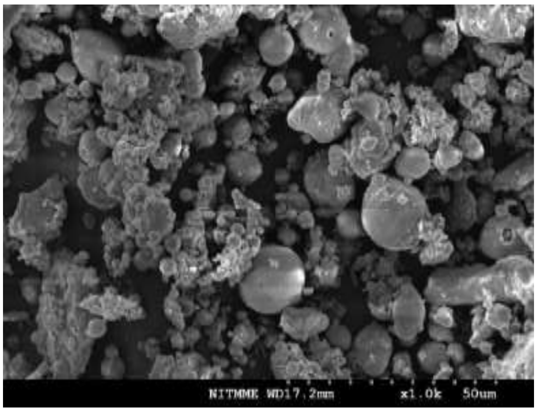
For smaller scale basic examination, tests were analyzed under optical magnifying instrument used to decide the morphology of tests and to research the appropriation of fortification and interfacial uprightness between the Al and fortifications.

### Density and Porosity tests

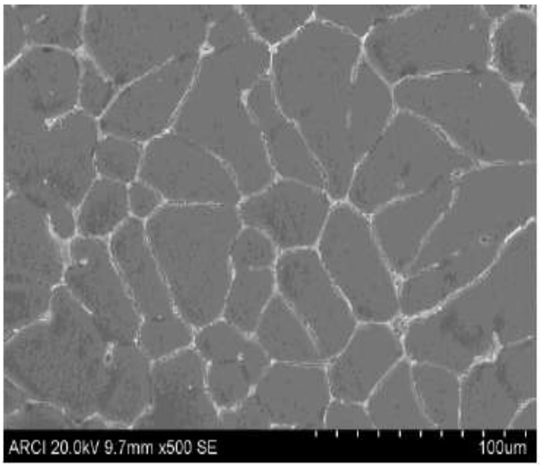
The thickness of the compound and composites was measured by the Archimedes waste strategy by utilizing the accompanying condition: ρMMC =(m)/((m-m1) X ρH2O) Where ρMMC is the thickness of the composite, „m" is the mass of the composite specimen in air, „m1" is the mass of a similar composite example in refined water and „ρH2O" is the thickness of refined water (at 293K) is 998 kg/m3. Hypothetical thickness counts, as indicated by the administer of blend were likewise used to decide the densities of the composites. This was acquired from the beneath condition. ρc = Vr ρr + (1-Vr) ρm Where ρc is the thickness of the composite, Vr is the weight proportion of support, ρr is the thickness of fortification and ρm is the thickness of the unreinforced Al6062. The porosity of the test materials were likewise figured from the accompanying condition. Porosity (%) = (1-(measured thickness/computed thickness)) X 100

### 4.0 Results and Discussion:

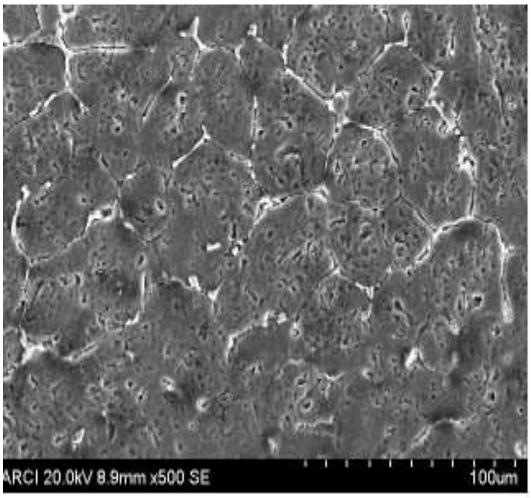
Figure demonstrates the SEM and optical micrographs of flyash particles, X-beam diffractograph and cross breed composites fluctuating with wt. rates of 8%. We can watch that, expansion of fly fiery debris, Br, Ni in the combination, i.e. by expanding the fly fiery debris and Br by weight percent the expanded rate substance can be seen obviously by utilizing the Olympus-5060-G x 4, Japan, figure demonstrates the microstructure of the combination and though the figures d, e, f demonstrates the expansion of the fly slag and Br, Ni to the composite, contrast in the microstructures was seen plainly.




SEM Micrograph of Fly ash particles at 50μm



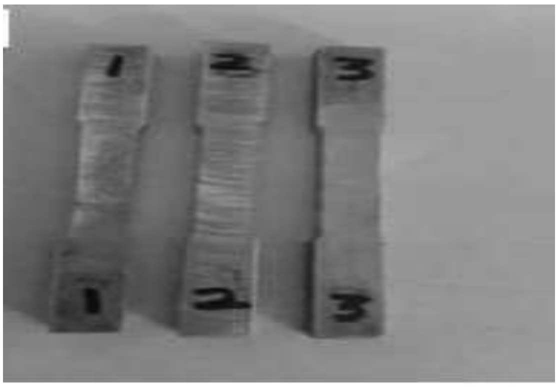

**Al6062 base** at 100X



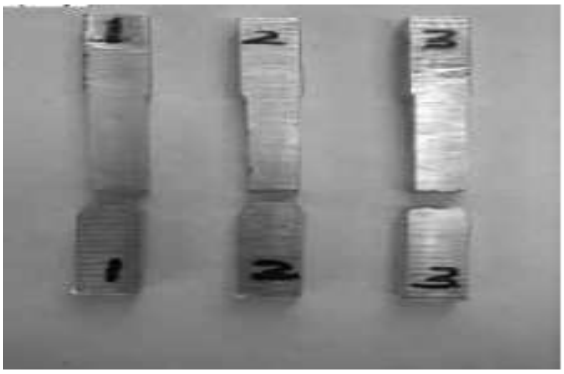

**Al6062+8% flyash+3%Br+1%Ni at 100X**

**Tensile Test**

In this study the experimental result shows that the addition of reinforcement particles improves the tensile strength of the MMCs shown in **Table**. From tensile test results, it was observed that



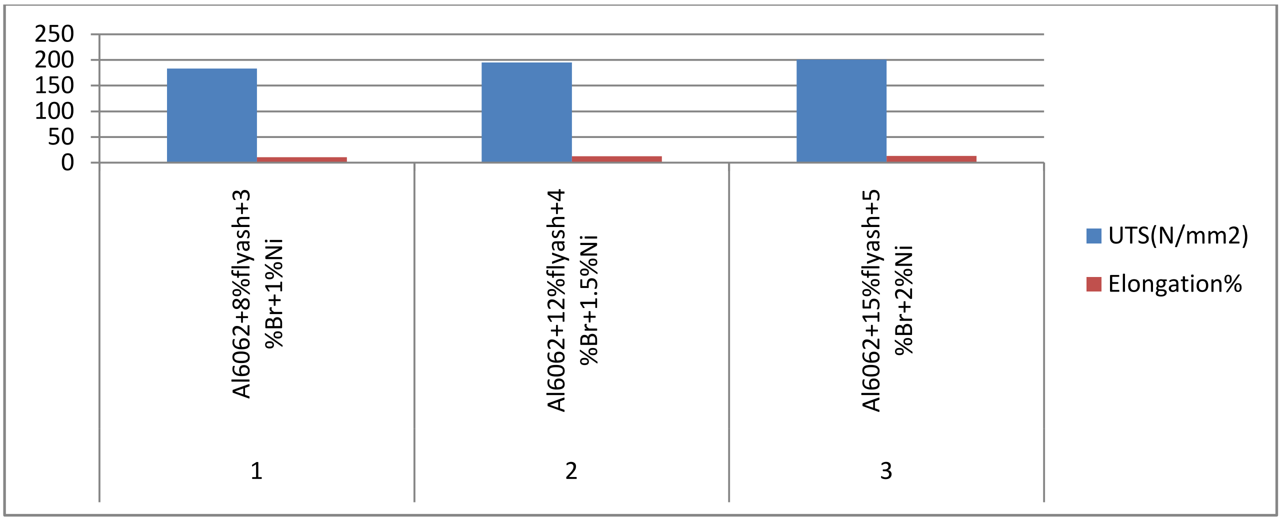
Specimens before the test



Specimens after the test

**Table shows Tensile strength of the AMMCs**

| Samples | Composition of samples | UTS(N/mm$^2$) | Elongation% |
|---|---|---|---|
| 1 | Al6062+8%flyash+3%Br+1%Ni | 183.03 | 10.82 |
| 2 | Al6062+12%flyash+4%Br+1.5%Ni | 195.23 | 12.36 |
| 3 | Al6062+15%flyash+5%Br+2%Ni | 200.63 | 13.23 |




Graph shows the percentage elongation and UTS of the given samples

## 5.0 Conclusion:

Following conclusions are made after various mechanical and micro structural analyses as follows.

1. MMCs with fly ash as reinforcement are successfully produced and tested for various mechanical and tribological properties. But the fly ash content can be increased up to 15 by weight percent.

2. The mechanical properties are found to increase with the increase in weight percent of the fly ash.

3. Ultimate Tensile Strength was increased with the increase in weight percent of fly ash. However there was decrease in strength of composites with 15 weight percent of fly ash reinforcement. With the particle size of 100 µm, there was improvement in strength by 9.8 %, 12.4 % with increase in fly ash content of 10 by weight percent. But with 15 weight of fly ash there was decrease in strength.

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