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Variation of mechanical properties of AL (6061)-FLYASH with Silicon Carbide Composite Solidification in Die Casting Process

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Abstract: **Metal matrix composites (MMCs) are amongst different classes of composites. MMCs offer a unique balance of physical and mechanical properties. Aluminum based MMCs have received increasing attention in recent decades as engineering materials with most of them possessing the advantages of high strength, hardness and wear resistance. The experimental investigation of the variation of mechanical properties of Al- fly ash composites samples processed by die casting are reported in this paper. In this case we are taken the casted components are machined to specimen dimensions and different material testing had been conducted to obtain the material properties and characteristics. We are varying mass fraction of and fly ash (5%, 10%, & 15%) and keeping 3%, 6%, 8% sic. We had got well advancements in mechanical properties like tensile, impact strength and hardness with the increase in wt % of reinforcement.**

***Keywords*- Aluminum Alloy (Al 6061), Fly ash, Mechanical properties.**

I. INTRODUCTION

Composites are just a combination of materials in such a way that the resulting materials have desired/required properties. Nowadays composite materials are widely used for many no of applications like engineering structures, aerospace, marine Application, sports and so on. Metal matrix composite, especially aluminum matrix and articulate reinforced composites are getting most applications in present days. The fly ash is extracted from power plant and among the various methods of producing MMC we had selected stir casting technique as it appears to be the best technique to introduce particles by forming vortex. Wet ability is increased by adding magnesium, magnesium removes the oxygen from the liquid surface thus diminishing the gas layer and enhancing the wetting action.

II. EXPERIMENTATION

In this work, Al6061 material is used as the matrix element, and silicon carbide and fly ash as reinforcement

Table.1 Chemical composition of Aluminum 6061

Chemical properties:- OES-ASTM E-1251-11					Test Method:	
Fe%	Si%	Mn%	Cu%	Ni%	Cr%	Ti%
0.304	0.790	0.086	0.215	<0.005	0.113	0.015
Sn%	V%	Co%	Zn%	Pb%	Mg%	#Al%
<0.003	0.007	<0.005	<0.005	0.005	0.820	97.677

- ***Silicon Carbide*:**

Silicon carbide is the only chemical compound of carbon and silicon. It is an excellent abrasive. It is having low density, high strength, high elastic modulus, high thermal conductivity, excellent thermal shock resistance. Elevated temperature Performance and the fact that they reported only a 35% loss of strength at 1350ºC are their best qualities. And its melting point is 2700 ºC.

- ***Fly Ash*:**

Fly ash is one of the most in expensive and low density reinforcement available in large quantities as solid waste by-product during combustion of coal in thermal power plants. They constitute mostly of silicon dioxide (sio2), aluminum oxide/alumina (al2o3) and iron oxide (fe2o3). Fly ash particles are mostly spherical in shape and range from less than 1µm to 100 µm. It is having high electrical resistivity, low thermal conductivity.

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In this work Al-Fa-Sic composites were produced by varying % of fly ash (5, 10 and 15 %) in Die casting process by using of stirrer.

1. Required amount of fly ash of by weight should be measured and kept aside.
2. Then the fly-ash were heated to 450-600 degree Celsius and maintained at that temperature for about 20 minutes to remove the moisture content.
3. Then weighed quantity of aluminum was melted in a crucible at 600-750 degree centigrade
4. The molten metal should be degassed at a temperature of 780 degree Celsius using solid dry hexachloroethane tablets. (<.5% weight age)
5. Then the molten metal was stirred to create a vortex and the weighed quantity of pre heated fly ash particle were slowly added to the molten metal maintained at >720 degree Celsius with continuous stirring at a speed of 400-500 rpm to a time of 6-8 minutes
6. During stirring magnesium about >2% should be added to ensure good wettability.
7. Then the melt with the reinforced particles were poured in to moulds the poring temperature should be maintained. At 680 degree Celsius.

III. MECHANICAL PROPERTIES:

3.1Tensile and yield strength:

To conduct tensile and the casted specimens are machined to standard IS 1608-2005 dimensions. And tested on universal testing machine.

3.2 Hardness:

Hardness test was carried out on the composite specimens are machined to standards IS 1500-2005 using Brinell hardness testing apparatus with 10mm diameter and load of 500kg. The loading time was 30 secs. Three readings were taken for each specimen and mean value was considered.

3.3 Impact test:

To conduct impact test and the casted specimens are machines to standards IS 1757-1988 dimensions. And tested on Charpy 'V' Notch test.

IV. RESULTS AND DISCUSSION

Al-FA-Sic composite was successfully casted using Die casting method.

Fly Ash %	Silicon %	Tensile Strength (MPa)	Yield Strength (MPa)	Hardness (HBW)	IMPACT (JOULES)
0	0	173.49	122.76	47.7	6, 4, 6
5	3	174.25	126.30	50.6	6, 6, 4
10	6	154.29	132.92	54.8	6, 6, 8
15	8	173.90	142.98	55.8	8, 8, 6

Table2: Mechanical properties of Al-Fa-SiC composite.

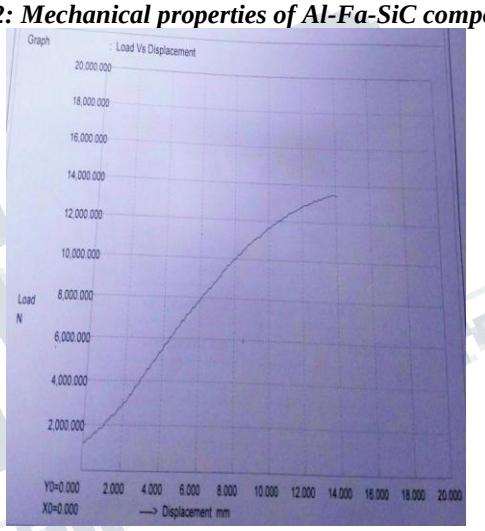

Fig 1 : Load v/s displacement graph of Tensile strength and yield strength

Fig 2: Stress v/s strain graph of Tensile strength and yield strength

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Fig 3: Tensile test specimen of pure aluminium 6061

Fig 4: tensile test specimen of Al 6061 with 3% sic and 5% fly ash

Fig 5: tensile test specimen of Al 6061 with 6% sic and 10% fly ash

Fig 6: tensile test specimen of Al 6061 with 8% sic and 15% fly ash

Fig 7: Hardness test specimens of Al 6061 with fly ash and sic all compositions

Fig 7: impact test specimens of Al 6061 with fly ash and sic all compositions

The results of tensile, yield strength, Hardness test and Impact test are as tabulated in table 2
Tensile strength and yield strength of the casted composites is comparatively higher than the un-reinforced material. Its variation is show in fig 1& 2.

Thus by observing the above figures and tables we can conclude that, with the addition of fly ash and Sic mechanical properties like tensile strength, hardness and impact strength can be increased up to some extent.

V. CONCLUSIONS:

Based on the observation and results obtained through experiments the following conclusions can be drawn.

- From the study it is concluded that we can use fly ash for the production of composites and clearing the fly ash storage issues.

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- ♣ Fly ash up-to 15% by weight can be successfully added aluminum 6061 alloy by Die casting route to produce composites.
- ♣ Hardness of aluminum (Al6061) is increased from 47 HBW to 55HDW with addition of fly ash and magnesium.
- ♣ The Ultimate tensile strength has improved with increase in fly ash content. Whereas ductility has decreased with increase in fly ash content.
- ♣ Impact strength increases with increase in reinforcement wt%.

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