

Experimental Investigation of Mechanical Properties of Al7075 Hybrid Reinforced with Mica Particulates and E-Glass Fibres

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Abstract- In this present investigation efforts are made to study the mechanical properties of as cast Mica particulates and Short E-glass fibers reinforced AA7075 Hybrid composites containing mica particulate of 200 microns and short E-Glass fibers of 2-3 mm length in different compositions. The vortex method of stir casting was employed, in which the reinforcements were introduced into the vortex created by the molten metal by means of mechanical stirrer. Castings were machined to the ASTM standards on a highly sophisticated lathe. The degree of improvement of mechanical properties of MMCs is strongly dependent on the kind of reinforcement. An improved mechanical properties occurs on reinforced compared to Unreinforced MMCs alloys.

1. INTRODUCTION

Metal is a chemical element that is a good conductor of both electricity and heat forms cat-ions and ionic bonds with non-metals. In chemistry, a metal is an element, compound, or alloy characterized by high electrical conductivity. An alloy is a mixture of two or more element in solid solution in which the major component is a metal. Most of pure metals are either too soft, brittle or chemically reactive for practical use. Combining different ratios of metal as alloys modifies the pure metals to produce desirable characteristics.

Metals are used because of desirable properties such as low weight, higher conductivity, and resistance to corrosion. Example: Aluminium, Copper, Brass, Silver, Lead.

Table 1.1: Chemical Composition of Al 7075 by Weight Percentage.

Element	Zn	Mg	Cu	Cr
% Composition	5.6	2.5	1.6	0.23

Table 1.2: Chemical Composition of E-glass fibre by Weight Percentage.

Element	Si	Al ₂ O ₃	CaO +MgO	BT ₃
% Composition	54	14	22	10

Table 1.3: Chemical Composition of mica particulate by Weight Percentage.

Element	Si	Al ₂ O ₃	K ₂ O ₃	FeO ₃	NaO ₂
% Composition	45.57	33.10	9.87	2.48	0.62

1. Objectives of present work

Mechanical properties like Tensile test, Hardness test, Corrosion test and Microstructure studies are conducted on Al 7075 reinforced with Mica and E-glass. These reinforcements provide comparatively high Strength and Hardness.

The main objective of this project is to develop Al (7075)/ E-Glass & Mica particulate metal matrix composites where the E-glass & Mica are used as reinforcement material & Al (7075) is used as matrix material. The different weight % of reinforcement will be added to matrix and liquid casting technique for the preparation of Al (7075)/ E-Glass & Mica metal matrix composites thus the developed composites will be tested for tensile strength behavior. They will be studied to ascertain the effect of E-Glass & Mica particle with Al & its %. Thus this will aid in reaching an optimum weight of % reinforcement the specific objective & scope of the present investigation are as follows.

To evaluate the composite materials as well as the base matrix Alloy Al 7075 to determine the tensile strength behavior studies on different composition.

2. EXPERIMENTAL DETAILS

Following steps are carried out in our experimental work:

1. Casting
2. Machining
3. Testing

2.1 Casting

Casting is a manufacturing process by which a liquid metal is poured into mould which contains hallow cavity of desired shape and then allowed to solidify, the solidified

part is known as casting. Here the furnace is heated upto 800°C , melting point of aluminium 7075 is 660°C but we are raising upto 800°C only the reason is to handle the temperature from furnace to pouring die and electrical resistance furnace is as shown in the fig 2.1. The vortex method of stir casting was employed, in which reinforcements were introduced into vortex created by the molten metal by mean of mechanical stirrer. When the temperature of the melt reaches 660°C molten metal is poured into a die which is in cylindrical pattern having diameter 30mm and length 300mm as shown in the fig 2.2. After that cast pieces are removed from the die, the cast pieces are shown in the fig 2.3.



Figure 2.1: Furnace



Figure 2.2: Pouring die

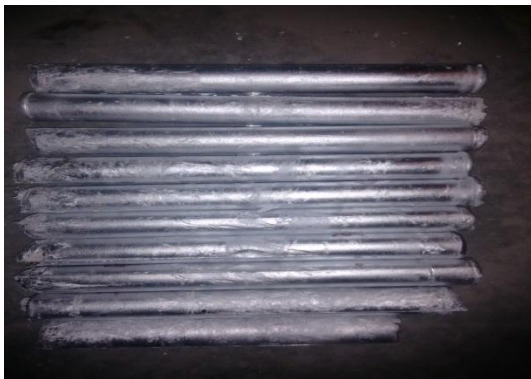


Figure 2.3: Cast pieces

2.2 Machining

After the casting, machined according to ASTM standards on highly sophisticated lathe. As per the ASTM standard E8 tensile test was conducted using a computerized universal testing machine. The tensile test uses specimens of 20 mm grip diameter, 30 mm grip length, 62.5 mm gauge length, 75 mm length of reduced cross section, inner diameter of 12.5 mm and total length 155 mm and it is shown in the figure 2.5. For the hardness test uses the specimen of 20mm diameter, 30mm length and it is shown in the figure 2.6. For the microstructure test uses the specimen of 20 mm diameter, 20 mm length.



Figure 2.5: Tensile specimen



Figure 2.6: Hardness specimen

2.3 Testing

Following tests are carried out in this process

- a) Tensile test
- b) Hardness test
- c) Corrosion
- d) Microstructure

2.1 Tensile test

The tensile test was conducted using a computerized universal testing machine as per the *ASTM E8* standard. The test uses specimens of 20 mm grip diameter, 30 mm

grip length, 62.5 mm gauge length, 75 mm length of reduced cross section, inner diameter of 12.5 mm and total length 155 mm machined from the cast specimens of various compositions mentioned earlier. Tensile test helps to calculate tensile strength, yield strength, percentage of elongation. The apparatus consists of loading unit and control unit. The tensile properties of reinforce alloy were evaluated using UTM machine as per the ASTM E8 standard at Advanced Metallurgical Laboratory, Peenya, Bangalore, India. Yield strength, Ultimate tensile strength and ductility were evaluated. An average of three results was taken as strength of each material. Tensile test specimens as shown in the figure 2.5 and 2.7 before and after the tensile tests.



Figure 2.7: after Tensile Test

3. RESULTS AND DISCUSSION

The following results are obtained in the experimental work.

Figure 3.1: UTS of hybrid composites for different compositions of reinforcements. From this graph we observe that the UTS increase as the percentage of Mica is increased, but it is also observed that with the increase in the addition of E-glass also increases UTS.

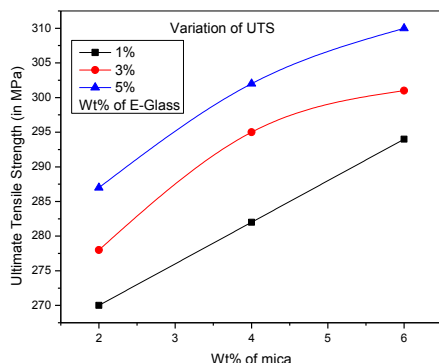


Figure 3.1: Variation of UTS in aluminium 7075 for different % of mica and E-glass

Figure 3.2: Hardness of hybrid composites for different compositions of reinforcements. From this graph we observe that the Hardness increase as the percentage of Mica is increased, but it is also observed that with the increase in the addition of E-glass also increases Hardness.

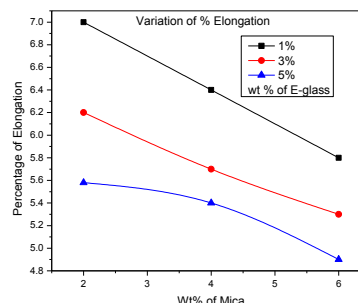


Figure 3.2: Variation of BHN in aluminium 7075 for different % of mica and E-glass

Figure 3.3: Percentage elongation of hybrid composites for different compositions of reinforcements. From this graph we observe that the % of elongation decreases as the percentage of Mica is increased, but it is also observed that with the increase in the addition of E-glass also decreases % of elongation.

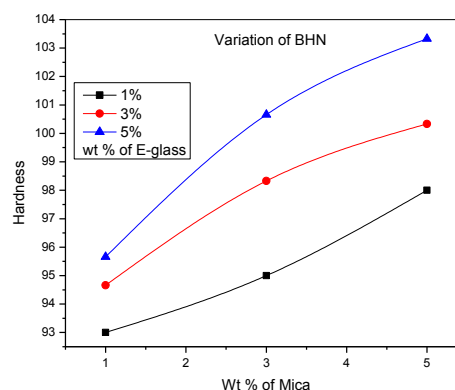


Figure 3.3: Variation of % of elongation in aluminium 7075 for different % of mica and E-glass

Figure 3.4: Yield strength of hybrid composites for different compositions of reinforcements. From this graph we observe that the yield strength increase as the percentage of Mica is increased, but it is also observed that with the increase in the addition of E-glass also increases yield strength.

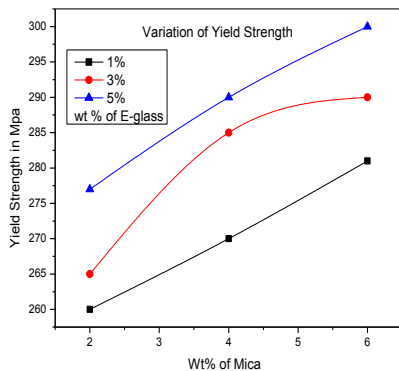


Figure 3.4: Variation of yield strength in aluminium 7075 for different % of mica and E-glass

4. CONCLUSION

After the systematic investigation the following conclusions have been drawn.

- The degree of improvement of mechanical properties of MMCs is strongly dependent on the kind of reinforcement as well as its volume fractions.
- As the addition of mica and E-glass reinforcement increases the UTS of aluminium 7075 alloy.
- As the addition of mica and E-glass reinforcement in aluminium 7075 alloy, there increase hardness, due to the presence of silica content in both reinforcement.
- There is a predominant decrease of ductility (% of elongation) of aluminium 7075 alloy, due to the addition of mica and E-glass reinforcement.

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