MECHANICAL ASSESSMENT OF COMPOSITE MATERIAL (Al-6061) REINFORCED WITH MARBLE DUST

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***Abstract**: The Al-6061 metal matrix composites have light weight, wear resistance and high elastic modulus. In the current project, Stir casting method has been employed to fabricate Aluminum based metal matrix composites (MMC's). The percentage composition by weight of Graphite and Silicon carbide have been fixed with 2% and 8% respectively while weight percent of Marble Dust varies from 5% to 10%. The specimens have been tested on Universal Testing Machine, Brinell Hardness Testing Machine and Izod hammer testing machine. The change in effect in percentages by weight of Marble dust in MMC's on tensile strength, hardness and toughness has been studied. With increase in percentage by weight of marble dust the tensile strength of MMC's has been increased. It has been observed that the toughness and hardness first increases with increasing percentage by weight of marble dust and remain constant for higher composition of marble dust.*

Keywords: MMC's, Brinell hardness Testing Machine, Stir casting, Universal testing machine

1. INTRODUCTION

Composite materials have been one of the major areas of scientific and applied research for many decades; however, only in the past decade they have been viewed and applied as engineering materials. Today we have significant progress and advances in our understanding of these materials and their metallurgical behavior. The greatest advantage is in the fact that we can inherit properties of both, the metal matrix and the reinforcements, providing a material with properties which can meet specific and challenging requirements in many applications. There is a wide spectrum of the types of metal matrix composite (MMC), each with a specific property profile.

Aluminium matrix composites with alumina reinforcements give superior mechanical & physical properties. Aluminium matrix composites with alumina reinforcements give superior mechanical & physical properties. It has good mechanical properties, exhibits good weldability, and is very commonly extruded. It is one of the most common alloys of aluminium for general-purpose use. Al-6061 as the base matrix material and aluminum oxide (alumina) and silicon carbide as the reinforcement material. Alumina weight percentage is varied (2 and 4 % by weight) and the weight percentage of silicon carbide is held constant (2 % by weight).

2. FABRICATION

The specimen has been prepared by keeping the fixed percentage of SiC and graphite with changing percentage of aluminium alloy and Marble Dust. The marble dust has been varied in the proportion 5-10% by weight.The temperature of the furnace temperature has been raised to 700°C during melting of aluminium. 8% by weight of SiC and 2 percent by weight of graphite have been introduced into the molten pure aluminium alloy using stirrer.The furnace temperature has been raised to 750°C with progressive melting and the melt has been held for this temperature for 5 minutes. All the specimens would follow the ASTM standards. Specimen size for Izod test 75mm X 12mm X 10mm. Compression test specimen size is of dimension of 75mm X 50mm X 12mm.

3. RESULTS AND DISCUSSIONS

3.1 TENSILE TEST

According to ASTM standards testing specimen has been prepared, each sample have dimension of 13mm in diameter and 60mm gauge length.

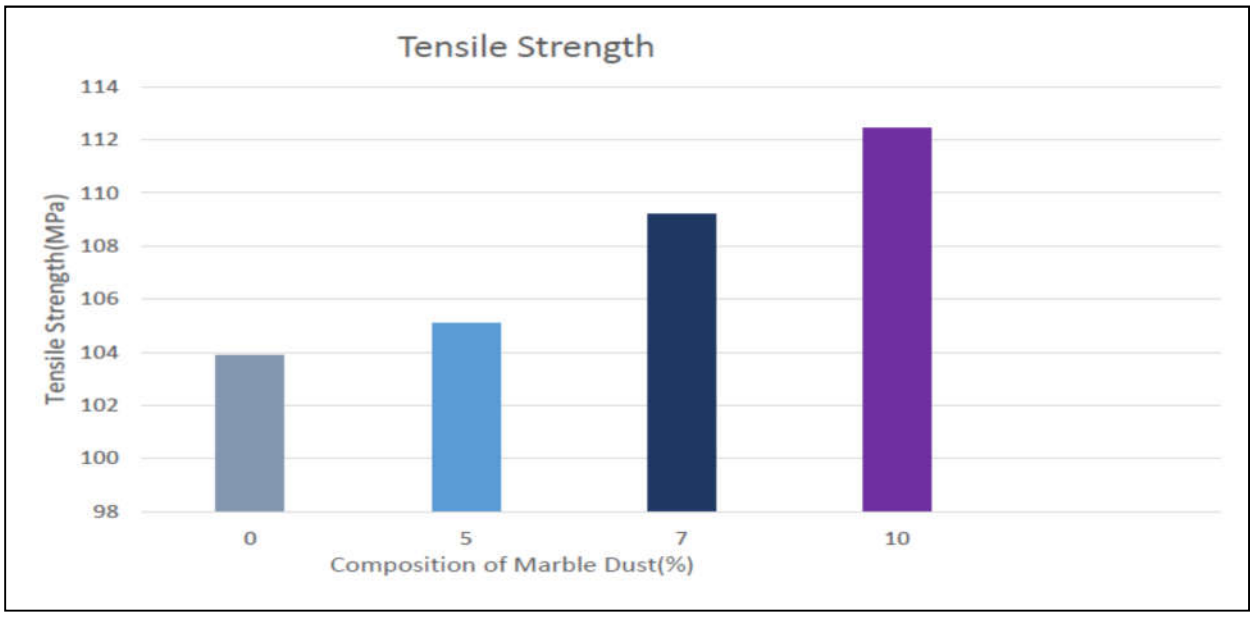

Figure 3.1 Graph showing tensile strength with Marble dust Percentage

When SiC is 8% and Graphite is 2% we got the tensile strength 103.89 MPa. After this when we keep the percentage of SiC and Graphite constant and add composition of marble dust of about 5% to 10%. We got the different value which is 105.11 MPa at 5% , similarly at 7% and 10 % of marble dust we get 109.19 MPa &112.45 MPa values of tensile strength.

It has been observed that with an increase in the percentage weight of marble dust tensile strength increased in value. The ultimate tensile strength of a composite is affected not only by the particle and matrix fraction but also by the particle and matrix fraction but also the micro geometry of the composite components.

3.2 HARDNESS TEST

The sample hardness has been calculated using Brinell micro hardness machine with application of a load of 500Kgf and this load has been applied for 10 seconds. Diameter of the Indenter has taken 10 mm. As for the load application during the BHN testing, it has taken to be 500 kgf for the softer material. Load application can be higher for the harder material like steel, Carbides etc. Load for 10mm indenter diameter vary from 500 kgf to 3000 kgf, according to the materials.

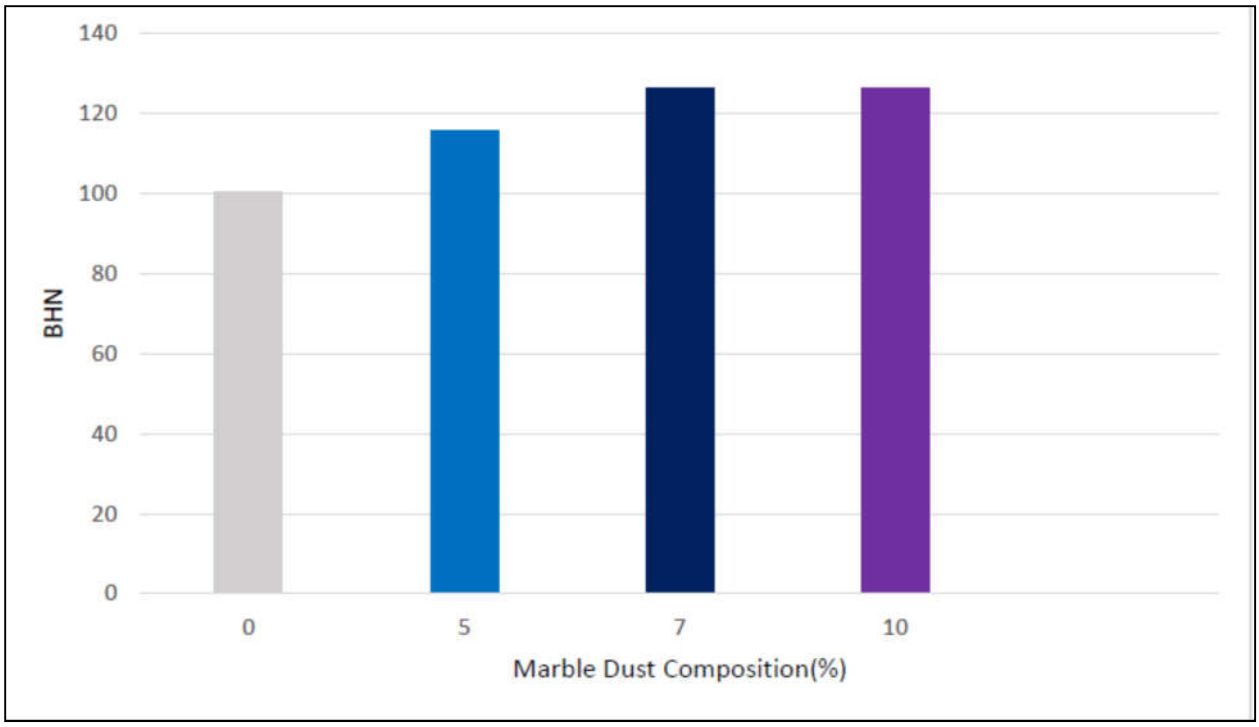

Figure 3.2 Graph showing Hardness with Marble Dust Compositions

Below bar diagram shows the different values of Brinell hardness number with the consistently variation of marble dust during casting. When SiC is 8% and Graphite is 2% we got the BHN 100.29. After this when we keep the percentage of SiC and Graphite constant and add composition of marble dust of about 5% to 10%. We got the different value which is 115.7098 at 5% , but at 7% and 10 % of marble dust we get same value of BHN which is equal to 126.47.

3.3 TOUGHNESS TEST

The toughness of materials has been determined with ASTM standard of Izod impact testing.

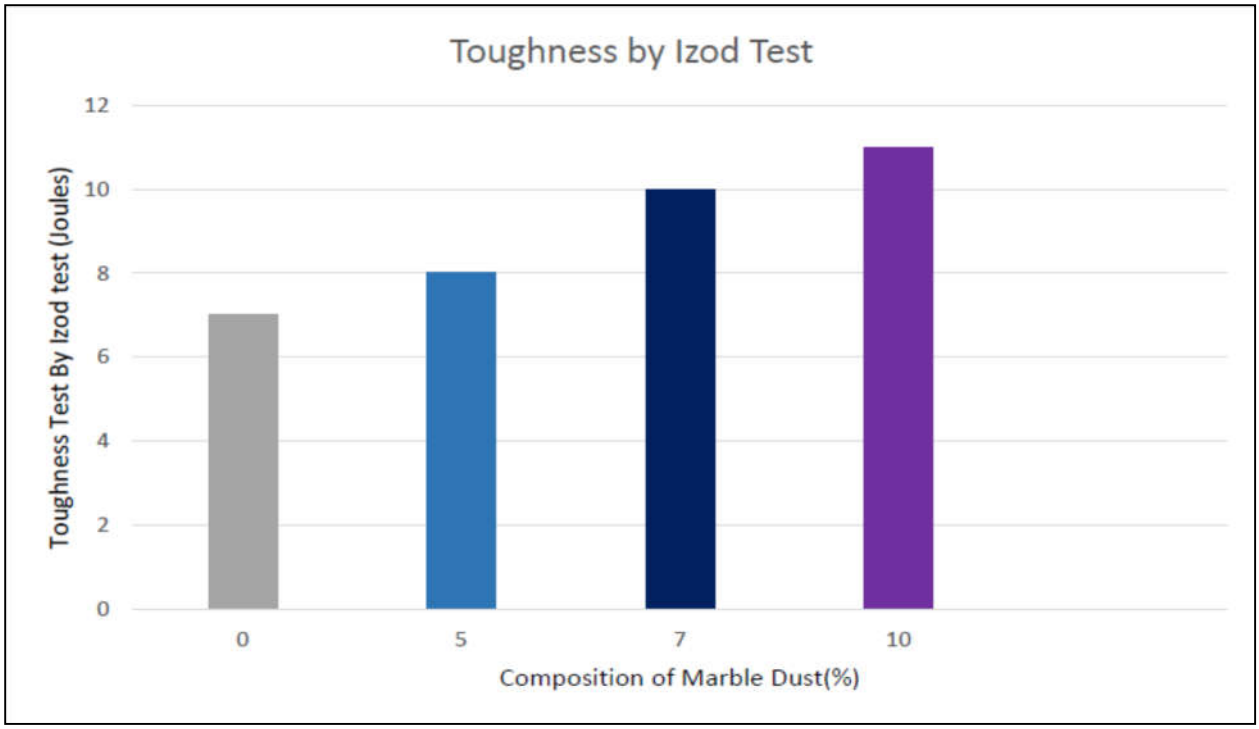

Figure 3.3 Graph showing Toughness with Marble Dust Compositions

Below bar diagram shows the different values of impact strength with the consistently variation of marble dust during casting. When SiC is 8% and Graphite is 2% we got the impact strength 7 J. After this when we keep the percentage of SiC and Graphite constant and add composition of marble dust of about 5% to 10%. We got the different value which is 8 J at 5%, similarly at 7% and 10 % of marble dust we get 10 J & 11 J values of impact strength. Impact strength increases with increasing marble dust content.

3.4 COMPRESSION TEST

Compression tests are run in much the same manner as the tension test on the specimen having brick of dimension of 75mm X 50mm X 12mm.

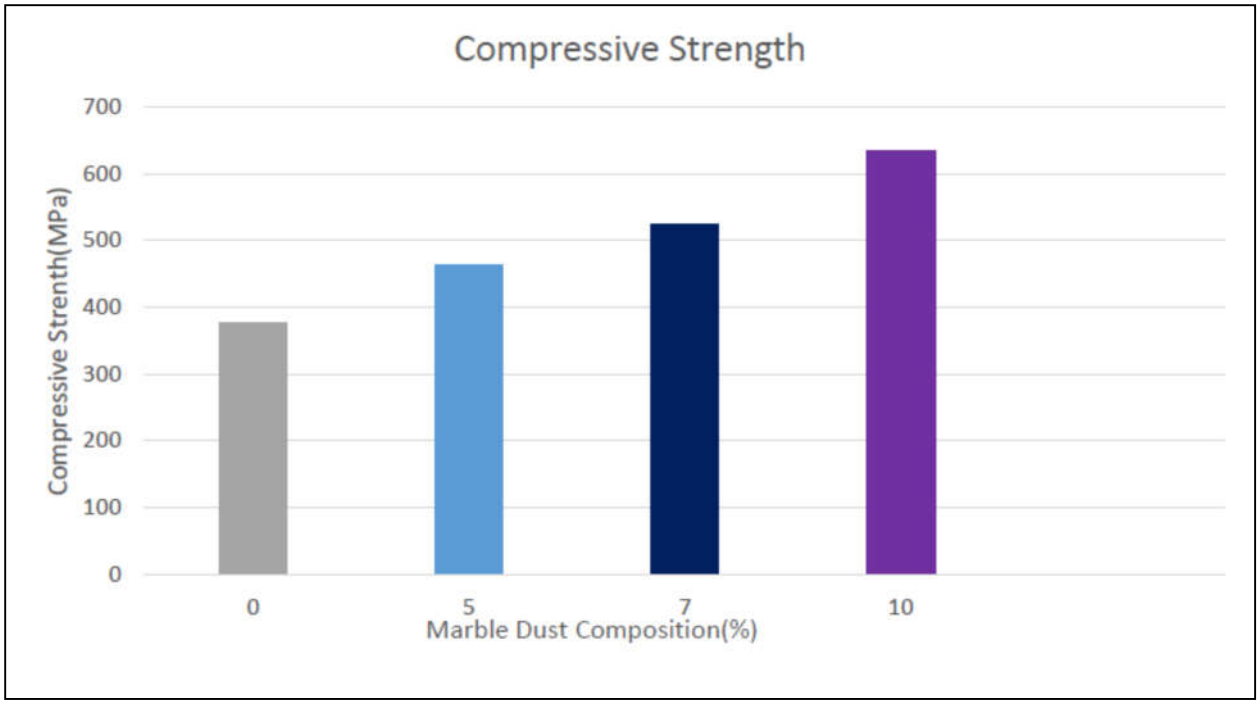

Figure 3.4 Variation of Compressive Strength with Marble Dust

When SiC is 8% and Graphite is 2% we got the compressive strength 375.76 MPa. After this when we keep the percentage of SiC and Graphite constant and add composition of marble dust of about 5% to 10%. We got the different value which is 463.26 MPa at 5%, similarly at 7% and 10 % of marble dust we get 523.26 MPa and 633.72 MPa values of compressive strength.

4. CONCLUSIONS

Tensile strength increases by the reinforcement of marble dust into the aluminum matrix. Hardness is increased with the increased in concentration of marble dust but it may decreases due to porosity occurs during casting. It also can be decrease with decrease in percent of MMCs. The value of impact strength increases with increase in percent of marble dust. The value of toughness get remain constant for higher percent composition of marble dust The Percentage elongation of the composite decreased with increase in marble dust content, which confirms that marble dust addition increases brittleness.

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39

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