An Experimental Study on Mechanical Properties of SiC and Short Basalt Fiber Reinforced Aluminium Alloy LM 25 Composite

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Abstract. The current investigation manages the conduct of aluminum LM25 sic composites and strengthened with basalt fiber. The first one of the composites consists of LM25 without adding any material. The second one of the composite has LM25 with 1% Basalt fiber and 1% SIC activated SIC powder state. Third one of the composite 2% basalt fiber and 2% SIC, fourth composite consists of 3%of basalt fiber and 3% of SIC, and all the composites are fabricated through ‘Stir Casting Method’. Mechanical properties like Tensile strength and effect qualities were tried essentially. The tried examples were inspected utilizing Scanning Electron magnifying instrument to separate support material and network material on the outside of composite. The Main Aim is to be results of the aluminium alloy LM25 metal are compared with aluminium alloy LM25, basalt fiber and sic based metal framework composites at relating estimations of test boundaries. The expansion of short basalt fiber and sic improves the yield quality and extreme elasticity of aluminium composite LM25 contrast with the unreinforced grid. A definitive rigidity, impact test, and microstructures of Al LM25, Ductility of composite increases with the addition of short basalt fiber and sic.

1. Introduction

Lately, there has been an expanding request from car, space and aviation enterprises for materials having high explicit quality, stability at high temperatures, and better wear resistance. The path toward improving the properties of conventional planning materials has provoked the methodology of strengthening polymers, earthenware, and metals with particles, fibers, and fibers, thusly inciting the making of composites. In fact, reinforcing of materials is not new but backdate to 1500 B.C. The usage of straw in making of bricks and the utilization of hair to strengthen plasters shows the use of composites in ancient civilization. However, the rapid development and use of composite materials begin in the Second World War, resulted in improvement in military vehicles and Fiber Reinforced Polymer (FRP) industries. The composite material technique is based on the idea of high-performance fiber reinforcement to strengthen the low performance matrix materials. Prior to making the Aluminum combination metal MMC material, numerous papers are concentrated in which the expansion of Silicon carbide, Basalt fiber, alumina, and Graphite and so on has been made and Tribological and mechanical properties were considered. Some of them are according to the accompanying. The two most ordinarily used metal systems region unit maintained aluminum composite and titanium mixture. All of those metals has tolerably less densities and is available in a combination of composite structures [4]. Aluminum and its compound have pulled in the principal consideration as grid material in metal framework composites. Economically, unadulterated aluminum has been utilized for its keen consumption obstruction. Aluminum amalgams, as 6061, 7075, LM6, and LM25 are utilized for their higher elasticity weight ratios. Tensile and effect properties of alumina and fly debris strengthened
aluminum compound LM25 composite with alumina 3% weight part and fly debris shifting from 5% to 15 % were contemplated [5]. Other researchers carried out experimental work on nanocomposites [6-12]. The outcomes found that by the expansion of alumina rigidity and the hardness were expanded and because of helpless wettability and fortifying high measure of fly debris diminishes elastic strength. MMCs fortified with clay materials and short strands invigorate higher tractable, pliability, sway quality and hardness up to certain extent after that flexibility of the composite have been diminishes step by step.

2. Experimental Procedure

The Experimental procedure consisting of preparation of composite specimens using stir casting technique and testing those specimens as per the ASTM standards.

![Casted cylindrical composite ingots](image1)

**Figure 1.** Casted cylindrical composite ingots

The projected composite ingots were machined with the assistance of Lathe machine according to ASTM E8/E8M:2009 standard. As appeared in figure.

![Machined tensile test specimens](image2)

**Figure 2.** Machined tensile test specimens

![Dimensions of specimen as per ASTM E8M standard](image3)

**Figure 3.** Dimensions of specimen as per ASTM E8M standard

3. Results and Discussion

| Table 1. Tensile properties of a specimen having 100% of Al LM 25 |
|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Load (KG)  | 0.0 | 2.30 | 4.60 | 6.90 | 9.20 | 11.50 | 13.80 | 16.10 | 18.40 | 20.70 | 23.00 |
| Displacement (mm) | 0.0 | 1.80 | 3.60 | 5.40 | 7.20 | 9.00 | 10.80 | 12.60 | 14.40 | 16.20 | 18.00 |
The above graph shows a load v/s displacement of a specimen having 100% aluminium alloy LM25. In the graph we can see how a specimen breaks due to apply of tensile load. Specimen break at a load of 23KN and the measured displacement is 18mm.

**Table 2.** Tensile properties of 1% basalt fiber, 1% silicon carbide and remain Al LM25

| Load (KG) | 0.0 | 2.30 | 4.60 | 6.90 | 9.20 | 11.50 | 13.80 | 16.10 | 18.40 | 20.70 | 23.00 |
|-----------|-----|------|------|------|------|-------|-------|-------|-------|-------|-------|
| Displacement (mm) | 0.0 | 1.60 | 3.20 | 4.80 | 6.40 | 8.00 | 9.60 | 11.20 | 1.80 | 14.40 | 16.00 |

The above graph shows a load v/s displacement of a specimen having 1% short basalt fiber, 1% silicon carbide, with aluminum alloy LM25. In the graph we can see how a specimen breaks due to apply of tensile load. Specimen break at a load of 23KN and the measured displacement is 16mm. comparing with without addition of basalt fiber and silicon carbide, the specimen tensile strength is less compared with addition of basalt fiber and silicon carbide.

**Table 3.** Tensile properties of 2% basalt fiber, 2% silicon carbide and remain AlLM25

| Load (KG) | 0.0 | 2.30 | 4.60 | 6.90 | 9.20 | 11.50 | 13.80 | 16.10 | 18.40 | 20.70 | 23.00 |
|-----------|-----|------|------|------|------|-------|-------|-------|-------|-------|-------|
| Displacement (mm) | 0.0 | 1.40 | 2.80 | 4.20 | 5.60 | 7.00 | 8.40 | 9.80 | 11.20 | 12.60 | 14.00 |
Figure 6. Load v/s Displacement

The above graph shows a load v/s displacement of a specimen having 2% short basalt fiber, 2% silicon carbide, with aluminium alloy LM25. In the graph we can see how a specimen breaks due to apply of tensile load. Specimen break at a load of 23KN and the measured displacement is 14mm. Comparing with without addition of basalt fiber and silicon carbide, the specimen tensile strength is less compared with addition of basalt fiber and silicon carbide.

Table 4. Tensile properties of 3% basalt fiber, 3% silicon carbide and remain AlLM25

| Load (KG) | 0.0 | 2   | 4   | 6   | 8   | 10  | 12  | 14  | 16  | 18  | 20  |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Displacement (mm) | 0.0 | 1.20| 2.40| 3.60| 4.80| 6.00| 7.20| 8.40| 9.60| 10.80| 12  |

Figure 7. Load v/s Displacement

The above graph shows a load v/s displacement of a specimen having 1% short basalt fiber, 1% silicon carbide, with aluminium alloy LM25. In the graph we can see how a specimen breaks due to apply of tensile load. Specimen break at a load of 23KN and the measured displacement is 12mm. Comparing with without addition of basalt fiber and silicon carbide, the specimen tensile strength is less compared with addition of basalt fiber and silicon carbide.

3.1 Impact test

Impact preliminary of metals gives information on dissatisfaction mode under rapid stacking condition driving sudden part where a sharp weight raiser (score) is accessible. In this investigation charpy v-score is utilized to discover the disappointment conduct of composite metal exposed to quick stacking at room temperature.

Figure 8. Impact test specimen size 10×10×55mm
Figure 9. As per dimension prepared impact test specimen

Figure 10. Broken specimens after impact testing

Table 5. Observed values of impact test

| S.I. no | Location                  | Observed values in (joules) |
|--------|---------------------------|-----------------------------|
| 1      | Transversal direction     | LM25                        |
|        |                           | LM25+1% Basalt fiber+1% SIC  |
|        |                           | LM25+2% Basalt fiber+2% SIC  |
|        |                           | LM25+3% Basalt fiber+3% SIC  |
|        |                           | 4.0                         |
|        |                           | 4.0                         |
|        |                           | 3.5                         |
|        |                           | 4.0                         |

The above table shows the observed values of impact test with 100% of LM5, and addition of 1% Basalt fiber, 1% silicon carbide with Al LM25, 2% Basalt fiber 2% silicon carbide with Al LM25, and 3% Basalt fiber 3% silicon carbide with LM5. We can see in above table with the addition of 2% Basalt fiber and 2% silicon carbide the energy required to failure of specimen is less compared to 100% Al LM25.

3.2 Microstructure Testing

Microstructure with 100% of Al LM25

Figure 11. Microstructure specimens 1, 2, 3, and 4

Figure shows the microstructure of 100% LM25, it consist of dendrite structure, the average grain size is 6.0.

Microstructure of 1% Basalt fiber, 1% Silicon carbide with Al LM25

Figure 12. Microstructure specimen 1, 2, 3, and 4

From the microstructure study it’s clear from the figures shown in 1,2,3,4 that. The dispersed material along the boundary shows basalt fiber melts, there is a good bonding between sic and LM 25 Al alloy and there will be no voids observed in the bonding area. The average grain size is 5.0.

Microstructure of 2% Basalt fiber, 2% Silicon carbide with Al LM25

Figure 13. Microstructure specimen 1, 2, 3, and 4
From the microstructure study it’s clear from the figures shown in 1, 2, 3, 4 that. The dispersed material along the boundary shows basalt fiber melts, there is a good bonding between SiC and LM 25 Al alloy and there will be no voids observed in the bonding area. The average grain size is 4.5.

**Microstructure of 2% Basalt fiber, 2% Silicon carbide with AlLM25**

![Microstructure specimen 1, 2, 3, and 4](image)

Figure 14. Microstructure specimen 1, 2, 3, and 4

From the microstructure study it’s clear from the figures shown in 1, 2, 3, 4 that. The dispersed material along the boundary shows basalt fiber melts, there is a good bonding between SiC and LM 25 Al alloy and there will be no voids observed in the bonding area. The average grain size is 4.5.

### 4. Conclusion

Taking into account the assessment done on mechanical properties of short Basalt Fiber and SiC/Aluminum blend LM25 composite, the going with finishes can be made. Aluminum amalgam LM25 and their composites have viably made through blend projecting in with uniform dissipating of Basalt fiber and sic. The expansion of short basalt fiber and sic improves the yield quality and extreme elasticity of aluminum amalgam LM25 contrast with the unreinforced lattice. A definitive rigidity, sway test, hardness test, microstructures of Al LM25, Basalt fiber composite when strengthen with 3 rate is expanded by extreme elasticity. Ductility of composite increments with the expansion of short basalt fiber and SiC Analytical calculations were also made using various methods.

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