SYNTHESIS AND CHARACTERIZATION OF AL 1100-CU ALLOY REINFORCED WITH AL 203 PARTICULATE METAL MATRIX COMPOSITES

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Abstract:- *Aluminium1100-Cu Alloy-Reinforced with Al2O3 particulate composites possess a unique combination of high specific strength, high wear resistance. Aluminium metal matrix composites (MMCs) have attracted considerable interest in various industries due to their inherent good mechanical properties and low cost. Aluminium MMCs are preferred to other conventional materials in the fields of aerospace, automotive and marine applications owing to their improved properties like high strength to weight ratio. The composites are prepared using the liquid metallurgy technique (stir casting technique), in which Al2O3 particulates were dispersed in the base matrix in steps of 3 into the Al-Cu Alloys.*

The amount of reinforcement is varied from 0 to 4 wt %. The prepared composites are subjected to the mechanical testing as per the ASTM standards. The Mechanical properties like tensile strength, hardness (Vickers Hardness) and wear test etc are tested in laboratory and results are tabulated. The tabulated experimental results of Al1100-Cu- Al2O3 composites are evaluated. The microstructure details of the test specimen are studied under an optical and electron microscope. The microstructures of the composites were studied to know the dispersion of particles in matrix.

Key Words: **Aluminium1100-Cu, Vickers Hardness, Al1100-Cu-Al2O3.**

1. INTRODUCTION

Down the ages, the cultural progress of man has been closely linked with the development of materials. Of the two varieties of materials-metallic and non metallic-the former has played a more decisive role. This aspect of advancement is particularly striking, since the several ages in ancient times which covered the cultural development of man were denoted by the metal which had a wide use then such as Bronze Age, Iron Age and so on. With the growth of the civilization, man discovered and developed more metals for this use, to solve technical and scientific problems.

The special position which metals occupy amongst materials is primarily due to the fact that their mechanical, electrical and magnetic properties can be widely varied by alloying ,heat treatment and deformation ,to adopt themselves to specific requirements[1] .The prerequisite for developing new materials and special methods of treating them needs a thorough knowledge of the chemical and physical properties of the existing pure metals and alloys.

1.1 MATERIALS AND METHODS

- **Stir casting-** Stir-casting techniques are currently the simplest and most commercial method of production of MMCs and it is relatively inexpensive and offers a wide selection of materials and processing conditions.
- **Casting process** -- Collect the raw materials (Al-1100& Alumina) and make the initial preparation by cutting Al-1100 in small pieces (250 g). Weigh the alumina for different composition.
- Pre heating of Al-1100, stirrer, furnace and alumina of about 2000 c. Next heat Al-1100 in the graphite crucible at about 7800c and allow it to become completely liquid. After it becomes completely liquid add the degassing tablet (S2Cl6) (Solid hexa chloro ethane) of about 2grms, remove the slag at this stage.
- Stirring is initiated to homogenize the temperature and then adding the alumina reinforcement in steps into the molten Al-1100 alloy. Stirring is done properly and if any slag is present is removed at this stage.
- Add the cover flux and stop the stirring at this stage. Pour the molten metal into the sand mould. Pour the molten metal into the sand mould which is prepared before the casting.
- After pouring the molten metal into the die, withdraw the composite from the die and the machining the composite according to the requirement and then different testing are carried out.

2. TEST RESULTS

2.1 TENSILE TEST

Tensile test was carried out on the UTM in accordance with ASTM E8-96a.

Table 1- Tensile test result

Sl No.	Material With Al2O3	Tensile Strength (N/mm2)	Elongation in length %
1	Al110 0%	143.6	15
2	Al1100 2%	169.2	12
3	Al1100 4%	178.5	10.8

It can be observed from the above tensile test results that the tensile strength has increased with increase in the percentage of Al2O3. This indicates that the specimen with higher percentage of the reinforcement can withstand a larger amount of load before fracture. The percentage elongation of the specimen decreases with increase in the percentage of Al2O3. This is a good attribute because it indicates that the dimensional stability is high for the specimen with higher percentage of the reinforcement.

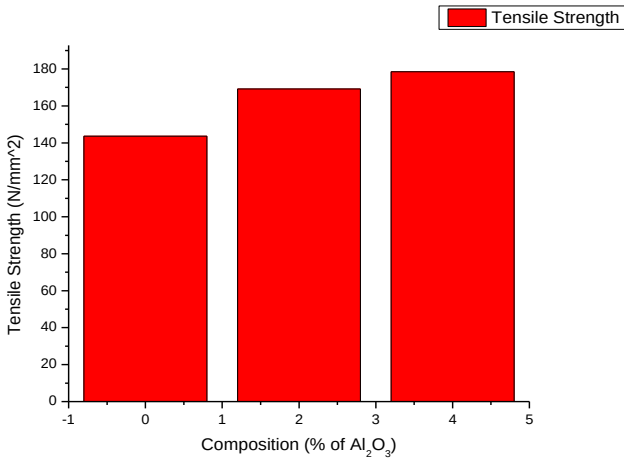

Chart- 1 Tensile strength variation graph

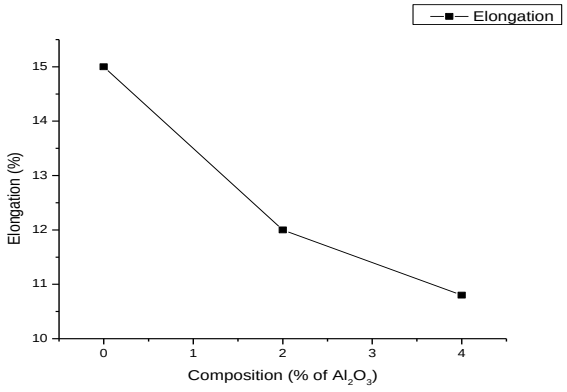

Chart -2 Percentage elongation v/s compositions

2.2 Vickers Hardness Test

Vickers Hardness Test results are tabulated below.

Table 2 - Tabular list for Vicker hardness test

Sl No.	MATERIAL	VHV
1	Al1100 with 0% of Al2O3	85
2	Al1100 with 2% of Al2O3	100
3	Al1100 with 4% of Al2O3	125

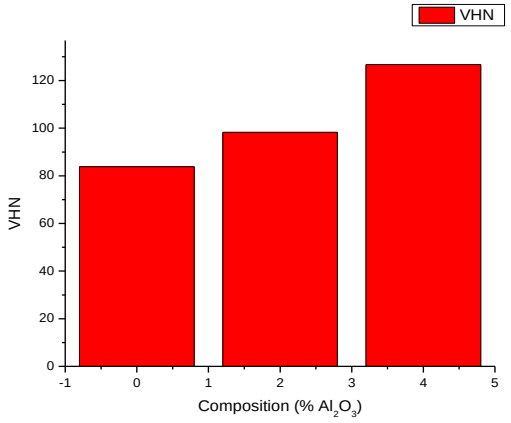

Chart 3- VHN Variations with different compositions

2.3 WEAR TEST

Wear test results are tabulated below

Sl No.	MATERIAL	FOR 2KG LOAD	FOR 3KG LOAD
1	Al1100with 0% of Al2O3	2 µm	3 µm
2	Al1100with 2% of Al2O3	1.5 µm	2 µm
3	Al1100with 4% of Al2O3	0.8 µm	1.5 µm

Table 3 – Tabular list for wear test values

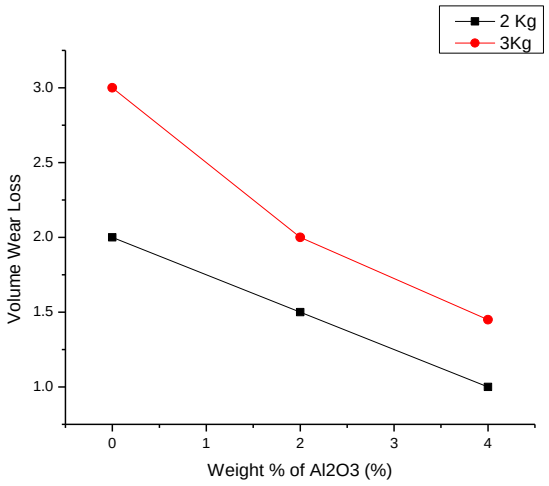

Chart 4 - Comparison of wear with different loads

3. CONCLUSIONS

The results of the present investigation may be summarized as follows:

1. The composite Al1100/Al2O3 was successfully produced by liquid metallurgy route.

2. The manufactured Al1100-Al2O3 composites exhibited higher values of tensile Strength than the base alloy Al1100.

3. It was revealed that the hardness of composite samples increased with increasing the weight percentage of Al2O3 particles

4. The ductility of the composite was found to be slightly lower than that of the Aluminium1100alloy.

5. It was also established that the wear resistance increased with increasing percentage of Al2O3 in the composite.

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