MECHANICAL PROPERTIES EVALUATION OF ALUMINIUM 6061-T6 MIXED WITH SILICON NITRATE ADDITION AT DIFFERENT PERCENTAGES

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Abstract:

The aluminium based composite are increasingly being used in the transport, aerospace, marine, automobile and mineral processing industries, owing to their improved strength, stiffness and wear resistance properties. In this composition it is aimed to present the experimental termination of the bailiwick conducted regarding hardness, tensile strength and wear resistance properties of Al6061-T6 mixed Si3N4 composites with different percentages. The scanning electron microstructure images reveal the presence of Si3N4 particle in the aluminium ground substance. The distribution of Si3N4 particles has also been recognized with X-ray diffraction proficiency. The mechanical prop such as ultimate tensile military capability and hardness have improved at the cost of reduction in ductility with increase in weight percentage of atomic number 14 nitride particulates in the aluminium metal matrix. The density and porosity of the composite plant also show an increasing trend with increase in mass fraction of Si3N4 particles in the aluminium matrix. The present research study focuses on the product of aluminium (AA6061-T6) matrix composites reinforced with various weight percentage of atomic number 14 nitride particles, the microstructures and mechanical attribute of the fabricated aluminium matrix composites are investigated.

1.0 INTRODUCTION

In recent years, aluminium intercellular substance complex (AMCs) acquired a dominating area in aerospace, car and aircraft sector due to better tribological public presentation , mechanical properties and light weight. Applications of AMCs are found mostly in cylinder liner, brake drum, connecting rod, cylinder block etc. where sliding wear plays a major character . So, AMCs are amended as per the applications programme to shuffling composite consisting numerous benefits viz. higher clothing resistor , higher long suit -to-weight ratio, first coefficient of friction and high corrosion resistance In addition of all these, AMCs present lower fabrication cost as compared to titanium, copper and zinc etc. Aluminum matrix feature may be improved by addition of particulate matter viz.: SiC, ZrO2, Al2O3, B4C, etc. A number of researchers worked on the feature investigating of AMCs, both for single and crossbreed particulate-reinforced Graphite provides lubrication effect and reduces the wear and friction during sliding. But a higher content of graphite can lead to increase in the wear rate due to a simplification in cracking intensity of AMCs Si3N4 as a reinforcement in composite increases the hardness, mechanical strength, corrosion resistance, dimensional stability, thermal conductivity and decreases the thermal expansion.

2.0 LITERATURE REVIEW

Prem Shankar Sahu [1] In present review an endeavor has been made to describe the effect of tailoring different reinforcements in aluminium alloy on vista relating to mechanical properties The successful commercial production of AMCs is finally depending on their cost effectuality for different application .

Abhishek Kumar, Shyam Lal, [2], made an attempt to study the wear rate for different stuff (Steel, Al and brass) under the effect of sliding speed, time and different loads, where the apparatus oarlock on disc has been used to study the spec of the adhesion wear.

J. Zhang et al. [3] have investigated the effect of Atomic number 14 Carbide and Black lead particulate on the resultant damping behavior of 6061 A1 metal intercellular substance composites to develop a high damping cloth . The micro structural analysis has been performed using scanning electron microscopy, optical microscopy and mental image analysis. It was shown that the damping capacity of Camellia State 6061 could be significantly improved by the addition of either Silicon Carbide or graphite particulate through spray deposition processing.

Shukla M, Dhakad [4] mechanical and tribological behavior of aluminium matrix composites when reinforced with silicon nitride particles (Si3N4). Potential area of applications has also been suggested on the basis of literature data.

Bodunrin MO, Alaneme [5] this review will comprehensively cover physical, mechanical, microstructural and tribological properties of AA/Si3N4 composites and also lights on its future perspectives.

3.0 MATERIALS AND METHODS

Al 6061-T6 alloy is used as matrix, because of its ease availability. This alloy is precipitation hardened alloy containing magnesium and silicon has main elements. It has good mechanical properties such as good joining characteristics, good workability, moderate to high strength and good acceptance of applied coatings and it can be widely used in aircraft fittings, couplings, marine fittings, hydraulic pistons etc

Experimental procedure

The proposed AMC was produced using AA6061-T6 having the chemical composition as shown in Table 2. It is also found that heat treatment and thermo mechanical treatment have the potential to remove casting defects hence these two treatments may be frequently used in practice to get the better output. Si3N4 offers excellent property combinations for example high mechanical strength, good wear and corrosion resistance, high chemical and thermal stability at low and high temperature. From the study it is found that Si3N4 is feasible to use as reinforcement in aluminium matrix and offers good mechanical, structural and wear properties. From the literature, it is noted that the Si3N4 is suitable for high thermal and wear resistant application. The ultimate tensile strength of cast AA6061 was found to be 161.5 MPa. The micro- and macro-hardness of cast AA6061 were 49.5 VHN and 31.6 BHN,

respectively, while percentage elongation was 8.7. The reinforcing particle was Si_3N_4 with mesh size of 50 μm. Table 3 provides the details of Si_3N_4 reinforcement particles.

Constituent	Si	Fe	Cu	Mn	Mg	Cr
Content (%)	0.8	0.7	0.4	0.15	1.2	0.35

Table: Properties of Aluminium 6061

Properties	Aluminium 6061
Elastic Modulus (Gpa)	70-80
Density (g/cc)	2.7
Poisson's Ratio	0.33
Hardness	30

4.0 Results and discussions:

The mechanical properties such as ultimate tensile strength and hardness have improved at the cost of reduction in ductility with increase in weight percentage of silicon nitride particulates in the aluminium metal matrix. The density and porosity of the composites also show an increasing trend with increase in volume fraction of Si3N4 particles in the aluminium matrix. The present research work focuses on the production of aluminium (AA6061-T6) matrix composites reinforced with various weight percentage of silicon nitride particles The microstructures and mechanical properties of the fabricated aluminium matrix composites are investigated

Tensile Strength:

the tensile strength property of Al6061 -T6 and their composite containing Al6061-T6 mixed Si3N4 respectively as a function of percentage weight.

Table: Tensile strength of composite samples vs Al 6061- T6 mixed Si3N4

Sample	Max load (kN)	load at break (kN)	UTS (MPa)	Youngs modulus (MPa)
1	34.77	23.69	365.85	27781.43
2	29.91	19.04	314.71	31150.97
3	33.73	23.16	354.89	29451.32
4	22.11	13.30	232.62	32681.84

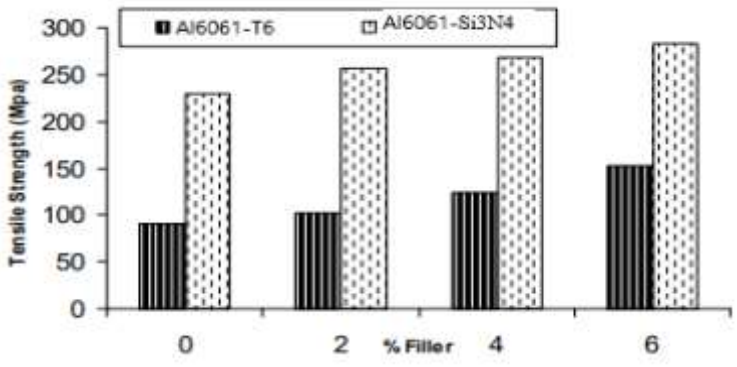

Figure: Variation in Tensile Strength with increasing %'age particulate content.

From figure it can be observed that the tensile strength of the composites is higher than that of their base matrix also it can be observed that the increase in the filler content contributes in increasing the tensile strength of the composite. Also from the figure it can be observed that the tensile strength of the Al6061& Si3N4 composites is higher than that of the composites of Al6061- T6 But the %'age increase in tensile strength of Al6061- T6 is where as for Al6061& Si3N4 is which clearly indicates the superiorness of Al6061- T6 composites and hence the greater.

Table: Flexural Strength of Composites vs Al 6061- T6 and Mixed Si3N4

Sample	Bend starting point (kN)	Point break load (kN)	Maximum deflection(mm)	Flexural strength (MPa)
1	**2.75**	**41**	**0.049**	**201.883**
2	**2.75**	**34**	**0.0893**	**167.415**
3	**3**	**37.75**	**0.076**	**185.88**
4	**2**	**23**	**0.1021**	**113.251**

The Vickers micro-hardness of cast Al6061-T6 and mixed Si3N4 base matrix and their composites containing 2-6 wt. %'age T6/ Si3N4 are evaluated using diamond indenter at an applied load of 100N are presented in figure. From the figure, it can be observed that the hardness of the composite is greater than that of its cast matrix alloy. The composites containing higher filler content exhibits higher hardness. Further, it can be observed that the hardness of the Al6061- Si3N4 composite are higher than that of the composite of Al6061-T6 and mixed Si3N4 possess higher hardness

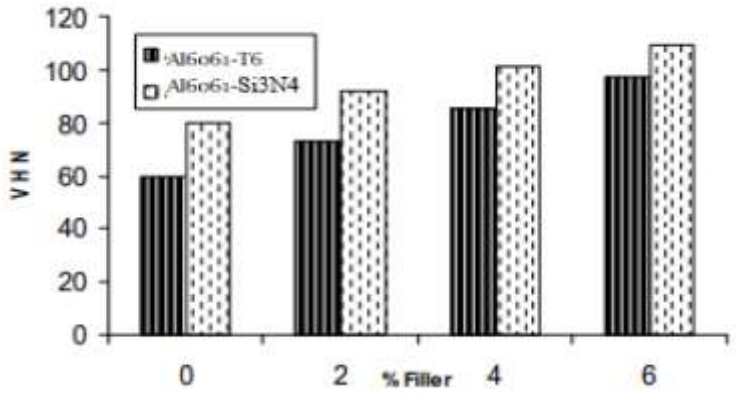

Figure: Microhardness of Al6061-T6 and mixed Si3N4 composites.

Microstructure Studies:

the presented with the microphotographs of cast Al6061-T6 and mixed Si3N4 composites respectively. From figures it can be observed that, the distributions of reinforcements in the respective matrix are fairly uniform. Further these figures reveal the homogeneity of the cast composites. The microphotograph also clearly revels the increased filler contents in the composites.

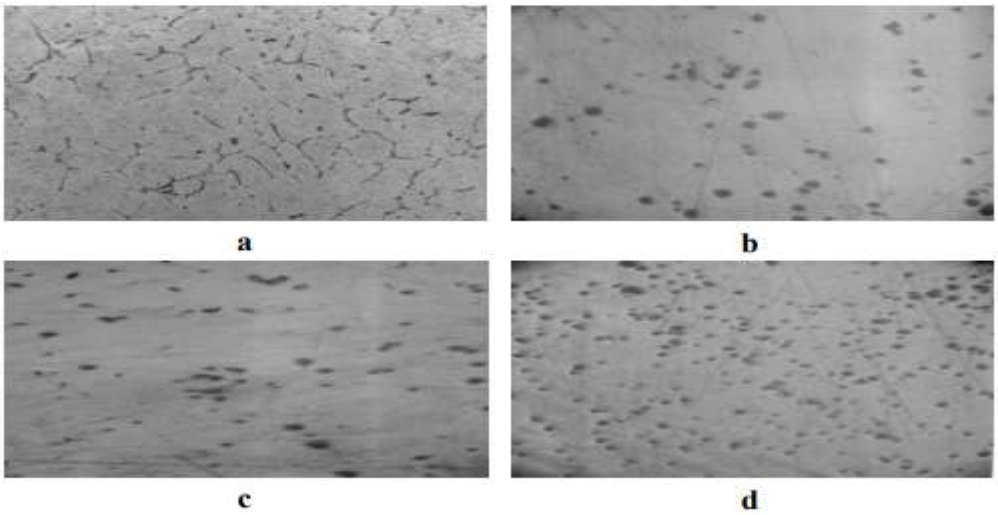

Figure: Microphotograph of Al6061 alloy and its T6 composites at 200X, a) Al6061 alloy, b) Al6061-2% T6, c) Al6061-4% T6, d) Al6061-6% T6 composites.

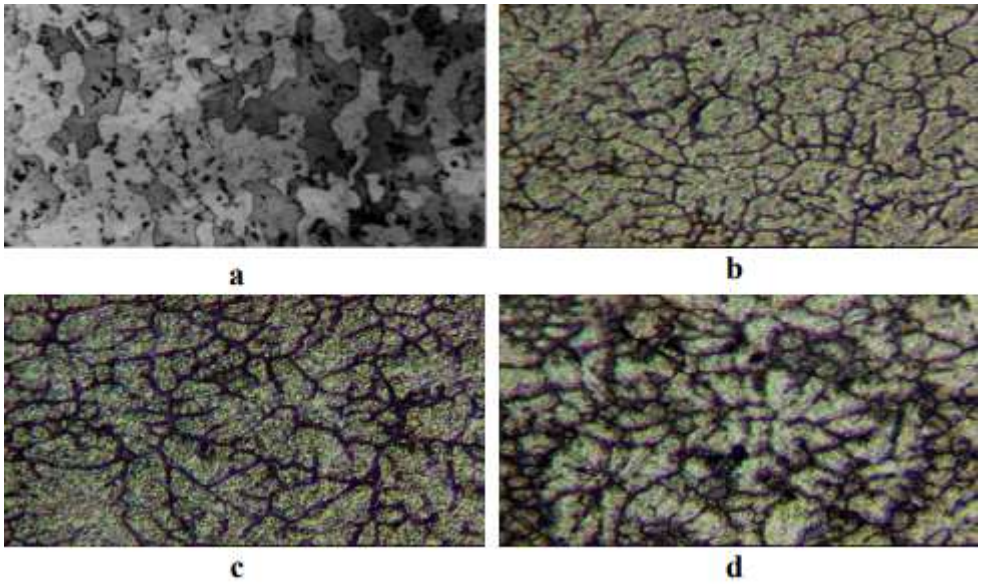

Figure: Microphotograph of Al6061 alloy and its Si3N4 composites at 200X, a) Cast Al6061 alloy, b) Al6061-2% Si3N4, c) Al6061-4% Si3N4, d) Al6061-6% Si3N4 composites.

CONCLUSION:

The significant conclusions of the studies on Al6061- T6 and Al6061& Si3N4 metal matrix composites are as follows.

- Liquid metallurgy techniques were successfully adopted in the preparation of Al6061-SiC and Al7075-Al2O3 composites containing the filler contents upto 6 wt %'age.
- The densities of the composites are found improved than their base matrix. 3. The microstructural studies revealed the uniform distribution of the particles in the matrix system.
- Microhardness of the composites found increased with increased filler content and the increase in hardness of Al6061- T6 & Al6061& Si3N4 composites are found to be 60-97VHN & 80-109VHN respectively.
- The tensile strength properties of the composites are found higher than that of base matrix and Al6061-SiC composites superior tensile strength properties then that of Al7075- Al2O3 composites.
- The wear resistance of the composites are higher, further the T6 contributed significantly in improving the wear resistance of Al6061- T6 composites.

References:

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