

Investigate the Thermomechanical Behaviour of Aluminium Metal Matrix

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ABSTRACT

Now a days aluminium alloy used in all applications like boiler, IC Engines, aircraft etc... Due to it's good mechanical behavior like high strength but it having high thermal expansion coefficient. In olden days cost iron is used for making IC engine parts due to heavy weight manufacturers shift to aluminium because aluminium have high strength, less weight and good machinability. One of the drawback is it having high thermal expansion coefficient due to that engine parts get damaged. In this investigation adding reinforcement to reduce the thermal expansion coefficient without affecting the mechanical properties. Reinforced like silicon nitride, boron carbide and graphite which good mechanical properties and low thermal expansion coefficient. Adding different percentage of reinforcement to aluminium alloy like sample 1 90% aluminium 7075 alloy + 10% silicon nitride, sample 2 85% aluminium 7075 alloy + 10% silicon nitride + 5% boron carbide sample 3 80% aluminium 7075 alloy + 10% silicon nitride + 10% boron carbide sample 4 85% aluminium 7075 alloy + 10% silicon nitride + 5% graphite sample 5 80% aluminium 7075 alloy + 10% silicon nitride + 10% graphite. Above sample investigate the mechanical properties like tensile strength hardness and impact strength, thermal property coefficient thermal expansion are studied.

KEYWORDS

Metal Matrix, Mechanical Strength, Reinforcement.

Introduction

Aluminium 7075 alloy which contain 5.8% zinc, 2.4 % magnesium 1.5 % copper & other having less than half % of silicon, manganese, chromium, iron etc... Remains aluminium. Compared to aluminium 6061, aluminium 7075 is high hardness, tensile strength due to aluminium 6061 which contain less zinc content. Aluminium 6065 has good machinability due to less hardness but now a days more advance machinability machine available. In IC Engine parts are manufacture by using aluminium silicon metal matrix composition silicon added to aluminium to increase the strength of the aluminium. In between the piston & cylinder there is a clearance gap because the aluminium is expanding during the temperature increase so by clearance gap fuel is escaped due to that Performance of the engine. Decrease and also if increase the pollution to the environment. So In this project mainly concentrated about reduces the thermal expansion. Coefficient without affecting the requirement of mechanical strength.

Stir Casting



Stir casting machine is used for preparing the metal reinforcement because matrix can distribute evenly to metal to improve the mechanical and thermal properties sample made at 700°C and stir speed is 600rpm for evenly distribute the reinforcement to aluminium 7075 alloy.

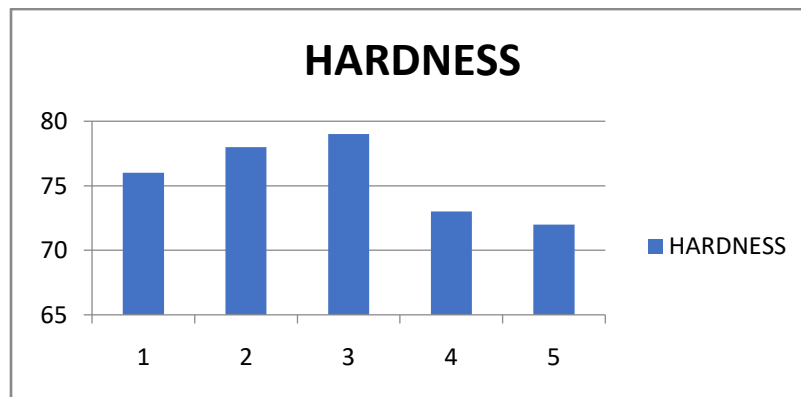
Properties

PROPERTIES	Silicon Nitride	Boron Carbide	Aluminum 7075	Graphite
Hardness	30500 MPa	44100 MPa	575 MPa	326 MPa
Tensile	525 MPa	569 MPa	572 MPa	76 MPa
Thermal conductivity	43 W/m*K	42 W/m*K	196 W/m*K	398 W/m*K
Thermal Expansion	$3.7 \cdot 10^{-6} K$	$9.4 \cdot 10^{-6} K$	$2.36 \cdot 10^{-5} K^{-1}$	$5.2 \times 10^{-6} K$
Density	3.25 Mg/m	2.55 Mg/m	2.81 g/cc	2.49 Mg/m
Compresion	5500 MPa	5687 MPa	607 MPa	345 MPa

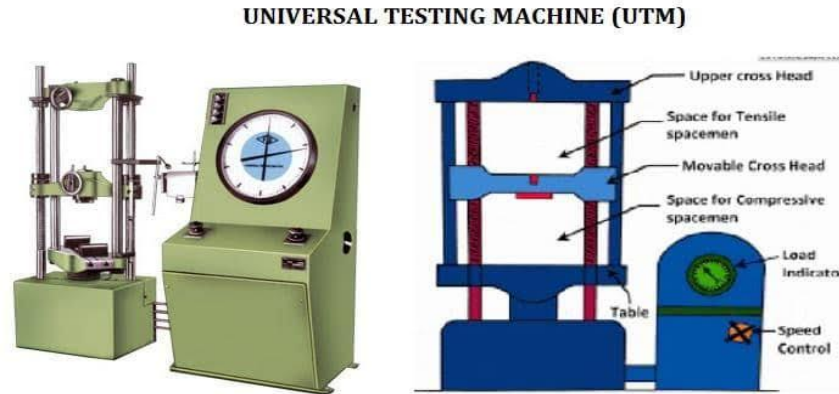
Hardness Test



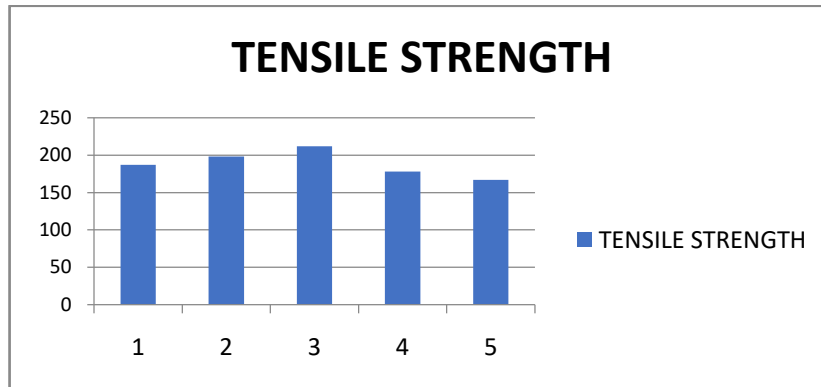
Sample 3 80% aluminium + 10% silicon nitride + 10% boron carbide having higher hardness compare to another sample because due to higher tensile strength it can the higher hardness compare to other sample.



Tensile Test



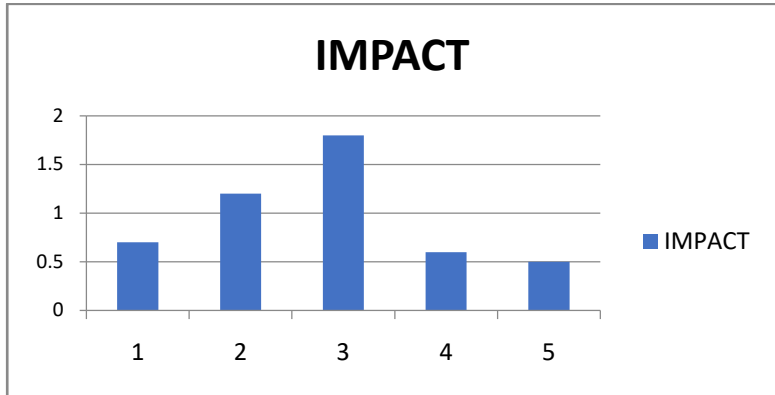
Tensile test Sample 3 80% aluminium + 10% silicon nitride + 10% boron carbide having higher tensile strength compare to another sample because boron carbide having higher tensile strength compare to other reinforcement.



Impact Test



Sample 3 80% aluminium + 10% silicon nitride + 10% boron carbide having higher impact strength compare to another sample because due to higher tensile strength it can with stand more impact compare to other sample.



Thermal Expansion



Graphite level increase in aluminium coefficient thermal expansion decrease. Graphite is also increase machineability properties but it reduces the mechanical properties.

THERMAL EXPANSION				
	L	W	L	W
100°C	50	10	53	12
100°C	50	10	52	12
100°C	50	10	51	11
100°C	50	10	51	10
100°C	50	10	50	10

Conclusion

Metal matrix composites are made used the stir casting machine at 700°C & 600rpm for evenly distribute the reinforcement to aluminium 7075 alloy. Sample 3 at 80% aluminium + 10% Silicon Nitride + 10% Boron Carbide having higher tensile strength, Impact & Hardness properties compare to other sample because Boron Carbide having good mechanical properties compare to others reinforcement. Thermal expansion coefficient of aluminium 7075 alloy reduce in all reinforcement but by adding graphite level increases thermal expansion coefficient reduce. Graphite having low mechanical properties Compare to Boron Carbide. For improving the mechanical properties by adding boron carbide \$ for improving the thermal properties by adding graphite.

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