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Analysis of Mechanical Properties of Aluminium6061-Zinc Metal Matrix Composite by Stir Casting Process

R.Ganesh.M.E/Assistant Professor.
M.Ananth,D.Madhan
Indra Ganesan college of Engineering, Trichy
arjunananth704@gmail.com

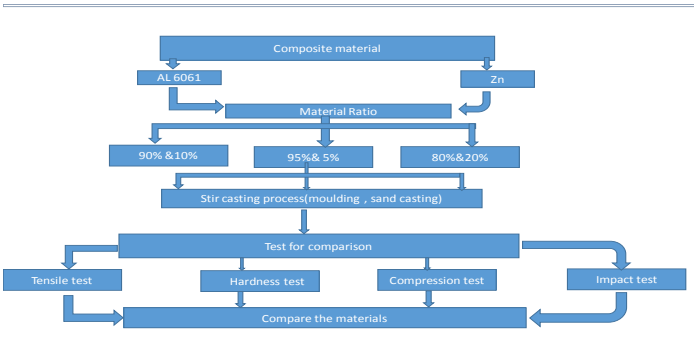
Abstract: ***Aluminium metal matrix composite have the potential to replace the conventional materials because of obtaining superior properties such as high specific strength, high stiffness, high hardness, high wear resistance and low density. The present works dealt with the mechanical behaviour of aluminium metal matrix mixed with zinc in the ratio Aluminium (6061)in(95%and5%),(90%and10%),(80%and20% wereprepared(6061)in(95%and5%),(90%and10%) by stir casting method used by sand casting and moulding.***

Keywords; compare the composite martials in mechanical properties test trail 1 and trail 2 materials

I.INTRODUCTION

Composite materials are playing vital and major role in research and development of various engineering and aeronautical sectors. In the past three decades composite materials are replaced most of the traditional materials because of obtaining superior properties such as higher specific strength, high hardness, high wear resistance, high thermal resistance and low density. Specifically aluminium metal matrix composites have preferred in aeronautics, marine and automotive industries for obtaining best result of mechanical properties. Composite materials are manufactured through solid and liquid method. In the liquid metallurgy route following methods are preferred such as stir casting method, electromagnetic stir casting method, centrifugal cast and in-situ method. The particle that is the particulate was reinforced with injection process into liquid matrix through liquid metallurgy route by die castingprocess. Die casting process is preferred because of less expensive and fit for mass production process. Among the entire liquid state production processes, stir casting is the simple and economical one (Hashim, 1999). Aluminium is one of the elements in boron group with atomic number 13. Pure aluminium has relatively soft material when comparing to the other non-ferrous materials. To overcome this issue of metal can be alloyed with other metals to obtaining superior mechanical and thermal properties. Most of the aluminium available in the market, manufacturers has been alloyed with at least one other element. The typical alloying elements are copper manganese, magnesium, tin and zinc. There are two principal classifications, namely casting alloys and wrought alloys, both of which are further sub divided into the categories heat treatable and non-heat-treatable. Composite materials are classified into based on matrix material such as if matrix material is polymer it is called as polymer matrix composite (PMC), if matrix material is metal it is called as metal matrix composite (MMC) and if the matrix material is ceramic it is called as ceramic matrix composite (CMC) (Surappa, 2003). 7000 series alloys such as 6061 are used in transport applications, like marine, automotive and aviation, due to their high strength and low density. Also used in Rock climbing equipment, bicycle components, inline skating-frames and hang glider airframes are commonly made from 6061 aluminium alloy. The problem exist in the stir casting process is the non-uniform distribution of the reinforcements. Present work is based on the mechanical behaviour of Aluminium6061 with graphene as reinforcement produced by stir casting method with different weight % of graphene were used and various tests were conducted on the composite material such as hardness test, tensile test, impact test, optical microscope and scanning electron microscope (SEM) tests were performed on the samples produced by stir casting method.

II.METHODOLGY



III.WORKING PROCESS

In this project STIR CASTING we have used sand mold casting for produce the requirement size. **Sand casting**, also known as **sand mould casting**, is a metal casting process characterized by using sand as the mould material.

A. Sand casting

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It is relatively cheap and sufficiently refractory even for steel foundry use. A suitable bonding agent (usually clay) is mixed or occurs with the sand. The mixture is moistened with water to develop strength and plasticity of the clay and to make the aggregate suitable for molding. The term "sand casting" can also refer to a casting produced via the sand casting process. Sand castings are produced in specialized factories called foundries.

There are six steps in this process:

1. Place a pattern in sand to create a mould.
2. Incorporate the pattern and sand in a gating system.
3. Remove the pattern.
4. Fill the mould cavity with molten metal.
5. Allow the metal to cool.
6. Break away the sand mould and remove the casting.

Sand casting

Mould casting

B.Oil fired furnace

Oil fired furnace is those furnace that are applied for heating various metals or alloys of metals. They are available in various sizes and are either gas fired or fuel fired. They can operate at various temperatures and are designed in such a way the minimum. Safe operation is an important aspect of this furnace because the fan and heating elements are separate from the load chamber. Due to this damage from accidental contact is eliminated. Metal lining is used in the entire work chamber which gives the furnace maximum durability.

IV.TEST FOR COMPOSITE MATRIAL

A .Tensile test

The tensile tests were carried out according to the UTES-40 standard by universal testing machine to determine the amount of tensile strength to withstand durinfracture**.**

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B.Hardness test

The hardness tests were conducted by Brinell hardness tester in accordance to the ASTM E10 standard with the ball indenter diameter10mm, load applied 500 kg and20 seconds. The test were carried out in the room temperature atmosphere in the range of 30 to 32°C and measurements of hardness were obtained from five different places on each sample then considered as average hardness value.

C.Compression test

The compression tests were carried out in according to ASTM standard by universal testing machine to determine the amount of compressive strength to withstand during fracture. Compression test conducted with the three different samples which is prepared by wire cut machine.

D.Impact test

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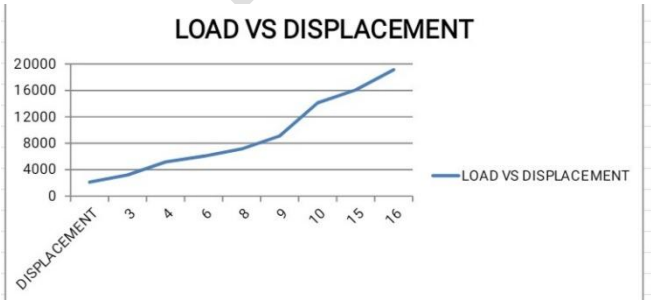
The impact test were carried out in accordance with thestandard ASTM E23-12C by Izod machine to determine the amount of energy absorbed by the specimen during fracture. Impact test conducted with three different samples, as shown in the fig.1. Required impact strength is equal to energy requ brethe specimen/area of cross section of specimen

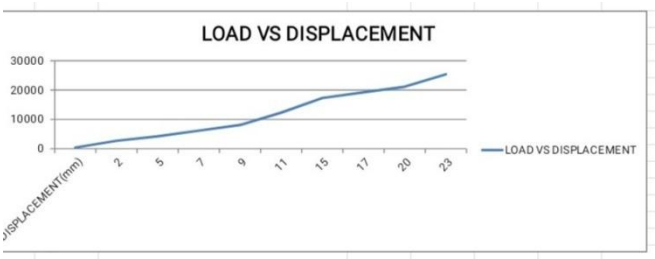
V.RESULT AND ANALYSIS

METERIAL	TEST	TRAIL	VALUE(N/mm ^2)	AVERAGE VALUE
(A) 80%(Al)-20%(Zn)	TENSILE	T1	152.766	160.378
		T2	167.99	
	COMPRESSION	T1	76.874	81.877
		T2	86.88	
	HARDNESS	T1	16	16.1
		T2	16.2	
	IMPACT	T1	8	8.55
		T2	9.1	
(B) 90%(Al)-10%(Zn)	TENSILE	T1	151.427	149.55
		T2	147.63	
	COMPRESSION	T1	80.128	81.889
		T2	83.65	
	HARDNESS	T1	91.5	69.25
		T2	47	
	IMPACT	T1	12	12.5
		T2	13	
(C) . 95%(Al)-5%(Zn)	TENSILE	T1	170.93	178.02
		T2	185.11	
	COMPRESSION	T1	77.706	80.678
		T2	83.63	
	HARDNESS	T1	33	64.85
		T2	96.7	
	IMPACT	T1	10	11
		T2	12	

Tensile graph:



Comprassion graph



VI.CONCLUSION

Composite materials especially aluminium and zinc composites having good mechanical properties compared with the conventional materials .It is used in various industrial applications these materials having light weight along with high hardness .it with stand high load compare with the existing materials are most applicable in the engineering products instead of existing materials. Finally we analyse and conclude that among the specimen **A** with **(80%(Al)-20%(Zn)),** specimen **B** with (**90%(Al)-10%(Zn))**& specimen with **Al & zinc** (**95%(Al)-5%(Zn**)), the specimen **B –(90%(Al)-10%(Zn))** having good mechanical properties (Hardness, Tensile, Compression, Impact) then the other two specimen of **A and C.**

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