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Fabrication of Hybrid Metal Matrix Composite of Magnesium with Alumina and Graphite and Study of Hardness and Microstructure

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***Abstract*---The materialistic world is what gets renovated in our day to day life. Aluminum is preferred for most works since it has lighter and non-corrosive properties in it. Also we may have to take some metals with light in weight and higher in strength then we have to select composites,. Composites can add two distinct materials special property in one. This paper deals with the compositing magnesium and alumina with graphite to form a material at various ratios and they are tested for best tensile stress. The paper will guide in a perspective manner that will help you to get the properties of the materials and fabrication and testing.**

***Keywords*---MMC (Metal Matrix Composites), tensile property, reinforcement.**

I. INTRODUCTION

Introduction to MMC

Metal composite materials have found application in many areas of daily life for quite some time. Often it is not realized that the application makes use ofmcomposite materials. These materials are produced in situ from the conventional production and processing of metals. Improvement in low temperature creep resistance (reaction less materials),

Metal matrix composites can be classified in various ways. One classification is the consideration of type and contribution of reinforcement components in particle-, layer-, fiber- and penetration composite materials. Fiber composite materials can be further classified into continuous fiber composite materials (multi- and monofilament) and short fibers or, rather, whisker composite materials.

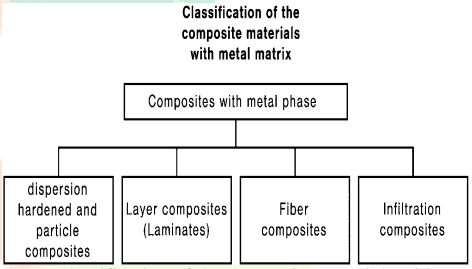

FIG 1.1: Classification of the composite materials with MMC

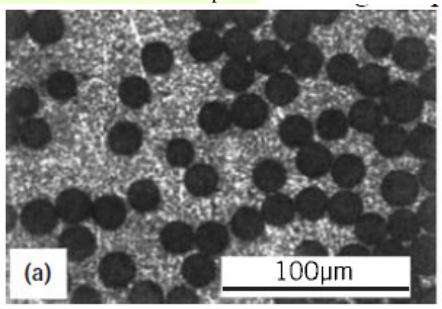

Fig 1.2 : Typical microstructures of some metal-matrix composites: (a) continuous alumina fiber/Mg

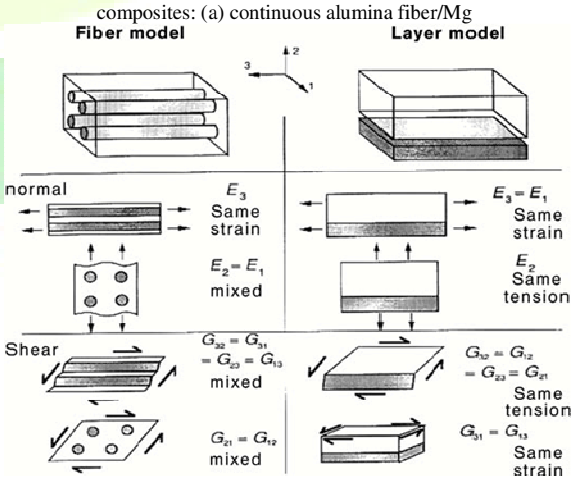

Fig 1.3 : Schematic presentation of elastic constants in composite materials

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II. FABRICATION MATERIAL

SELECTION OF MATERIALS AND COMPOSITION

- The base metal is chosen as Magnesium and ADC12.
- The reinforcement is chosen as Silicon Carbide composite.

FABRICATION OF METAL MATRIX COMPOSITES

Aluminium ADC12

- Aluminium alloy ADC12 is one of the most extensively used of the ADC series aluminium alloys.
- It is a versatile heat treatable extruded alloy with medium to high strength capabilities.
- ADC12 is a precipitation hardening aluminium alloy, containing magnesium and silicon as its major alloying elements.

SILICON CARBIDE - SiC

Silicon Carbide is a synthetic material with an outstanding hardness, only superseded by Diamond, CBN and B_4C. The chemical inertness to most of the alkaline and acids in combination with its excellent heat and abrasion resistance make Silicon Carbide every suitable under extreme operating conditions. Silicon Carbide is the only chemical compound of carbon and silicon. It was originally produced by a high temperature electro chemical reaction of sand and carbon.

TABLE 2.1 : HYBRID RATIO OF THE REINFORCEMENT

Experiment	A	B	C
1	6	7.5	320
2	6	10	330
3	6	15	340
4	9	7.5	330
5	9	10	340
6	9	15	320
7	12	7.5	340
8	12	10	320
9	12	15	330

Table6.3hybrid ratio of the reinforcement

Stir Casting

- Stirring speed: 700 rpm
- Stirring time: 2 min
- Crucible preheating temp: 400°C
- Pattern material: Mild steel
- Stirring rod material: stainless steel (304 grade)
- Stirring blade: stainless steel (304 grade)

Fig 2.1: Stir Setup

Manufacturing of composite

- Matrix: Hybrid Mg & ADC 12
- Reinforcement: SiC

III. HARDNESS TEST METHODS

- Rockwell Hardness Test
- Rockwell Superficial Hardness Test
- Brinell Hardness Test
- Vickers Hardness Test
- Micro hardness Test
- Moh's Hardness Test
- Scleroscope and other hardness test methods

TABLE 3.1 THE HARDNESS OF THE MATRIX ALLOY IN THE AS CAST – VARIATION OF VOLUME FRACTION

	FACTORS			RESPONSE
Experiment	A (%)	B (%)	C (grams)	hardness (HBW)
1	6	7.5	320	53.1
2	6	10	330	52.7
3	6	15	340	40.53
4	9	7.5	330	46.23
5	9	10	340	40.8
6	9	15	320	41.36
7	12	7.5	340	40.46
8	12	10	320	40.8
9	12	15	330	49

IV. HARDNESS VARIATION IN TERMS OF GRAPH

ITERATION 1
Y-AXIS = HARDNESS VALUE

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PERCENTAGE RATIO: Mg/6% ADC12/7.5%SiC

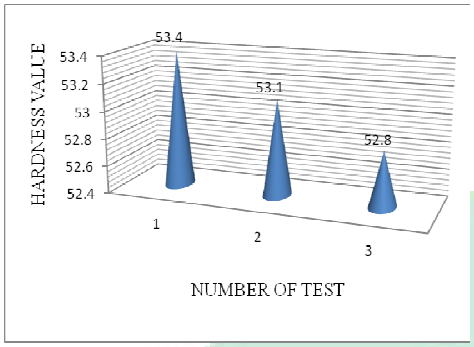

Fig 4.1 : Iteration 1

ITERATION 2
Y- AXIS = HARDNESS VALUE
PERCENTAGE RATIO: Mg/6% ADC12/10% SiC

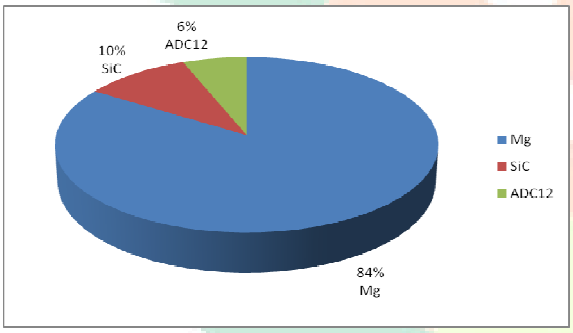

Fig 4.2 : Graph variation for Second Iteration

ITERATION 3
Y – AXIS = HARDNESS VALUE
PERCENTAGE RATIO: Mg/6% ADC12/15%SiC

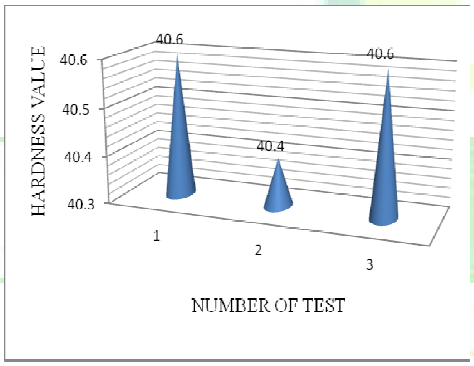

Fig 4.3 : Iteration 3

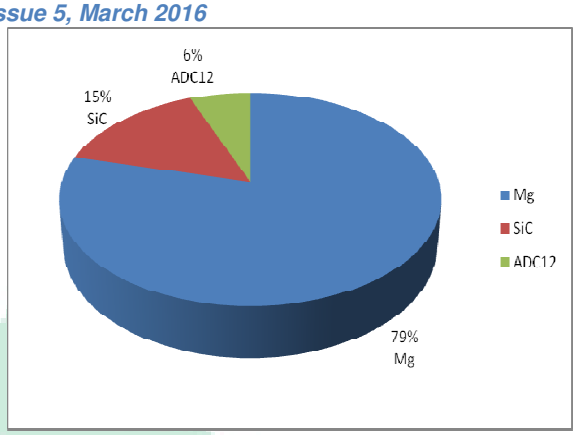

Fig 4.4 :Graph variation for Third Iteration

ITERATION 4
Y – AXIS = HARDNESS VALUE
PERCENTAGE COMPOSITION: Mg/9% ADC12/7.5% SiC

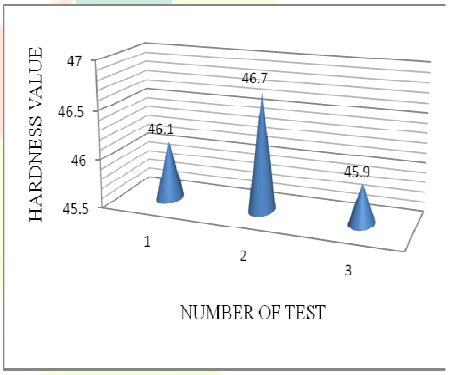

Fig 4.5 : Iteration 4

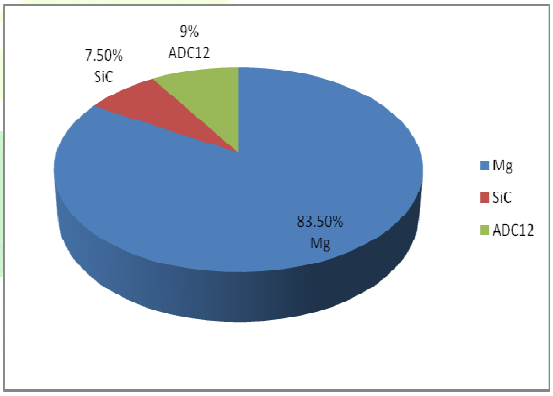

Fig 4.6 Graph variation for Fourth Iteration

ITERATION 5
Y – AXIS = HARDNESS VLUE
PERCENTAGE RATIO: Mg/9% ADC12/10% SiC

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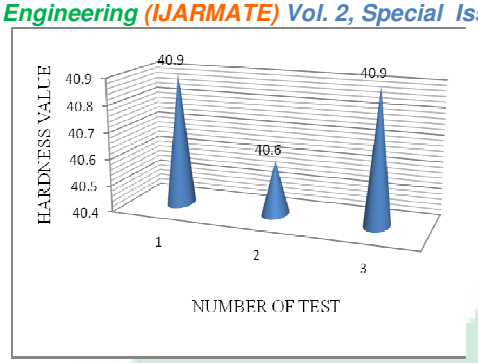

Fig 4.7 Graph variation for Fifth Iteration

ITERATION 6
Y – AXIS = HARDNESS VALUE
PERCENTAGE RATIO = Mg76% ADC12/15% SiC

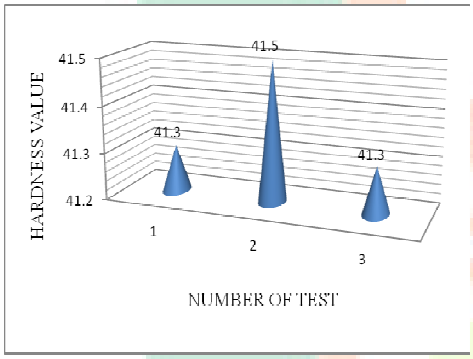

Fig 4.8 : Iteration 6

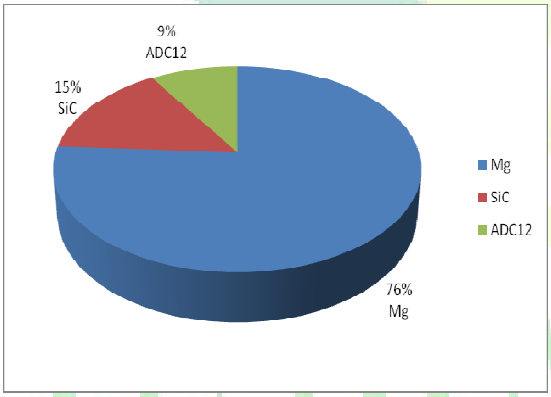

Fig 4.9 : Graph variation for Sixth Iteration

ITERATION 7
Y – AXIS = HARDNESS VALUE
PERCENTAGE RATIO: Mg/12% ADC12/7.5% SiC

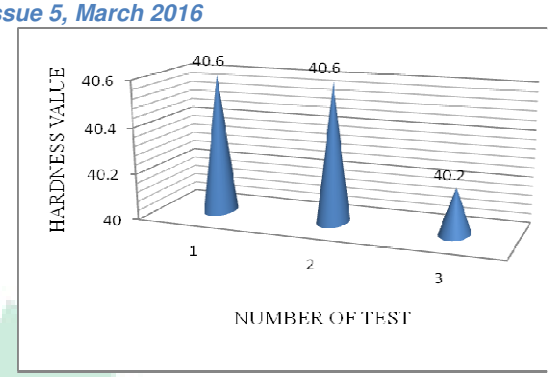

Fig 4.10 : Graph variation for Seventh Iteration

ITERATION 8
Y- AXIS = HARDNESS VALUE
PERCENTAGE RATIO = Mg 78% AD 12 12% SiC 10%

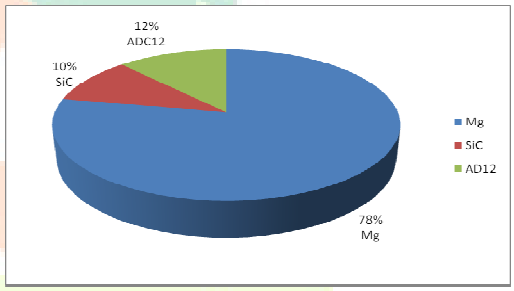

Fig 4.11 : Graph variation for Eighth Iteration

ITERATION 9
Y – AXIS = HARDNESS VALUE
PERCENTAGE RATIO = Mg/12% ADC12/15% SiC

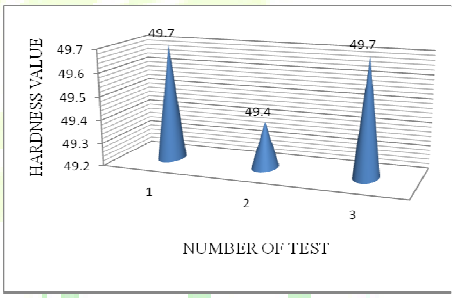

Fig 4.12 : Iteration 9

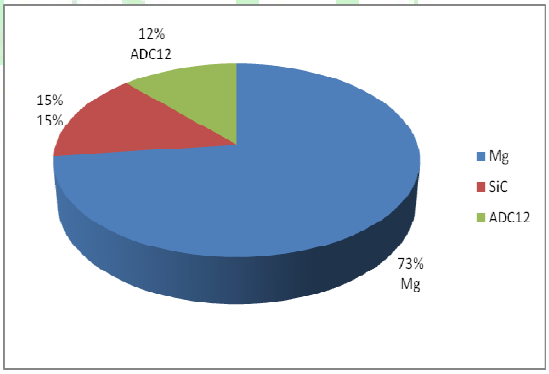

Fig 4.13 : Graph variation for Ninth Iteration

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TABLE 4.2 : HARDNESS VALUE FOR 9 ITERATION

ITERATION	HARDNESS (HBW)
	53.1
2	52.7
3	40.53
4	46.23
5	40.8
6	41.36
7	40.46
8	40.8

V. MICROSTRUCTURE

Specimen Preparation

The specimens for the metallographic examination were prepared according to ASTM standard E-3-07 (2007). The specimens were cut from the cast samples selected in random using abrasive cut off wheel. The mounted sample surfaces were coarse grinded to generate initial flat surface necessary for the subsequent grinding and polishing steps. The samples were washed thoroughly before proceeding from one grinding stage to the next stage. Successive grinding were done using fine emery papers with decreasing grit size of the grinding particles. Distilled water was used as a lubricant for fine grinding and polishing process. The spectrometer as shown in below figure 5.16. The Kellers reagent was used as etchant. The chemical composition of the Kellers reagent prepared is given in Table 8.22. Few drops of etchant were applied on the polished specimen covering the entire metal surface with eyedropper.

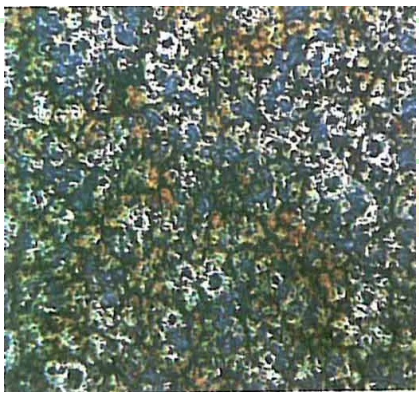

Fig 5.1 Etchant : 10% HF solution Mag : 100X

TABLE 5.1 : CHEMICAL COMPOSITION OF KELLER'S REAGENT

Reagent	Composition
Kellers Reagent	94 ml Water, 3 ml Nitric Acid, 2 ml Hydrochloric Acid and 1ml Hydrofluoric Acid.

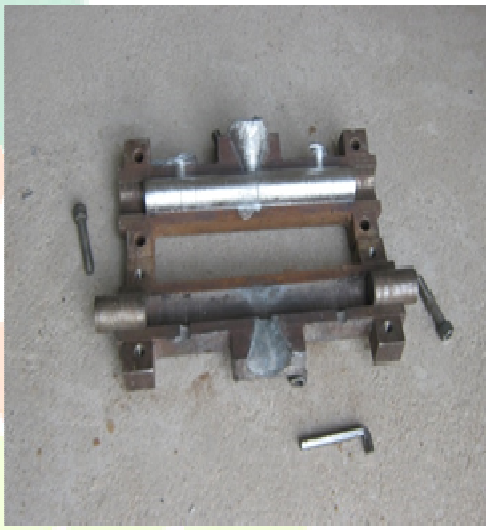

Figure : 5.2 Two ends closed by two rods white solvent is the MMC

VI. CONCLUSION

MMC are used in alteration of metals due to their special properties and the mixing of our composite is strong in the hardness and can be used in various application like automobile and aerospace.etc., . In our project work we carried stir for two minutes which is very much enough for magnesium composites.

The main aim of our project is to increase the hardness in the magnesium composite and we got a better result in terms of hardness test for the percentage of composition (Mg/6% ADC12/7.5%).

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The density of the material was made to measure, which was better than actual magnesium value. This will increase the weight ratio.

The analysis of variance was calculated for the various iterations involved in the project in which we found that factor (SiC) was responsible for increasing the hardness of the material.

Microstructure was made to analyze by viewing it in the metallographic testing machine and which confirmed the reinforcement of Magnesium, Aluminium ADC12, Silicon carbide.

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