Fabrication and Metal Matrix Composite of Magnesium Alloy AZ63 by using Stir Casting

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***Abstract*— It has been increasingly important to develop lightweight and high-strength materials for improving energy-efficiency through the weight reduction of transportation camers, Magnesium alloys have attracted lots of attentions, since the density of magnesium is approximately two thirds of that of aluminum and one fifth of steel. As a result, magnesium alloys offer a addition, very high specific strength. magnesium alloys among posses good damping conventional engineering alloys. In capacity. excellent castability, and superior machinability. However, compared to other structural metals, magnesium alloys have a relatively low mechanical strength, especially at elevated temperature. The need for high-performance and lightweight materials for some demanding applications has led to extensive efforts in the development of magnesium matrix composites and cost-effective fabrication technologies. They are proved to have good mechanical properties through an incorporation of structural filler (e.g., ceramic whiskers such as silicon carbide whisker and others, aluminum oxide, graphite and other particles, carbon fibers and carbon nanotubes: CNTs) . Considered as the ideal reinforcing filler in various composite system and main important for this project its fabrication and Metal Matrix Composite of Magnesium Alloy AZ63 (aluminum is 6% and zinc is 3%) and using the al2o3 and MWCNT(multi walled carbon nano tudes) powder and stir casting**

***Index Terms:* Magnesium, Metal Matrix Composite, Casting, MWCNT, Reinforcement.**

I.INTRODUCTION

MAGNESIUM ALLOY:

The addition of alloying elements in pure magnesium helps to alter its properties. Magnesium is chemically active and can react with other metallic alloying elements to form intermetallic compounds. In most of the magnesium alloys, the presence of intermetallic phases can be observed. These phases aid to influence the microstructure, and hence, affect the mechanical properties of the magnesium alloy. Solid solution hardening

Addition of Metallic Elements on Magnesium

Aluminum. Aluminum is one of the most commonly used alloying elements in magnesium, as it has the most favorable influence on magnesium. Addition of aluminum results in the enhancement of hardness

Zinc. Zinc is one of the most commonly used and effective alloying elements in magnesium. It is usually used in conjunction with aluminum to increase the strength without reducing ductility. The increase in strength to comparable levels is not achievable if only aluminum content is increased . Moreover, zinc incorporated into magnesium alloy with nickel and iron impurities can also assist to improve the corrosion resistance .

Classifications of Magnesium Alloys:

Alloy Designations. the abbreviation letters for the alloying elements that are commonly used to designate the magnesium alloys, as given by the American Society for Testing and Materials (ASTM B275) . Each alloy is labeled by letters that indicate the main alloying elements, followed by figures that represent the percentages of these elements.

The designation of a typical magnesium alloy consists of three parts. For part 1, the initial alphabet of two main alloying elements makes two abbreviation letters, which represent the two main alloying elements arranged in or- der of decreasing

percentage. If the percentages of the alloying elements are equal, the letters are arranged alphabetically. For part 2, the amounts (in weight percentage terms) of the two main alloying elements are stated. It consists of two whole num- bers, which corresponds to the two alphabets. For part 3, it distinguishes between the different alloys with the same percentages of the two main alloying elements. It is made up of a letter of alphabet assigned in order as compositions become standard, namely:

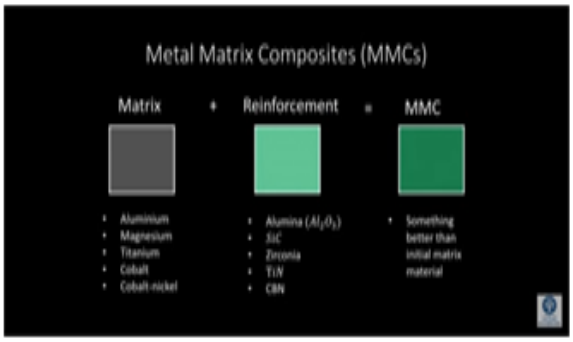
1 First compositions, registered with ASTM
2 Second compositions, registered with ASTM
3 Third compositions, registered with ASTM
4 High purity, registered with ASTM
5 High corrosion resistance, registered with ASTM

For example, considering magnesium alloy AZ63:
AZ Indicates that aluminum and zinc are the two main alloying elements
63 Indicates the percentages of aluminum and zinc (6 and 3, respectively), which are rounded-off to whole numbers

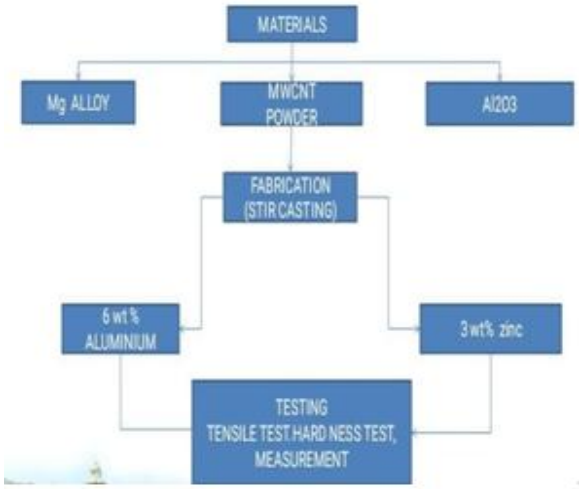
APPLICATIONS:

II.METAL MATRIX COMPOSITE

Metal matrix composites (MMCs) are lightweight structural materials used in a small number of aircraft, helicopters and spacecraft. MMC materials consist of hard reinforcing particles embedded within a metal matrix phase. The matrix of MMCs is usually a low density metal alloy (e.g. aluminium, magnesium or titanium)

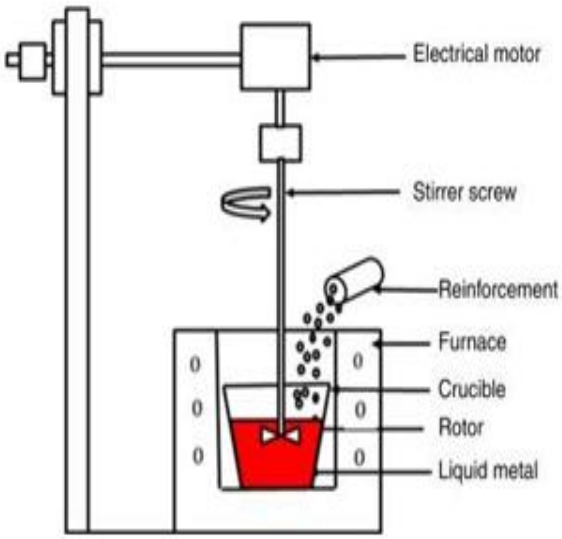


III.METHODOLOGY



IV.WORKING PRINCIPLE

STIRCASTING:



RAW MATERIALS

Composite were fabricated by bottom pouring type stir casting process. The materials used for casting were magnesium, aluminium and zinc as the base alloy metals with reinforcements such as al2o3 in composites for the same. the image of used materials. the density and rockwell harness of purchased raw materials. The raw materials purchased were cut down into smaller pieces for easy melting and for materials to properly accommodate in the furnace pot of bottom pouring stir casting machine the composition of the samples. All the components are cleaned properly before starting the furnace and graphite paste is applied to all the components through which the molten material is going to flow. Then the furnace is switch on and a temperature is set to a particular value i.e. 850˚C, through a laptop that is connected to the control panel of the equipment. Then we check melt temperature that has been set to 800˚C.Next the die and the runner are heated with die heater and runway respectively. When the furnace is heated to the required temperature then the metals are added slowly into the furnace. After all the metals are melted putting the stirrer into the furnace so that everything mixes properly. After proper stirring the metals in the furnace, making sure that the runner is properly aligned to the die, the furnace is opened to let the metals flow through it. After the metals are inside the die then we allow it to solidify and remove it from the die later. Meanwhile, the runner is taken out from the heater and tapped rigorously to remove excess metal. After the die is cooled down, the specimen is taken out

METHOD OF TESTING

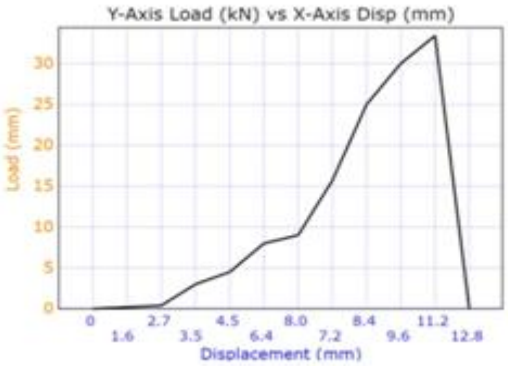
- Tensile test
- Hardness test

After tensile test the specimen will be break because of load apply

V. RESULTS

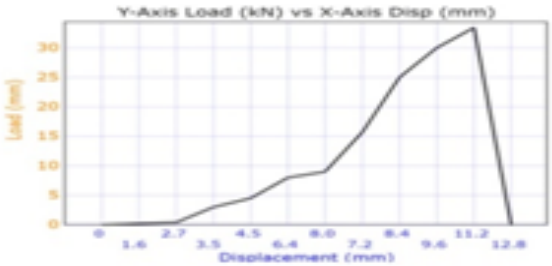
SPECIMEN1: (AZ63+MWCNT 2%)

Specimen 1	AZ63+MWCNT 2%
Yeild Load (kN)	18.75
Yeild Stress (N/mm^2)	155
Elongation %	12.2
Maximum Load (KN)	200
Maximum Tensile Strength (MPa)	164.72
Specimen diameter (mm)	20.0
Intial Gauge Length (mm)	100.08
Fianal Gauge Length (mm)	102.63
Load at Peak	28.2

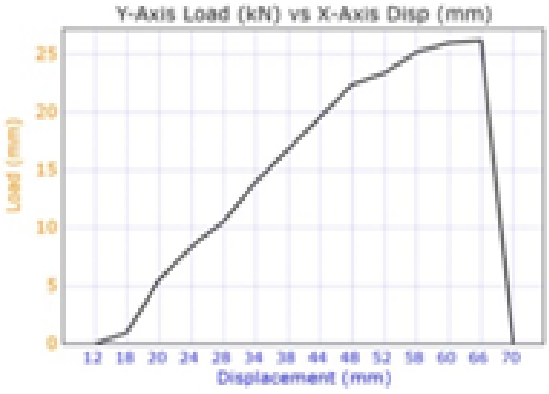


SPECIMEN2: (AZ63+MWCNT 3%)

Specimen 2	AZ63+MWCNT 3%
Yeild Load (kN)	20
Yeild Stress (N/mm^2)	165.3
Elongation %	17.1
Maximum Load (KN)	200
Maximum Tensile Strength (MPa)	160.7
Specimen diameter (mm)	20
Intial Gauge Length (mm)	100.02
Fianal Gauge Length (mm)	101.09
Load at Peak	32.4



Specimen 3	AZ63+MWCNT 4%
Yeild Load (kN)	19.86
Yeild Stress (N/mm^2)	155.19
Elongation %	12.1
Maximum Load (KN)	200
Maximum Tensile Strength (MPa)	169.6
Specimen diameter (mm)	20
Intial Gauge Length (mm)	100.03
Fianal Gauge Length (mm)	103.01
Load at Peak	31.6



SPECIMEN3: (AZ63+MWCNT 4%)
HARDNESS TEST

ISO No : IS1500:2005 Material:Magnesium Alloy

Condition of the Part:

Surace Preparation:
Grinding Machined Lapping Filling Other

Test Position:

Measuring unit:
Rockwell C(HRC) Vickers (HV)
Rockwell B(HRB) Brinell (HB) Shore

LOCATION	HARDNESS					
AZ63+MWCNT 2%	71	76	74.3	76	74	Average : 74.26
AZ63+MWCNT 3%	80	81.1	81	79.4	79	Average : 80.1
AZ63+MWCNT 4%	86	81	81	80	83.6	Average : 82.32

VI.CONCLUSION

The attractive properties of Mg alloys include light weight, high specific strength, excellent castability and machinability However, these alloys have limited formability, limiting their industrial application. Strengthening of Mg alloys via the introduction of solid solution atoms and grain refinement additives are effective approaches. Much progress has been achieved in the development of high strength Mg alloys through solid solution strengthening using various types of solute atoms. Researchers incorporated various alloying elements such as Al, Zn, Ca, Mn and RE elements in Mg matrix. The chemical composition of Mg alloys affects the microstructure and then improves the mechanical properties and corrosion resistance

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