ROLE OF HEAT TREATMENT AND EVALUATION OF MECHANICAL PROPERTIES OF Al LM13 REINFORCED WITH HEMATITE

Rajesh.T.R[1], Meghani Molies Reddy[2], Batluri Tilak Chandra[3], Sunil Kumar.M[4]

[1]*Assistant Professor, Mechanical Engineering, GCEM, Bangalore, Karnataka, India*
[2]*Assistant Professor, Mechanical Engineering, SIET Tumakuru, Karnataka, India*
[3]*Assistant Professor, Mechanical Engineering, SSIT Tumakuru, Karnataka, India*
[4]*Assistant Professor, Mechanical Engineering, PNSIT, Bangalore, Karnataka, India*

Abstract

Aluminium alloys are usually used in automotive and aerospace industry due to their acceptable mechanical property and very low down density , most excellent rust conflict and frictional wear ,short thermal coefficient of extension as compare with respected to stereotypical metallic materials and different alloys .The amazing motorized properties of aluminium alloys and reasonably low down manufacture cost brand name as a especially desirable applicant used for a range of diversity of application concurrently from methodical and technological view . The tendency include in designing metal matrix material composites is to mutually in the appropriate attribute metals and ceramics. Present work is cantered on the study of behaviour of in aluminium alloys (alluminiumLM13) with hematite (Fe2O3) composite manufactured by the stir casting method, diverse proportion of reinforcement is utilize .Tensile test, compression test, hardness test, was complete on the model specimen produced by the strincasting procedure.

Keywords: *Al LM13, Hematite, Tensile, Compression and Hardness Test, Stir Casting.*

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1. INTRODUCTION

Materials which are used in present days in automobile, aerospace are composites instead of metallic materials like bone, natural fibres, etc as they either natural or manufactured by different methods. A typical composites are the most growing and suited engineering materials now to people .To move forward in the area of material science and metallurgy has given consanguineous to these attractive and amazing materials.

Composites are heterogeneous in nature designed by the foregathering of two or more components with filler and a compactable matrix If the mixing occurs on a microscopic scale, the recent is then known as alloy or polymers usually, a composite materials is composition of reinforcement phase such as fibres, flakes, particles and fillers securely surrounded in a matrix of metals, ceramics, polymers. The matrix retains the reinforcement to form the wanted shape. the entire property of the matrix are improved by the strengthening .while designed correctly the innovative mixed material shows good strength and other unique materials metal matrix are largely used in so many applications embarrass automotive and parts of aircraft, consumption product and electronic product , these can be manufactured by typical or stereotypical methods .such as stir casting, injection moulding, powder metallurgy to create a parts for automobile and aerospace applications.

1.1 Over View of Metal Matrix

Metal matrix composites similar compositions it contains of a minimum two bodily and chemically segment of distinct, it's only appropriate for it to deliver the dispersed properties and specific phases are not available. Usually there exists a two phases particulate or fibrous segment in a metallic matrix for ex; AL2O3 copper matrix reinforced with fiber for excellent leading magnets. Aluminum alloys reinforced with Sic particles used in thermal management, aerospace and automobile applications.

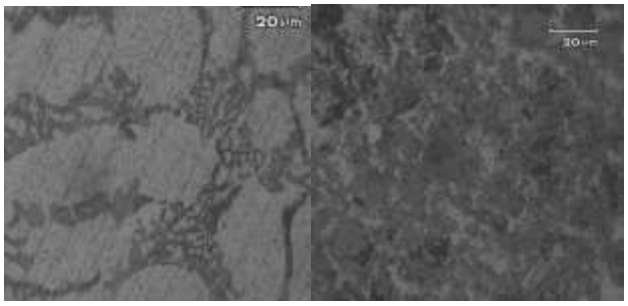


Fig 1.1 As caste 12%Hematite Fig 1.2 AlLM13-Heattreated

2. LITERATURE SURVEY

Phanibhushana.M.V, Dr.C.N Chandrappa,.[1] at present analysis, uncontaminated aluminium Al6061 -2, 4, 6 and 8% (by weight)hematite (ferrous oxide Fe2o3) composites were manufactured by the stir casting process.Micro structure analysis is made on the visual microscopy, in that they identified a homo allocation of hematite particle in the metal matrix phase and also obtained a high-quality bounding b/w metal matrix and hematite. The hardness of the Al6061-hematite composites increased by 30% in the reinforcement of hematite and density of the composites also improved with raise in the reinforcement of the hematite than the pure

aluminium Al6061and tensile potency of composites is enhanced by 25 % when 8% of hematite is reinforced to the base Al6061, increasing of mechanical properties were viewed with rising amount of in a stir casting process.

S.Karunakara, P.Dinesh, at ., 2014 [2] In this investigational learning, Al base hematite particle reinforced composite material was manufactured by powder metallurgy. The compression strength of the hybrid, stretching strength of the composite and hardness at irregular compaction pressure and different temperature were studied. The result of the tests exposed that hematite particles can be effectively used as a reinforcement material and it does not deteriorate the property. The ever-increasing hematite particles percentage and high compaction pressure resulted in high density of the compact. There by ever-increasing compression strength of composite, tensile strength of composite and hardness of component. Sintering play a most important role having straight effect on physical properties of the component with changing sintering temperature, maximum compression strength of 270Mpa ,tensile strength of 187 Mpa and hardness about 69 BHN was attain for 8% hematite particles at sintering temperature 5000c and compaction pressure 400Mpa .

S.Ezhil vannan, S.Paual vizhian,at.,2014[3] at present investigation. Efforts are made to study the microstructure properties of a cast Al alloy 7075 with short basalt fibre reinforcement in the percentage varies from 2.5 to 10% in the steps of 2.5% and fabrication using campo-casting technique.

2.1 Summary of Literature Review

In the current exploration, the potency of compound AlLM13-Hematite is calculated by the proportion of strengthening and compare with the impotency of tempered sampling with the same composition and calculate the mechanical strength of the compound accounting microstructure examination using visual microscopy of the case made-up with hematite particulates of 150 microns in diverse composition such as 3%, 6%, 9% , 12% and 15% by Means of stir cast manner.

3.1 Objectives

1. To prepare the economical MMC material by taking Al LM13 alloy with metal matrix particulate like Hematite as reinforced phase using stir casting method.
2. To examine the micro structural characteristics of the as cast composite material.
3. To made the heat treatment to the cast composite materials and comparing with as cast composite materials.

The Tensile strength, compression strength & Hardness of the cast composite materials are identified by preparing the specimen by ASTM standards

3.2 Materials and Methods

3.2.1 Materials

For the present investigation purpose the aluminium used for preparing of metal matrix alloys was pure LM13 and it was purchased from fen fee metallurgy Bangalore, Karnataka, India and hematite powder was purchased by Hindustan minerals Mangalore and magnesium was commercial available. The chemical properties of AlLM13 and hematite are as mentioned in table 3.1 and 3.2 respectively

Table 3.1 Chemical composition of LM13

Chemical composition	Cu	Mg	Si	Fe	Ma	Ni	Zn	Pb	Tin	Ti
percentage	1.3	1.5	13.0	0.8	0.5	3.0	0.1	0.1	0.1	0.2

Table 3.2 Chemical composition of Hematite

Chemical composition	Fe	Mn	Mg	Ti	Al	Ca	Si	Loss of ignition
Hematite	81.13	0.14	1.55	0.03	0.57	4.8	4.2	5.82

3.3 Experimental Work

The fluid state method is also called as stir casting manner, be mainly utilized intended for the fabrication of composite substances in that a reinforcing stage is heterogeneously mixes with a molten medium metal by the use of a automatic stirring after this the fluid composite materials is afterwards made by means stereotypical manufacturing techniques it might be process by stereotypical metal shaping techniques.

1. Melting the aluminum LM 13 alloy.
2. Arranged and pre heating of the reinforcements.
3. De- gassing and removal of slag.
4. Combined the metal and reinforcing material.
5. Collecting the molten metal and reinforcement and mix to the die.

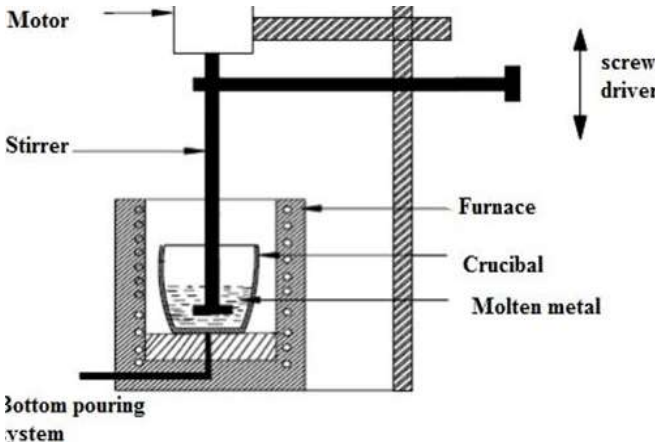


Fig 3.3.1 Stircasting processes

For melting the alloy an electric arc furnace is mainly used. The container heater and is Heated electrically at 3 phase resistance of 12.55 kW capabilities. The heater range is 1200^0 C with precision of +/- 1.5 C. The aluminum alloy which was earlier melted. The aluminum LM 13 is cut to small pieces rendering to the essential and additional to the pre heated vessel. Once the vessel has been changed , switch on the heater to 750˚C temperature.

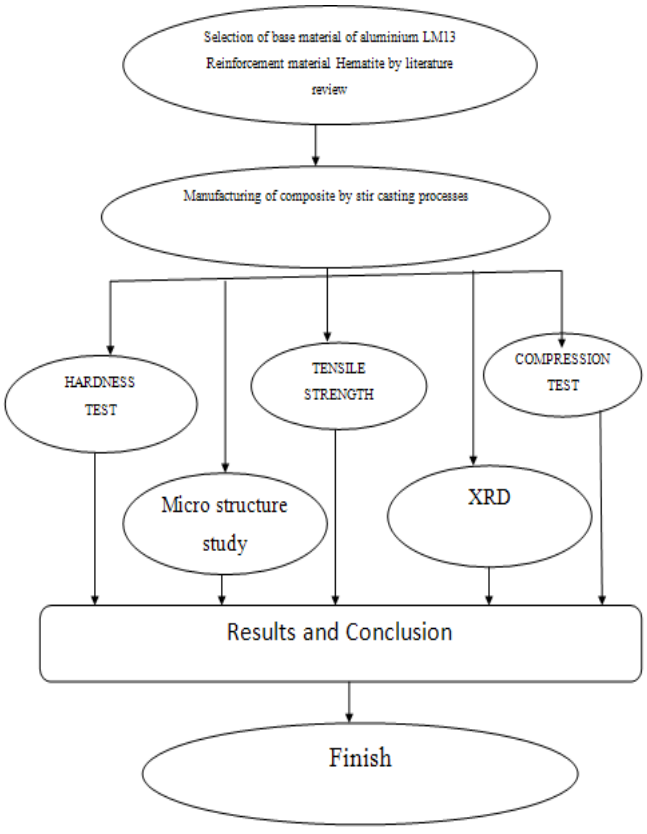
3.4 Heat Treatment

This involves tempering of Aluminum alloy to a desired temperature for calculated time.The alloying elements become solid solution and form homogenous phase. The mechanical factors which affect the final properties of alloy are soaking temperature, time and cooling rate.

The type of treatment process used is T6 method. Commonly applied T6 Heat Treatment Process:

1. Solutionising :Keep at furnace in 525^o Celsius for 8hrs.
2. Quenching : Sudden Quenching Water at 30^o C.
3. Natural Aging : Upto 5 Hrs
4. Precipitation : Keep in furnace at 165^oC for 8hrs.
5. Hardness to be achieved between 80-100 BHN

Experimental Procedure



3.5 Hardness Test

Hardness is usually thought about as a opposition to penetration. The material will be stronger .Hardness is straightforwardly with the material mechanical properties. Agent referring hardness includes grain size, grain shape, structure of the grains, etc. Usually hardness increments the ultimate tensile strength and yield strength , because of this hardness test of the composite material is more important .The common method of testing includes Brinell, Rock well and Vickers hardness test.

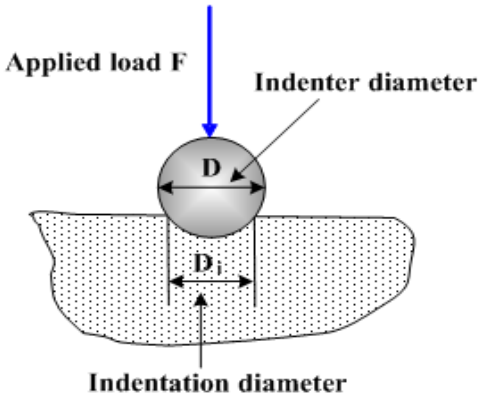


Fig 3.5 Brinell hardness testing

3.6. Tensile Test

Tensile strength is the function of a fabric or substance to endure a pull (tensile) force. It is habitually deliberate in units of force per cross-sectional area. This is important concept in material science, mechanical and structural engineering. The ability to resist failure under tensile stress is the most important and widely measured properties of materials used in structural applications. Tensile strength is important in the use of brittle materials more than ductile materials.

3.6.1 Yield Strength

Yield strength of metals is expressed in materials science and engineering field as the stress at which a material starts to warp plastically. Before to the yield point the material will warp elastically and will come back to its initial shape when the applied stress is realized. If the yield point is starts, some amount of the deformation will be permanent and non-reversible. In the three-dimensional volume of the principal stresses ( ), an unbounded number of yield points together forms a yield surface.

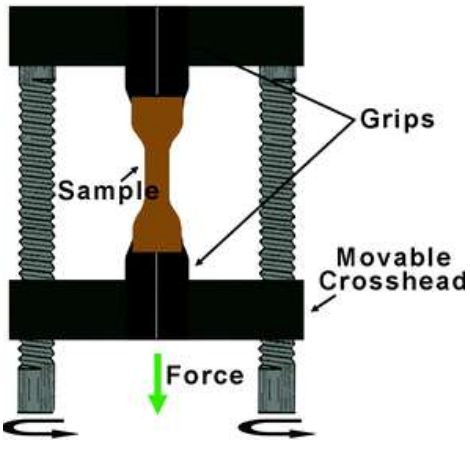


Fig 3.6.1 Tensile test on UTM

3.7. Compression Test

The compressive impotency is the material or specimen to endure loads offers to decrease the size. It may be identified by drawing applied force vs change in length and diameter in a universal testing machine. Few materials are broken at their compressive capability limit; others distort invariably, so a considering quantity of change in shape might be taken as the boundary for compressive load. Compressive capability is a key factor for design of configurations.

Fig 3.7 Compression Test component

4. RESULTS AND DISCUSSION

4.1 Hardness Test

The graph shows hardness v/s ageing period, results for LM13-Hematite particulate composite for heat treated and ice quenched specimen

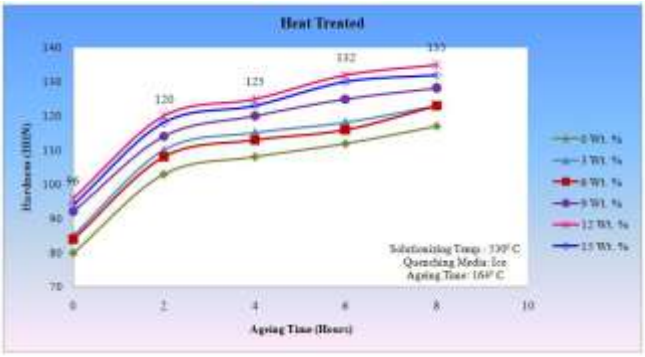


Fig 4.1 Hardness indentation on the component

4.2 Tensile Test

The graph shows tensile strength v/s composition, results for LM13-Hematite particulate composite for heat treated and ice quenched specimen

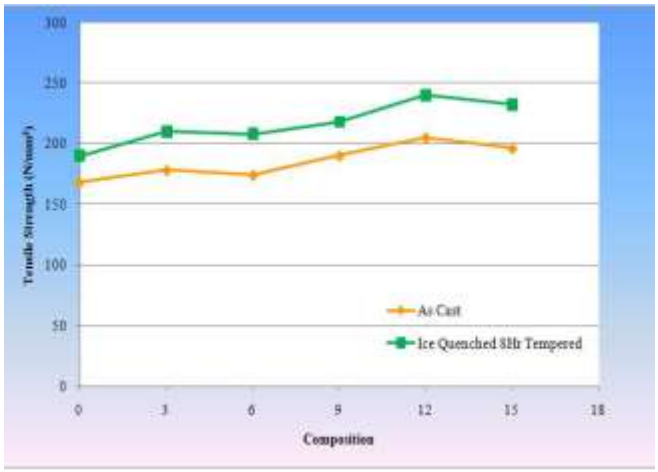


Fig 4.2.1 Tensile power of as cast and ice quenched 8Hr tempered Al LM13-Hematite

Fig 4.2.2 Tensile test specimen

Table 4.2 Compression of as cast and ice quenched Tensile strength

Composition of Hematite %	As cast Tensile strength in N/mm²	Ice Quenched 8Hr Tempered Tensile strength in N/mm²
0	168	190
3	178	210
6	174	208
9	190	218
12	205	240
15	196	232

4.3 Compression Test

The graph shows tensile strength v/s composition, results for LM13-Hematite particulate composite for heat treated and ice quenched specimen

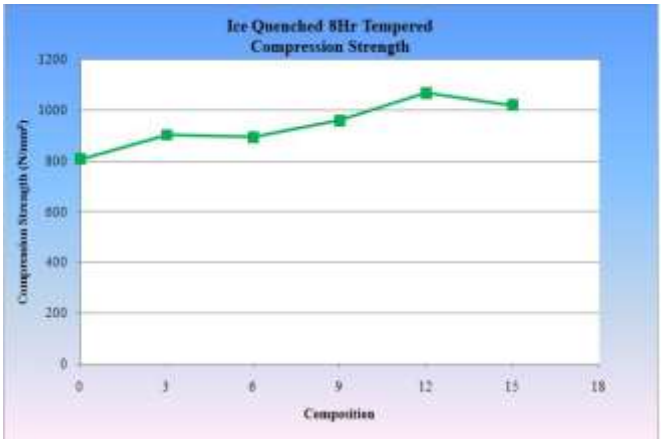


Fig 4.3.1 Compression strength of Ice Quenched 8Hr tempered AlLM13-Hematite

Fig 4.3.2 compression force of Ice Quenched 8Hr tempered Al LM13-Hematite

5. CONCLUSION

The conclusions written from the actual research are as follows:

1. The results verified that the Al alloy LM13 Reinforced with Hematite composite prepared by stir casting processes is clearly extraordinary to base Al alloy LM 13 in the resemblance of tensile strength, compression strength as well as Hardness.
2. Inclusion of Hematite particles in aluminium matrix increases the hardness of the composite matrix material.
3. It is identified that elongation will decrement with increment particles wt. percentage, which exactly shows that the Hematite inclusion increment brittleness.
4. Aluminium matrix composites is effectively manufactured by stir casting technology with gently uniform distribution of Hematite particles.
5. It shows that from the actual study that Ultimate Strength and Yield strength begins to grow with increment in weight percentage of Hematite particles in the matrix.
6. The Increase in hardness takes place with increasing of Hematite particles in the matrix.
7. Results from the XRD indicate the presence Hematite particles in aluminium alloy matrix. The oxide phases like Al2O3 and SiO etc. have included homogenously entirely in the MMC thus strengthening the existing composite.
8. Compression strength is incremented by adding Hematite particles in the matrix material.
9. Stir casting process, stirring geometry of the apparatus, preheating temperature of the , particle inclusion rate etc. are the important parameters.

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BIOGRAPHIES

Rajesh T R working as a Assistant professor at GCEM Bangalore, Having a 3 years of experience in academics. Currently carrying out some research work.

Meghani Molies Reddy working as a Assistant professor at SSIT Tumkur, Having a 6 years of experience in academics. Currently carrying out some research work.

BatluriThilak Chandra working as a Assistant professor at SSIT Tumkur, Having a 6 years of experience in academics. Currently carrying out some research work on Development and tribological studies on PMMC for automotive applications

Sunil Kumar M working as a Assistant professor at PNSIT Bangalore, Having a 3 years of experience in academics. Currently carrying out some research work.