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The Study of Mechanical properties of LM6 Reinforced with Albite Particulate Composites and fabricated by Chill Casting Method.

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***Abstract:* -- The study is intended to investigate mechanical properties of LM6 based metal matrix composite, where Albite particulates are character enhancing reinforcement. Composites were fabricated by chill casting process utilizing copper as a chill. Specimens were prepared as per ASTM standards at different weight percentages of Albite varied from 0 to 12 with increment of 3. The microstructure study clearly indicates uniform distribution of Albite particulate in matrix alloy. These results revealed that increase in weight percentage of Albite as reinforcement in LM6 matrix alloy increases the tensile strength, compressive strength and hardness giving rise to improved microstructure of composite.**

Keywords: Albite, Chill Casting, Copper chill, LM6, Mechanical Properties, Stir Casting.

INTRODUCTION

Metal matrix composite (MMC) utilization has expanded crosswise over aerospace, defense verticals, and segments like mechanical autonomy, mining are expected to develop for next 20 years. Maria Mrazova [1,2] discovered that 21 Century flagship models like Boeing747 & Airbus380 utilizes 20-25% aluminum alloy composite. Although AAC Is expensive than rest of its competitors, certain Ways that can decrease cost are simple fabrication high production rate & less expensive yet better reinforcement.[3]. Aluminum alloy composite (AAC) are getting to be distinctly potential designing material offering magnificent blend of properties like high specific strength, stiffness, thermal conductively, low co-efficient of thermal expansion & wear resistance.[4]. Lm6 was selected as matrix in light of its application in areas like automobile, aeronautics & marine. And its capacity to resist hard cracking, die filling limit, & corrosion resistance makes it commonly used Al-Si alloy.[7]. The review by A.Ramesh et al. [8] uncovered that Albite moderately increases ultimate tensile strength, hardness, & young's modules when utilized along Aluminum alloy composite (AAC).[8] Study by K.G.Anath Prasad revealed Copper chills to have ideal Chilling effect, positive impact on grain structure & distribution of Dispersoid than iron, steel, SiC chills [9&10]. From above studies it has been concluded that volumetric heat capacity depends on temperature gradient and copper chills have great volumetric heat capacity [10]

EXPERIMENTATION:-

MATERIALS 2.1

2.1.1 LM6:- LM6 is a eutectic alloy containing silicon as major alloying element. It possesses great ductility and strength to weight ratio having density of 2.65kg/cm3. Table 1 shows composition of LM6.

2.1.2 Albite:- Particulate form of Albite mineral (NaAlSi3O8) with diameter of 90-150 micrometer is used. Table 2 shows Composition of Albite.

2.1.3 Chill:- Copper chill has been used in light of thermal properties. Table 3 shows some required properties of Copper.

Table: - 1. LM6 (chemical composition) in wt

Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb	Sn	Ti	Al
0.1	0.10	10-30	0.6	0.5	0.1	0.1	0.1	0.05	0.2	85

Table: -2. Albite (chemical composition) in wt%

SiO_2	Al_2O_3	Na_2O_3	K_2O	FeO_3	LoI
70%	18%	10.5%	0.5%	0.06%	0.2%

Table: - 3. Copper Chill properties.

Density	Thermal conductivity	Specific heat	Melting point
8.96 g/cm^3	401 W/m.k	151 j/kg K	1357.77 K

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COMPOSITE PREPRATION:-

Stir casting technique was embraced. Albite was pre heated at 5000c & added to molten LM6 in electrical resistance furnace. Stir speed was approximately kept up in the middle of 450-630rpm for about 15minutes to resist precipitation of Albite particulates is as shown in figure1. American foundry society measurements were taken for preparation of mould. Molten compound at different weight % of Albite varied from 0-12 wt% in increment of 3 wt% is poured into separate mould boxes presented with copper chills at one end, As shown in figure 2. These chill having incredible volumetric heat capacity (VHC) Favors directional solidification & accelerates cooling rate.

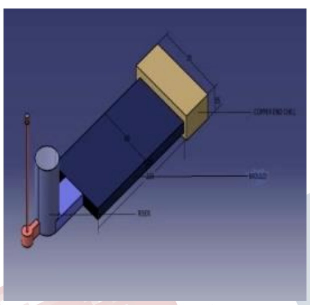


Fig.1 [a]

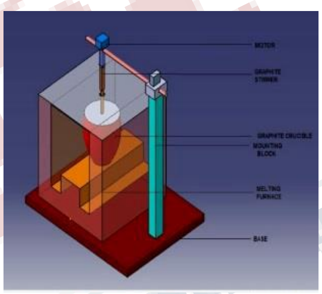


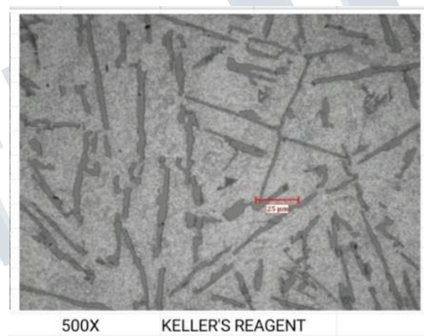
Fig.2 [b]

PREPRATION OF SPECIMENS:-

1. Microstructure Test.

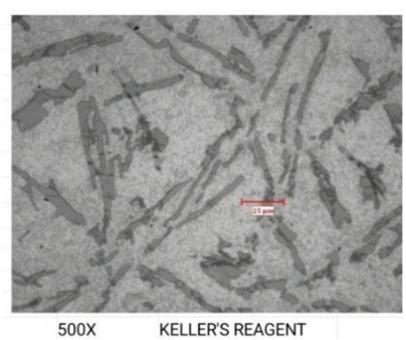
Specimens were machined as per ASM E3 volume9 (ASM metal handbook metallographic) were polished then etched using Keller's reagent for proper inspection of grain boundaries. Micro photographs were captured using Nikon microscope LV150 with climax image analyzer which are shown below. They all reveal the presence of eutectic reinforcement silicon needles & fine precipitation of alloy elements dispersed in the matrix of aluminum solid solution. Chilled Casted Specimens of LM6 Reinforced with Albite At Different Weight Percentages.

LM6+0%Albite



LM6+3%Albite

LM6+6%Albite



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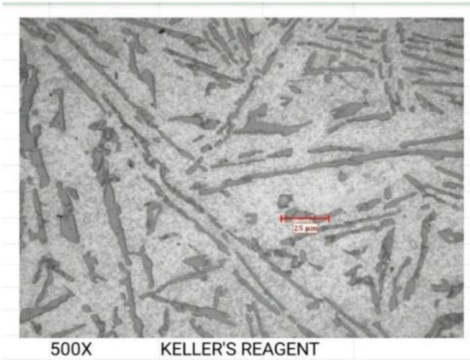
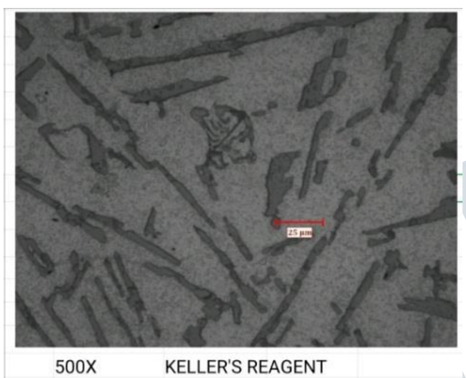
LM6+9%Albite



LM6+12%Albite



2. Tensile Test.

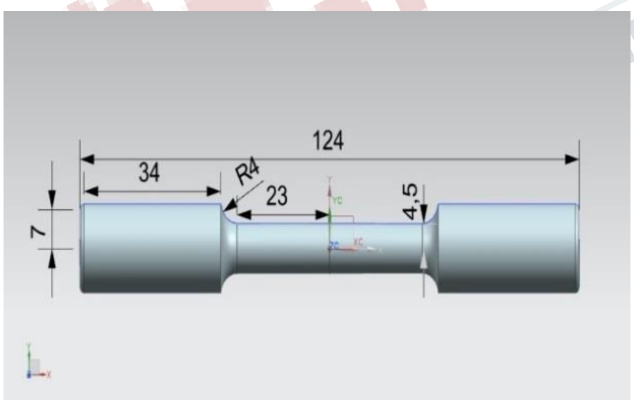


Fig. 2[a]

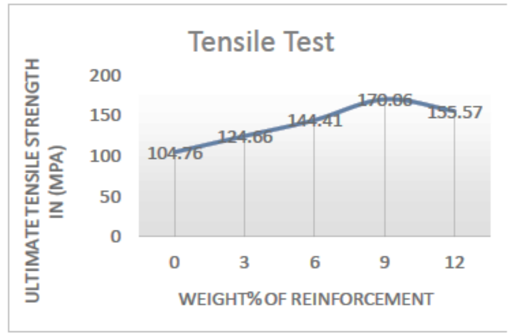


Fig. 2 [b]

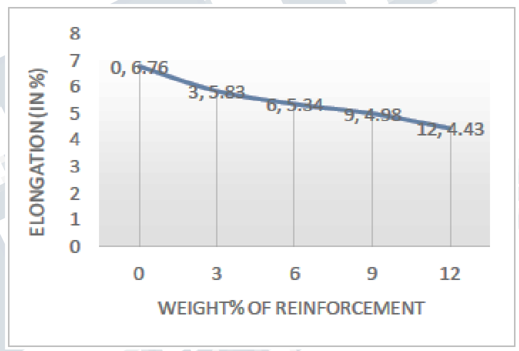
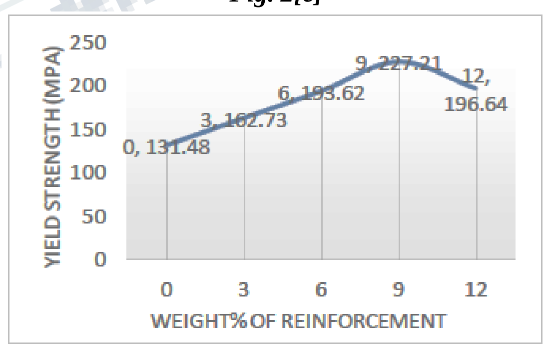


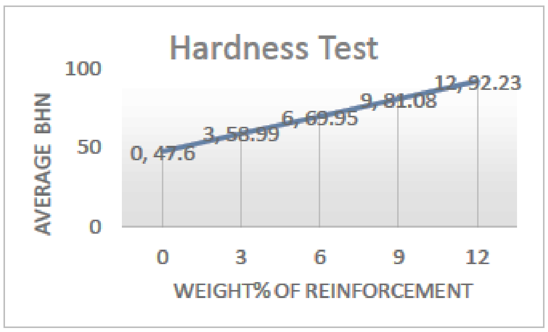
Fig. 2[c]



Tensile test is utilized to study Ultimate Tensile Strength & Yield Strength. Test is carried out in ultimate testing machine (UTM) values of tensile strength (UTS) & Yield strength at different weight% of Albite are plotted, as fig-3&4. Plot 2 shows an increment in UTS up to 9 weight%. Addition of brittle reinforcement into ductile matrix makes composite brittle & increase in ultimate tensile strength. Moving on to 12 weight% there is an comparative decrease due to agglomeration of particle which leads to formation of micro cluster in turn weakening the bond between matrix & reinforcement[15][16]. The same trend is followed by yield Strength, increment in Yield strength is due to porosity resulted because of uniform dispersion of small particulates of Albite. [11]

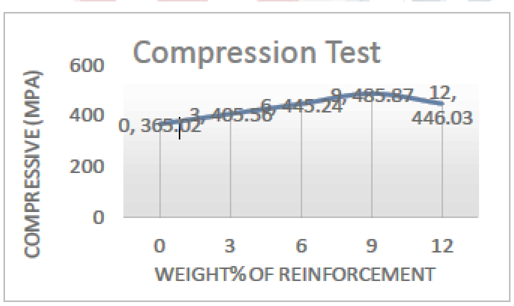
3. Brinell hardness Test.

Fig. 3



Hardness is the resistance of material to limit to distortion, the current study deals with distortion due to indentation. Brinell hardness test was performed on composite example from base of the cast to top, BHN Test conducted at 3 different locations of the specimens and average value is considered[Shown in table 5] Figure 5 demonstrates an expanding pattern of BHN, which is generally attribute because of hard particulates of Albite. [12] Another minor factors offered by copper plates to achieve grain reinforcement of composite. [11,13].

4. Compressive Test.



The maximum compressive strength that a solid material can sustain without crack corresponding to compression strength. Standard cylindrical specimens were mounted independently on base plate of UTM & test was carried out gradually applying load & relating results were plotted down. The figure 4 makes it clear that compressive strength follows increasing pattern throughout the weight% of Albite unlike UTS. One of the major factors may be presence of silicon as major alloying element & essential in both LM6 & Albite respectively, this unique blend present in composite resulted in coherence & minimized dislocation at the interface of matrix & reinforcement. [14].

CONCLUSION:-

• Chill casting technique was successful embraced using copper as a chill material for synthesis of LM6 based composite tensile strength & yield strength tends to increase with increment in weight percentage of Albite until 9% & slight decrement at 12% due to agglomeration.

• Compression strength on other hand follows an increasing order with increment of Albite weight, possibly due to usage of very small particulates of Albite.

• Scrutinizing the microstructure of composite reveals formation of silicon dendrite pattern & aligned orientation as a result of fair rate solidification.

• Hardness test ensures that increase in weight percentage of Albite increases hardness due to presence silicon in both matrix & reinforcement.

• Results obtained by copper chill casted LM6 composite is better than conventional method of casting taking tensile strength, compressive strength & hardness into consideration.

• Finally it can be concluded that increase in weight percentage of Albite in LM6 matrix increases tensile strength, compressive strength & hardness of composite shaping a vivid microstructure

REFRENSES:-

1) Maria mrazova, ADVANCED COM MATERIALS OF THE FUTURE IN AEROSPACE INDUSTRY, INCAS BULLETIN, Volume 5, Issue 3/2013 http: //bulletin .incas. ro/files/mrazova_m__v5_iss_3_full.pdf

2,3) Madhu Kumar YC, Uma Shankar. Evaluation of Mechanical Properties of Aluminum Alloy 6061-Glass Particulates reinforced Metal Matrix Composites, page 3207. Vol.2, Issue.5, Sep.-Oct. 2012 pp-3207-3209 http://www.ijmer.com/papers/Vol2_Issue5/AP253207320 9.pdf.

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Vol 2, Issue 4, April 2017

4) Das S. Development of Aluminum alloy Composites for Engineering Applications", (August 2004), "Vol. 57, No. 4, pp. 325-334.
http://www.igcar.ernet.in/transiim/2004/TP-1897.pdf
Rohatgi P K, Cast aluminum-matrix composites for automotive applications, JOM (April, 1991), Volume 43, Issue 4, pp 10–15,
http://link.springer.com/article/10.1007/BF03220538

5) Saravanan,K. Subramanian,V. Ananda Krishnan,R. Sankara Narayanan, Effect of Particulate Reinforced Aluminum Metal Matrix Composite Mechanics and Mechanical Engineering, c Lodz University of Technology page29C.,Vol. 19, No. 1 (2015) 23–30 1 (2015) 23–30
http://www.kdm.p.lodz.pl/articles/2015/19_1_3.pdf

6) N. Chawla, J.J. Williams, G. Piotrowski, and R. Saha (2001), "Tensile and fatigue fracture of Discontinuously Reinforced Aluminum", Advances in Fracture Research, pp16.http://www.gruppofrattura.it/ocs/index.php/ICF/ICF10/paper/download/4993/7000

7) Sourav Kayala, R. Beherab*, G.Sutradhara. Mechanical properties of the as-cast silicon carbide particulate reinforced Aluminium alloy Metal Matrix Composites. International Journal of Current Engineering and Technology ISSN 2277 - 4106, 2277 - 4106,
http://inpressco.com/wpcontent/uploads/2012/11/Paper8318-3221.pdf

8) Ramesh, J. N. Prakash , A. S. Shiva Shankare Gowda Sonnappa Appaiah. Comparison of the Mechanical Properties of AL6061/Albite and AL6061/Graphite Metal Matrix Composites,A,j once.org,Vol. 8, No.2, pp 93-106, 2009.

9) Ananth prasad, nityanand bandekar. Study of Dispersoid Content and Chill Effect for Improved Mechanical Properties of Aluminum-Garnet-Carbon Hybrid Metal Matrix Composites.March 2015, Volume 3 Special Issue, ISSN 2349-4476.,
http://www.ijetmas.com/admin/resources/project/paper/f201503111426091722.pdf

10) Joel Hemanth. Action of chills on soundness and ultimate tensile strength (UTS) of aluminum–quartz particulate composite. Journal of Alloys and Compounds, 2000; 296;193-7.

11) Sajjadi S.A., Ezatpour H.R. and Parizi M.T., (2011), "Comparison of microstructure and mechanical properties of A356 Al-Al2O3 composites fabricated by stir and compo casting process", International Journal of Materials and Design, Vol. 34, pp. 106-111.

12) Nityanand Bandekar, Ananth Prasad."Study of Dispersoid Content and Chill Effect for Improved Mechanical Properties of Aluminum-Garnet-Carbon Hybrid Metal Matrix Composites". March 2015, Volume 3 Special Issue, ISSN 2349-4476
http://www.ijetmas.com/admin/resources/project/paper/f201503111426091722.pdf

13) Ananth Prasad et.al, Journal of Materials Science and Chemical Engineering, 2015, 3, 1-8&#0;."Study of Microstructure and Mechanical Behavior of Aluminum/Garnet/Carbon Hybrid Metal Matrix Composites (HMMCs) Fabricated by Chill Casting. Method&#0;".http://file.scirp.org/pdf/MSCE_2015031216202758.pdf

14) A. Misra, J.P. Hirth, R.G. Hoagland. Length-scale-dependent deformation mechanisms in incoherent metallic multilayered composites, Acta Materially. October 2005, Vol.53 (18).

15) Ananth Prasad, nityanand Bandekar. Journal of Materials Science and Chemical Engineering, 2015, 3, 1-8&#0;"Study of Microstructure and Mechanical Behavior of Aluminum/Garnet/Carbon Hybrid Metal Matrix Composites (HMMCs) Fabricated by Chill Casting Method&#0;"
http://dx.doi.org/10.4236/msa.2011.27118&#0;

16) Batluri tilak Chandra, Sanjeevamurthy, H.S.Shiva Shankar. (2016) International Journal of Scientific & Research Publications, "Effect of Cold Quenching On Mechanical Properties of Al7075-Albite Particulate. Composite&#; "http://www.ijsrp.org/research-paper-0816/ijsrp-p5647.pdf

