COMPARISON STUDY OF DRY SAND ABRASIVE BEHAVIOUR ON AS-CAST AND HEAT TREATED ALUMINIUM LM13-HEMATITE PARTICULATE COMPOSITE

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Abstract

Aluminium LM13 is most popularly used in automotive application due to its good mechanical and tribological properties. The reinforcement hematite (hard ceramic material) is a rich iron ore mineral. In this present work is to study the wear performance of the contrived Aluminium LM13-Hematite particulate composite manufactured by liquid metallurgy technique. The Hematite particles having grain size 100-150 µm spread for the range of 3wt.%, 6wt.%, 9wt.% & 12wt.% in Steps of 3wt.% were fused in to Aluminium LM13 matrix. The Aluminium LM13-Hematite composite has been subjected to solutionazing temperature at $530°C \pm 2°C$ *for 2 hours followed by water quenching and ageing treatment for 6 hours at* $175°C \pm 2°C$. *Microstructural studies were carried out for both as-cast and heat treated specimen in order to verify the nature of the arrangement. The Sand abrasive wear tests have been conducted to influence on Reinforcement and consequences of load for both as-cast and heat treat specimen. The weight percentage of reinforcement increases abrasive wear rate (Weight loss in mg) decreases in heat treated sample compare to as-cast sample. The load is increased wear rate decreases for heat treated sampling compare to as-cast sample.*

Keywords: *Aluminium LM 13, Hematite, Liquid Metallurgy Technique, Sand Abrasive Test Etc…*

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1. INTRODUCTION

For achieving the better and good performance of Al LM13 based matrix composites by adopt proper action (D Ramesh et al.,) details the abrasive wear performance of Al-6061 as-cast with Al-6061/frit composite [1] they observes under identical adopted conditions al-6061/frit particulate composites exhibit significant improvement in hardness, wear resistance and reduced density when compare to al-6061 matrix alloy. (Bhaskar H B et al.,) [3] examine the dry sliding wear actions of Al-2024 as-cast alloy and Al-2024/Beryl particulate composite. Under the identical conditions the Al-2024/Beryl heat treated composite gives better performance on wear than as-cast matrix alloy.

We are investicating Al LM13 alloy with Al LM13/Hematite composites were manufacture by a spin cast technique by changing the strengthening from 0 wt. % to 12 wt. % in stepladder of 3. The wear performance of both the as-cast and solutionized Al LM13/Hematite alloy and its composites are differentiate for effect of reinforcement, and various applied loads,

2 EXPERIMENTAL

2.1 Material Selection

Aluminium LM13 matrix alloy was select as matrix substance due to her remuneration like outstanding casting property, Thermal conductivity, strength, toughness, and warmth treatable. Spreads a wide application in automotive &automobile industries Table 1 illustrate the chemical composition of Al Lm13 matrix alloy substance use in this current study.

Hematite element size about 100-150 µm was use as reinforcement substance for Al lm13 matrix matter. Table 2 show the element symphony of Hematite particle reinforcement use in current investication.

Table 1: compound symphony of Al LM13by wt%

Chemical composition	Cu	Mg	Fe	Si	Mn	Ni	Zn	Ti	Al
Al LM13	1.5	1.4	1.0	1.2	0.5	1.5	0.1	0.2	80.8

Table 2: compound symphony of Hematite by wt%

Chemical Composition	Fe_2O_3	Mno	Tio_2	Al_2O_3	Cao	SiO_2	Loss on Ignition
Hematite	81.12	0.15	0.03	0.57	4.8	4.2	5.82

2.2 Composite Production

Aluminum LM13/Hematite composites were well prepared using liquid metallurgy manner (VORTEX). Particulate MMC`s are most often created either by dissolve incorporation and stir spreading technique or by natural powder blending. Stir casting path is generally practiced in a commercial way. Its advantage lies in its simplicity, overall flexibility and applicability to large volume of production, low cost. Al LM13 matrix material was melted using 6 KW electrical resistance heater. Pre heated Hematite contaminants were slowly added into the auminium lm13 matrix material and mixed carefully by means of mechanized stirrer (Shown in Fig 1) thoroughly mixed composite dissolve maintained at temp of 850^{o}C was added into the preheated metalic die. The percentage of Hematite particles was diversified from 0 wt% to 12 wt% at suitable intervals of 3 wt%. Cast Al LM13-Hematite particulate composite be machined to test standards

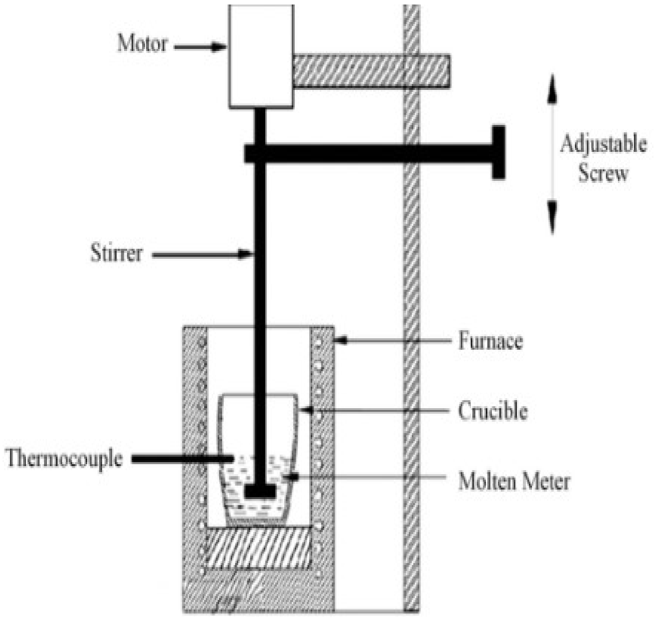

Fig 1: Liquid Metallurgy Technique

2.3 Heat Treatement

The cast Al LM13/Hematite exposed to solutionizing treatment by a heat 531°C done for duration of 2 hours with dampen heater, tracked through slacking (quenching) in Water. Synthetic aged treatment remained passed available in place of period of 6 hours at 175°C. Metallographic

2.4 Microstructure

Aluminium LM13 with Hematite composites were subjected to microstructural studies. The standard metallographic technique was adopted on Aluminium LM13 with Hematite particulate composites for microstructural characterization. The polished specimens were etched with Keller's reagent

3. SAND ABRASION TEST

The three body abrasive test was carried out at occasion malaise on AL LM13 alloy-Hematite Particulate composites of as cast and solutionazed specimen. Trials stood performed by typical neoprene wheel graze testing tackle as per ASTM G65 81 canons. Fig2 is the snap of the sand abrasion tester. Facts of the sand graze tester engaged in this present revision are reported in Table 3 shows test specimens of size 75X25X8mm were metallographically prepared and polished. Loads were mottled as of 2N to 10N insteps of 2N with a perpetual helm hustle of 200 rpm. Silica grit of grain size 50µm was charity as the rasping means. Having a Test extent of 30minutes was espoused for all specimens. Using digital assessing poise of exactitude 0.1 mg wear loss was measured for both As-cast and Heat Treated specimen.

Table 3: Description on sand abrasion testing apparatus.

SL No	Description	Particulars
1	Abrasive Material	AFS 50-70 test sand
2	Rubber Wheel speed	200rpm through a helical geared motor of 1.5kw
3	Test Load	1-45 N
4	Rubber Wheel Dia	228mm
5	Power	430v AC (3 Phase)
6	Specimen Dimension	75×24×8 mm
7	Erodent	AFS 3080
8	Sand mass flow rate	0.25Kg/Min
9	Rubber Hardness	60-62 Shore A
10	Duration	30 Min
11	Pressure	5.88N/mm^2
12	Load	12.78N

Fig 2: Standard Testing Machine of Sand Abrasive Wear

4 RESULTS AND DISCUSSION

4.1 Microstructure

The optical micrograph of the Al LM13 as cast and Al LM13 Heat Treated composites are shown in figure 3.No gathering of frit elements we observed in matrix phase, and dispersal of Hematite atoms has looks to be identical. This increases the properties of the combinations.

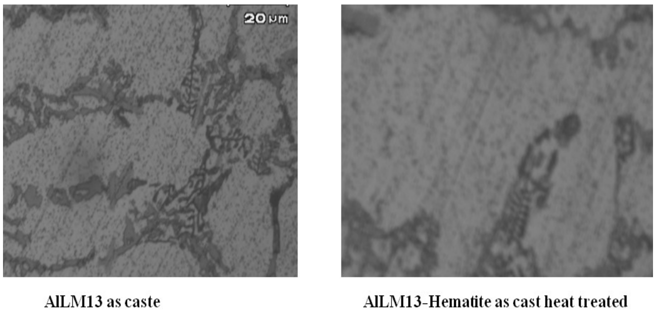

Fig 3: Shows microstructure as cast un Heat treated and Heat treated Al LM13-Hematite

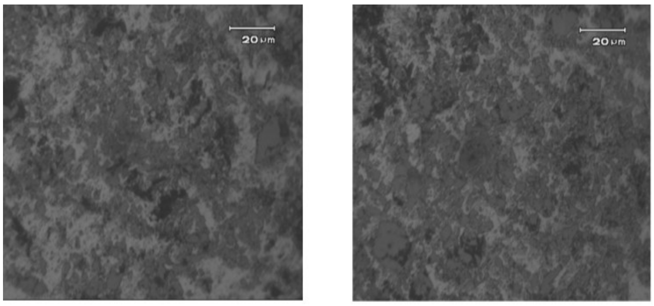

Fig 3a: Optical micrograph of Al LM-13/Hematite composite indicating fine attachment among the matrix and the Alloy.

4.2 Sand Abrasion

4.2.1 Outcome on Reinforcement

Fig 4 demonstrates the dissimilarity of rough wear loss (weight loss) of as-cast and heat-treated Al LM13 with Hematite particulate composite. It is noticed that heft defeat Drops with escalation in reinforcement content in conditions alloy in both as-cast and thermally salted disorders. Each specimens premeditated, heat-treated specimens exhibited well abrasive wear resistance than as-cast matrix adulterant and its composites. Decrease in burden loss with in upsurge in weight fraction of bolstering indicates higher hardness of composites. The inclusion of hard Hematite particles in soft ductile matrix alloy protects and reduces the magnitude of dissemination of the rasping constituent part on the shallow. (D.Ramesh et al.,2011). Higher hardness results in better rasping attire surrender of the tackles

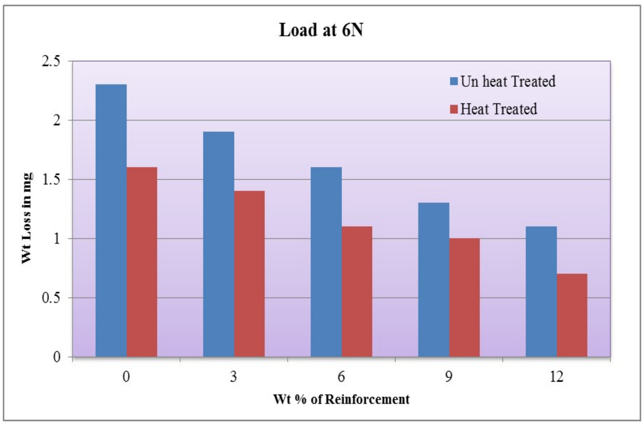

Fig 4: Displays deviation of weight reduction of Al LM13 with Hematite Particulate composite for both As-Cast and Heat treat Specimen.

4.2.2 Effect of Load

The deviation of mass loss of Al LM13-Hematite Particulate composites per load now as-cast and heat-treated circumstance is exposed in Fig 5 a and 5 b. There is a stable rise in attire up to a weight of 8 N and a step rise is noticed at 8 N for whole specimens premeditated.

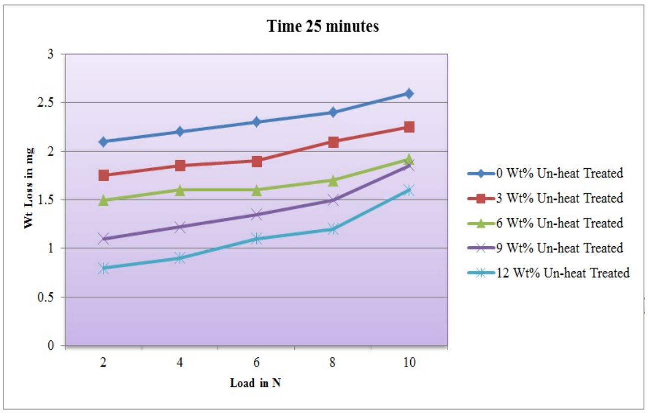

Fig 5 a: Shows the Variant of weight loss by means of increase in load for Al LM13-Hematite particulate composites under un-heat treated conditions

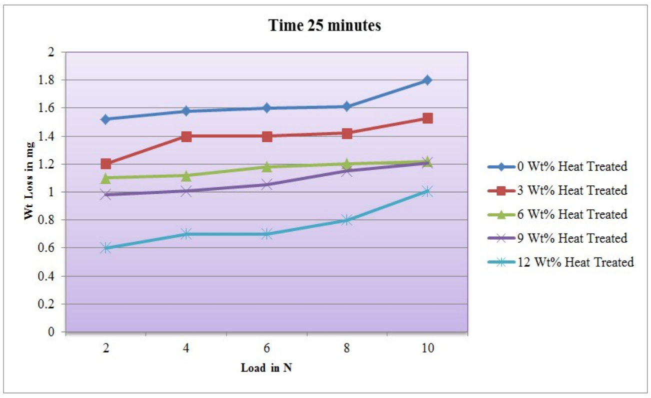

Fig 5 b: Variation of weight loss with increase in load for Al LM13-Hematite particulate composites under heat treatment conditions

5. CONCLUSION

Microstructural studies clearly indicate a fairly uniform distribution of the Hematite particles in the Aluminium LM13 matrix with a good interference relationship among the reinforcement and the matrix alloy. The Sand abrasive wear test reveals influence on Reinforcement and consequences of load for both as-cast and heat treated specimen. The weight percentage of reinforcement increases abrasive wear rate (Weight loss in mg) decreases in heat treat sample compare to as-cast sample. The load is increased wear rate decreases for heat treat sampling compare to as-cast sampling.

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