

# Al5083 matrix hybrid composites reinforced with zircon sand (ZrSiO<sub>4</sub>) particles and rice husk (RHA) particles are synthesized by the stir casting method

S.Dhileepan<sup>1</sup>, Dr.D.Lenin singara velu<sup>2</sup>, I. Justin antony raj<sup>3</sup>, J. Sebastin joyal<sup>4</sup>

<sup>1</sup> Assistant Professor, Department of civil Engineering, Vandayar engineering college, Thanjavur-613501-TN-India.

<sup>2</sup> Assistant professor, Department of production engineering, NIT-Tiruchirappalli, TN-INDIA.

<sup>3,4</sup> Assistant Professor, Department of Mechanical Engineering, Vandayar engineering college, Thanjavur-613501-TN-India.

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**Abstract:** Al5083, rice husk ash (RHA), zircon sand (ZrSiO<sub>4</sub>) hybrid composites are fabricated by the stir casting method with different weight fraction of RHA (5,10,15,20wt%) and constant ZrSiO<sub>4</sub> of (5wt%). The mechanical and wear behaviour such as hardness and wear test has been carried out by using Brinell hardness testing and pin-on-disc apparatus respectively. Micro structure of the specimens are also investigated by using scanning electron microscope (SEM). Wear properties of the specimen are studied by using a pin-on-disk wear tribometer with different parameter like velocity of 1, 1.5, 2m/s and weight 10, 20N. Samples are successfully fabricated by stir casting. SEM, EDAX reviews are showing the presence of reinforcement. Hardness is increased by the presence of ZrSiO<sub>4</sub> and wear properties of the Al5083-RHA(10%)-ZrSiO<sub>4</sub>(5%) have high wear resistance compare to other samples.

**Keywords:** Composite materials, Scanning electron microscope, stir casting method, wear test.

## 1. INTRODUCTION

The constituents are combined in a microscope picture. Material is composed of reinforcement, fibres, particles (metals, polymers). The matrix holds the reinforcement to the overall mechanical properties of the matrix. The most primitive man-made for building construction purpose. For many researchers, the term metal matrix composites are often equated with the term light metal matrix composites (MMCs). Substantial progress is achieved in recent decades, so that they could be introduced especially in the automobile industry. MMCs have been used cases with strengthened cylinder surfaces as well as particle. Unlimited possibilities for modern material science, the material and custom made are dependent on the applications. The most primitive man-made composite material are straw and mud combined to form bricks for building.

## LITERATURE SURVEY:

Hussein Abdizadeh et al.(2011): Above researcher conducted the experiments on aluminium having

corrosion resistance and mechanical properties like strength at high temperatures. Nigamanada ray et al.(2010): Above researcher conducted the experiments on zircon sand consists of mostly zirconium silicate (ZrSiO<sub>4</sub>), minerals, foundry molds to increase the resistance against metal penetration. Shailovekumar et al.(2010) Above researcher conducted the experiments on the arrangement and type of fiber (or particle) reinforcement having the greater the strength. Research Gap: Above researcher is not done with micro structural observations of Al 5083 hybrid composite shows the uniform distribution of reinforcement particles and the matrix and not researched over with the addition of zircon sand (ZrSiO<sub>4</sub>) and rice husk ash (RHA) particles and the hardness of the composite increased gradually as well as wear resistance also increased.

## 2. EXPERIMENTAL DETAILS:

### MATERIALS /MACHINES/EQUIPMENTS USED

For performing the experiment and testing of composites, the following Materials /machines/Equipments are used.

- Matrix (Al5083)
- Reinforcements (RHA, ZrSiO<sub>4</sub>)
- Digital control Electric resistance Muffle Furnace
- Weighing Machine
- Graphite crucible
- Graphite stirrer
- Mild steel Mold
- Power Hacksaw
- Lathe Machine
- Emery papers grid size - 100, 300, 600, 1000, 0/1, 0/2, 0/3, 0/4.
- Double disc polishing machine
- Scanning Electron Microscope (SEM).

**Table . 1. chemical composition of Al5083 alloy**

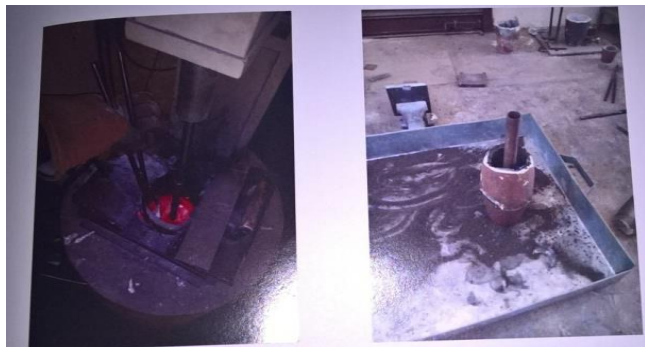
Element	SiC	Fe	Cu	Mn	Mg	Ti	Cr	Zn	Al
%	0.4	0.1	0.4-1	4.0-4.9	0.1-5	0.05-0.25	0.05-0.25	0.2-5	92.7

Reinforcement consists of

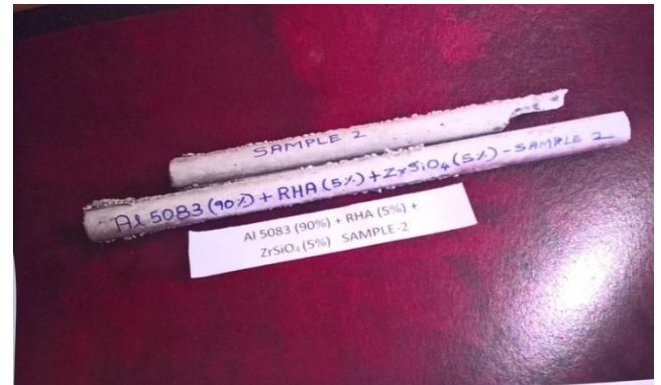
- 100% chemically pure zircon sand ( $ZrSiO_4$ ) purchased from ESSAR ceramics .
- Rice Husk Ash (RHA) prepared by ourselves which is having the micron size of 300 microns and 75 microns respectively.

**Table.2. composition of matrix and reinforcement in wt%**

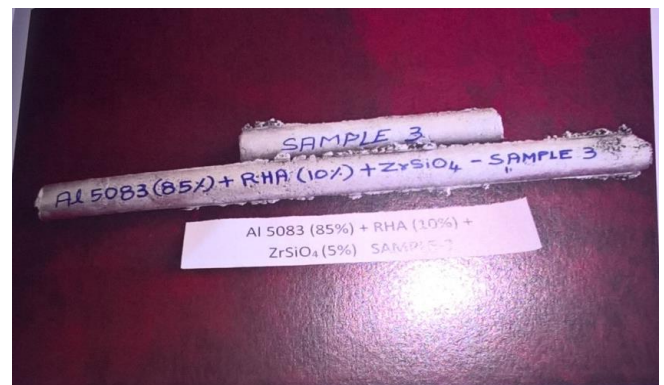
Samples	Al5083 in %	RHA in %	ZrSiO <sub>4</sub> in %
1	95	5	0
2	90	5	5
3	85	10	5
4	80	15	5
5	75	20	5



**Fig.1. Experimental setup of stir casting and Molten metal poured into cylindrical**



**Fig.3. Composite sample of 5%RHA+5%ZrSiO<sub>4</sub>**



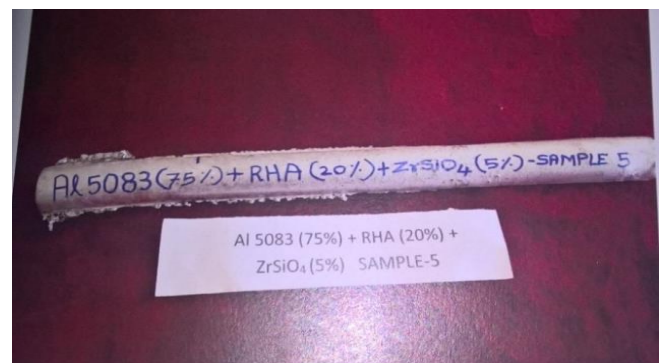
**Fig.4. Composite sample of 5%,10%RHA+5%ZrSiO<sub>4</sub>**



**Fig.5. Composite sample of 15%RHA+5%ZrSiO<sub>4</sub>**



**Fig.2. Composite sample of 5% RHA**



**Fig.6. Composite samples of 20%RHA+5%ZrSiO<sub>4</sub>**

**Microstructure**

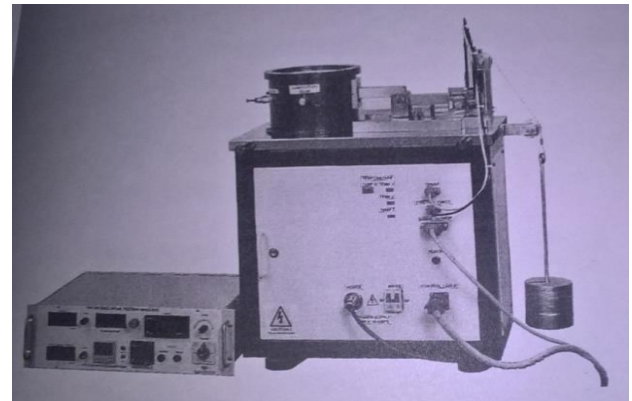
For making the scratch less surface ,the entry papers grid size -100,300,600,1000,0/1,0/2,0/3,0/4 are used .Flaky powders of different fineness water is spread over a rotating disc covered with polishing and fineness (12-15m,5-6m,1m) are usually used for successive polishing stages.



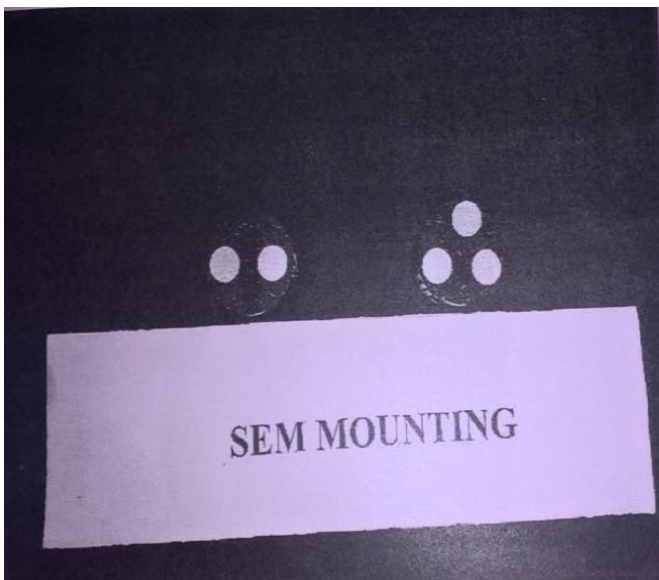
**Fig.7.Scanning Electron Microscope.**



**Fig.9.Brinell Hardness testing machine.**



**Fig.10.Pin-On-Disk Apparatus.**



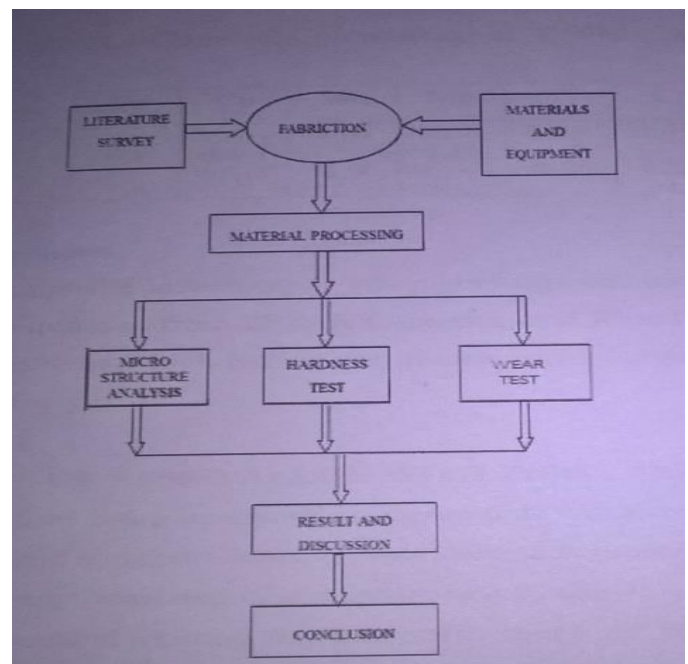
**Fig.8.Specimens for Microstructure Analysis.**

**Brinell Hardness Test:**

Test material is intended with a 5mm diameter hardened tungsten carbide ball subjected to a weight of 250kg is applied for 20 seconds.Brinell hardness test is worked by surface area of the indentation

**3. Methodology**

The experimental work has been planned as per the flow chart given in the figure . 11.for execution.



**Fig.11.Work flow chart**

**REINFORCEMENTS:**

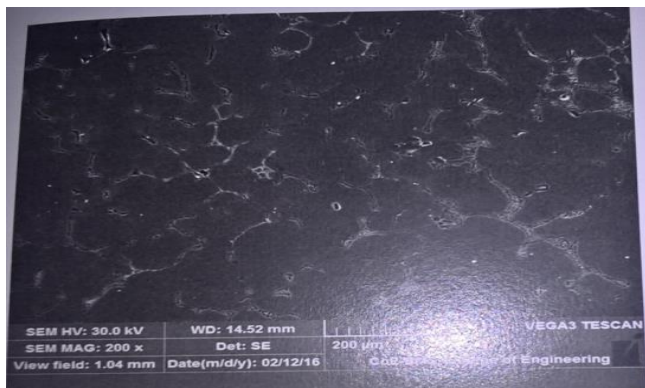
In this composite investigation 100 percentage chemically pure zircon sand ( $ZrSiO_4$ ) is purchased from ESSAR ceramics and Rice Husk Ash (RHA) prepared by ourselves which is having the micron size of 300 microns and 75 microns respectively.

**Table.3. Processing parameters**

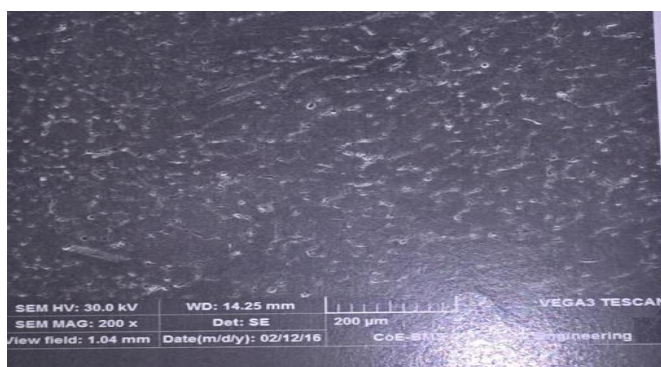
Processing temperature	800°C
Stirrer speed	300-500 rpm
Feed rate of reinforcement	2-3 g/stroke
Stirring duration	10 minutes
Incubation	3 hours

**IV- Result and discussion**

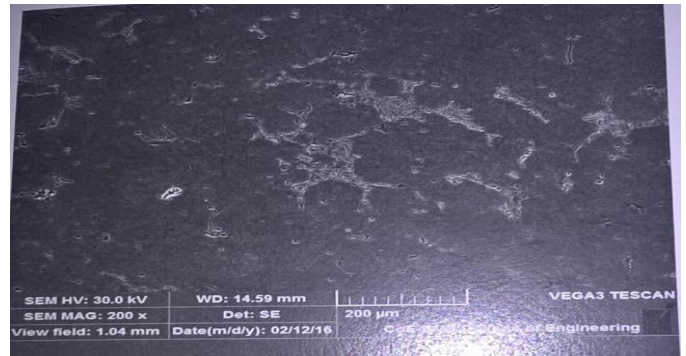
The scanning electron micrographs are taken for analyzing the bonding ,grain size of the reinforcement and the formation of pores,clusters and also the inter metallic formation.The below figure shows the SEM image of the composites of the different combinations for 200x magnifications.



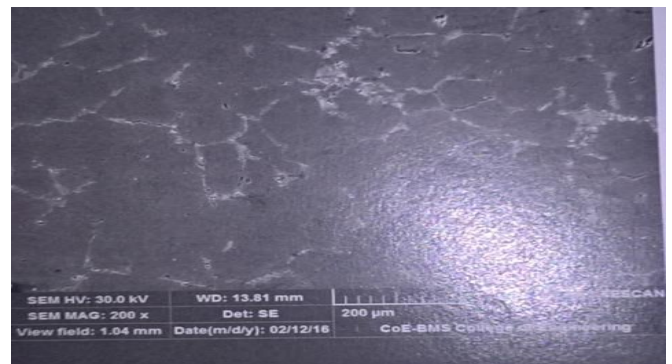
**Fig.12.SEM image of 5%RHA+5%ZrSiO4 composite**



**Fig.13.SEM image of 10%RHA+5%ZrSiO4 composite**



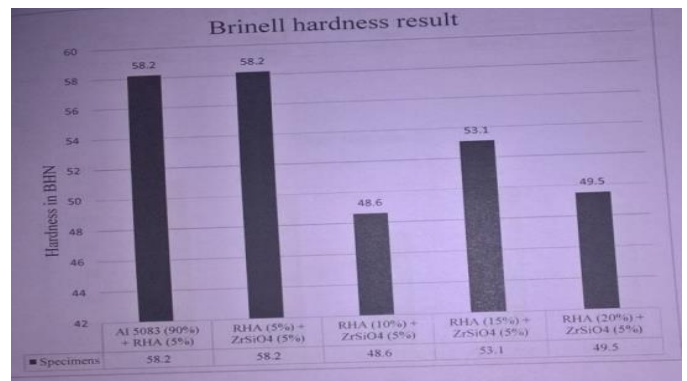
**Fig.14.SEM image of 15%RHA+5%ZrSiO4 composite**



**Fig.15.SEM image of 20%RHA+5%ZrSiO4 composite**

**HARDNESS:**

The below figure shows the hardness result sample 5%RHA,5%Zrsio<sub>4</sub>+5%RHA have the higher hardness value followed by sample having 5%Zrsio<sub>4</sub>+20%RHA.By addition of reinforcement ,the hardness value will be increased .The curve indicates that the increment of hardness value for the corresponding sample with percentage in x-axis.



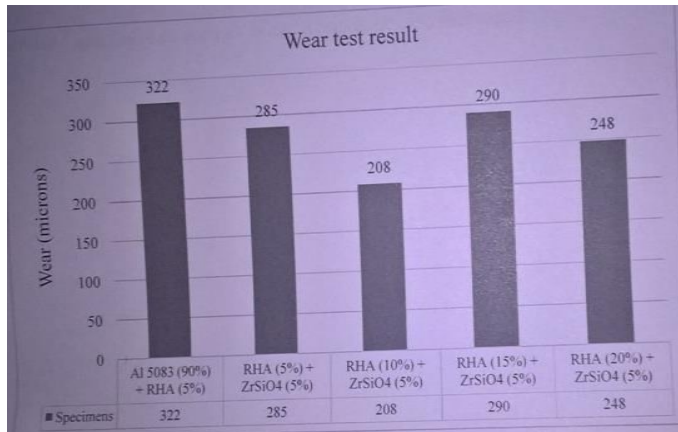
**Fig.16.Hardness chart of the composites**

**Table .4. Parameters for wear test**

Load(N)	Trac radius(mm)	Speed(rpm)	Time(min)	Frictional force(N)	Coefficient of friction
15	60	520	30	1	0.08

**WEAR TEST:**

Usually the compression property of the composite will get loose in the Zircon sand and RHA reinforced composites. As compared to the 5%RHA,5%ZrSiO<sub>4</sub>+5%RHA,5%ZrSiO<sub>4</sub>+10%RHA,5%ZrSiO<sub>4</sub>+15%RHA,5%ZrSiO<sub>4</sub>+20%RHA composite ,the resultant graph shows the low value in the 5%ZrSiO<sub>4</sub>+10%RHA composites and having higher wear resistance over the Zircon sand (ZrSiO<sub>4</sub>)and Rice Husk Ash (RHA) reinforced composites.



**Fig.17.Wear test result**

**V – Conclusion:**

- 1) Al5083 matrix hybrid composites are reinforced with Zircon sand (ZrSiO<sub>4</sub>) particles and Rice Husk (RHA) particles synthesized by the stir casting method.
- 2) The composite with hybrid reinforcement has good distribution and interfacial bonding .
- 3) Micro structural observations of Al 5083 hybrid composite shows the uniform distribution of reinforcement particles
- 4) Micro structural observations of Al 5083 hybrid composite shows good interfacial bonding between the particles and the matrix.
- 5) The addition of Zircon sand (ZrSiO<sub>4</sub>) and Rice husk ash(RHA) particles, the hardness of the composite increases gradually .
- 6) Addition of Zircon sand (ZrSiO<sub>4</sub>) and Rice husk ash(RHA) particles having increased Wear Resistance .

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