# Experimental investigation of microstructure and mechanical characteristics of Al5083 & Fly ash composite.

**K.Ganesh[1] , I.Justin antony raj [2] , P.kamaraj[3] ,J.Sebastin joyal [4]**

*[1 2 3 4] Assistant Professor, Department of Mechanical Engineering, Vandayar engineering college , Thanjavur-613501-TN-india.*

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***Abstract:** Applications of this project is in* ship building, rail cars, vehicle bodies, tip truck bodies, mine skips ,cages and pressure vessels. *Present study is to investigate the mechanical wear behaviour of Al5083 flyash composite fabricated by the stir casting method with different volume fraction of fly ash (5,10,15wt%).Mechanical test is about hardness test and tensile test has been conducted by using brinell Hardness Testing and universal testing machine respectively. Microstructures of the specimens are analyzed to understand the modes .*

**Keywords:** *Composite materials, Raw materials, Scanning Electron microscope.*

## 1.INTRODUCTION

Al5083 alloy matrix hybrid composites reinforced with flyash particles are studied. Al5083 alloy matrix hybrid composites can be synthesized by the stir casting method. SEM review is studied . Uniform distribution of reinforcement particles for cast composite is studied. Project deal with interfacial bonding between the particles and the matrix. Incorporation of flyash particles( upto 15wt% led ) are marked with improvements in the resistance of the Al alloy.Wear test is studied.

## 2.LITERATURE SURVEY

**A.P.S.V.R.Subrahmanyam. et.al(2015)** Above researcher conduct experiments on effect of rice husk ash and fly ash of aluminium alloy (AlSi10Mg) Matrix composites**. Hussein Abdizadeh et al (2011).** Above researcher conduct experiments on study of metal matrix composites (MMCs) and aluminium (Al)as the best metal for producing these composites. **Shailovekumar et al (2010).** Above researcher conduct experiments on study the strength of composite depend primarily on the amount. **K.Kalaiselvan et al (2010).** Above researcher conduct experiments on studied this work focuses on the fabrication of aluminium (6061-T6)matrix of $B_4C$ particulates by modified stir casting route. **Research Gap:** Above researchers are not done research with stir casting method and not researched over the incorporation of flyash particles upto 15wt% led are marked with improvements in the resistance of the Al alloy without much effect in tensile strength and hardness.

## 3. EXPERIMENTAL DETAILS:

### 3.1 CNC lathe settings

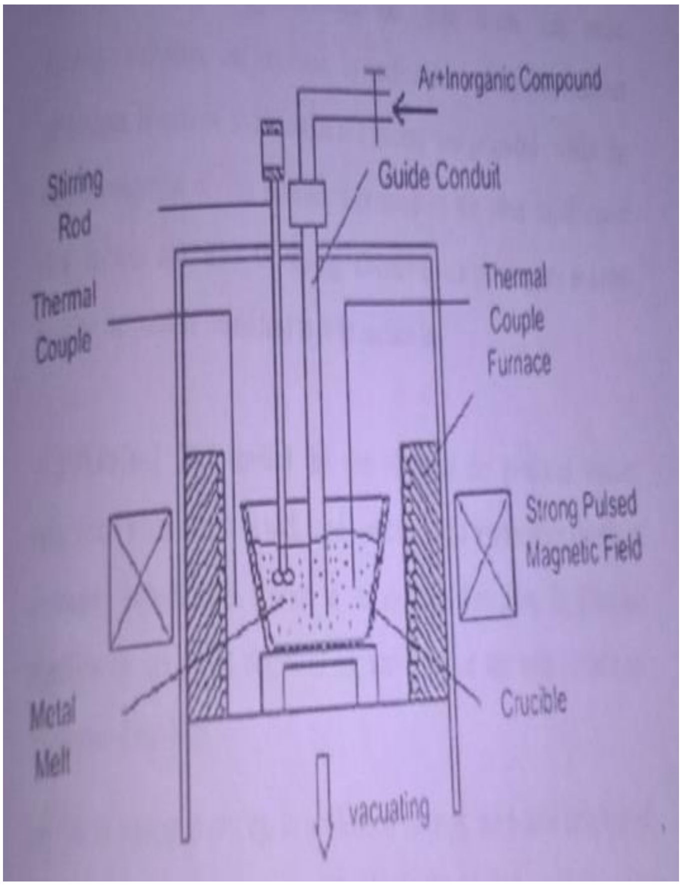


**Fig.1.Schematic setup for fabrication of AMC Via stir casting technique**

A stir casting setup is as shown in figure 1 consisted of a resistance muffle furnace and a stirrer assembly is used to synthesize the composite . Variable speed vertical drilling machine having range. Stirrer is made by cutting and shaping a graphite block and three blades at an angle of 120 apart .5Kg capacity Graphite crucible is placed inside the furnace .

**Fig.2.Experimental setup of stir casting and poured molten metal in the mould**

**Table .1. processing parameters**

| | |
|---|---|
| Processing temperature | $800^0$C |
| Stirrer speed | 640rpm |
| Feed rate of reinforcement | 20 g/min |
| Stirring time after reinforcement | 10minutes |
| Incubation time | 3hours |
| Slag removing agent | Scum powder |
| Degassing tablet | Hexo chloro ethane |

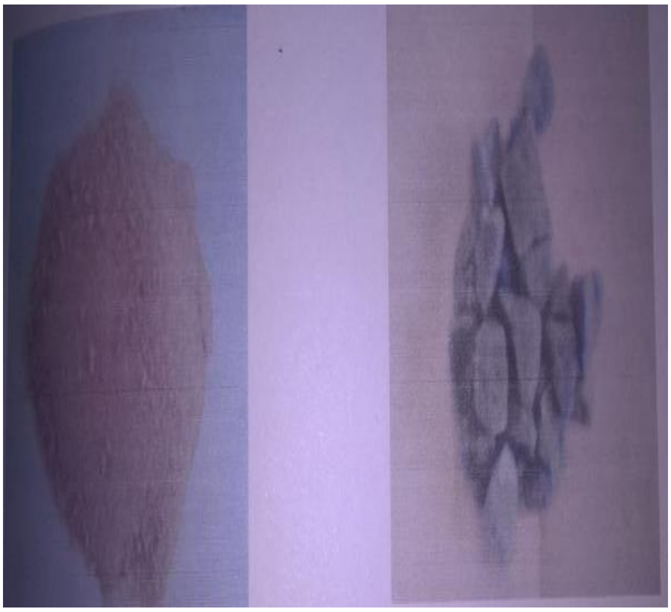

**Fig.3.Scum power and Degassing Tablets**

**Table .2. Chemical composition of A15083 alloy**

| Element | SiC | Fe | Cu | Mn | Mg | Ti | Cr | Zn | Al |
|---|---|---|---|---|---|---|---|---|---|
| % | 0.4 | 0.1 | 0.4-1 | 4.0-4.9 | 0.15 | 0.05-0.25 | 0.05-0.25 | 0.25 | 92.7 |

**Table 3.Composition of matrix and reinforcement in wt%.**

| Samples | Al 5083in wt.% | Fly ash in wt.% |
|---|---|---|
| 1 | 95 | 5 |
| 2 | 90 | 5 |
| 3 | 85 | 10 |
| 4 | 80 | 15 |

## MICROSTRUCTURE:

Fig.4.shows the experimental setup of Scanning electron microscopy.The as cast composites are cut into required size and which surface is prepared for microstructure analysis .The emery papers grid sizes (-100,300,600,1000,0/1,0/2,0/3,0/4) are used for making the scratchless surface and then the fine scratches caused by final grinding and fineness are used as polishing abrasives .A mixture of powder , velvet cloth ,alumina ,magnesia and diamond powders are used as a material.

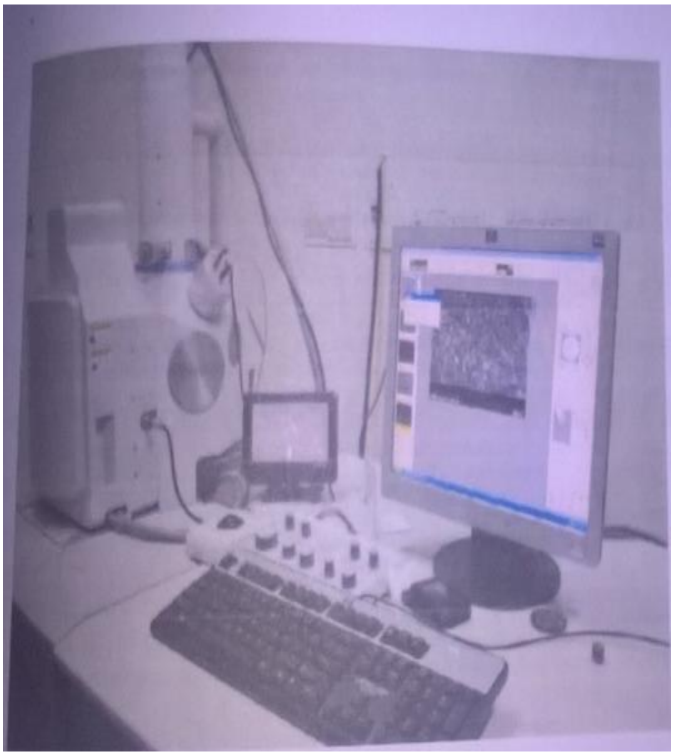

**Fig.4.Scanning Electron microscopy**

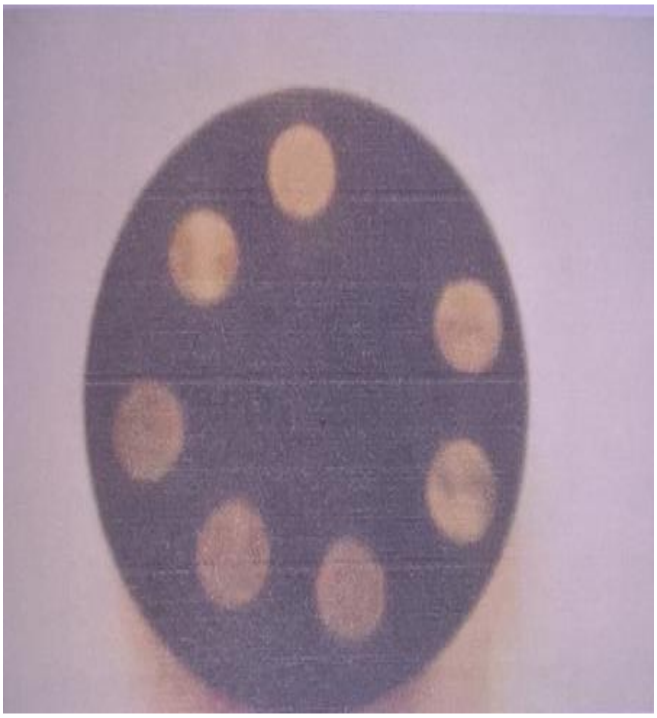

**Fig.5.Specimen for Microstructure Analysis.**

## Brinell Hardness Test :

Test material is indented with a 5mm diameter hardened tungsten carbide ball subjected to a weight of 250kg applied for 20 seconds .The diameter of the indentation left and hardness number is calculated by dividing the load applied and the impression is the average of five readings at right angles.

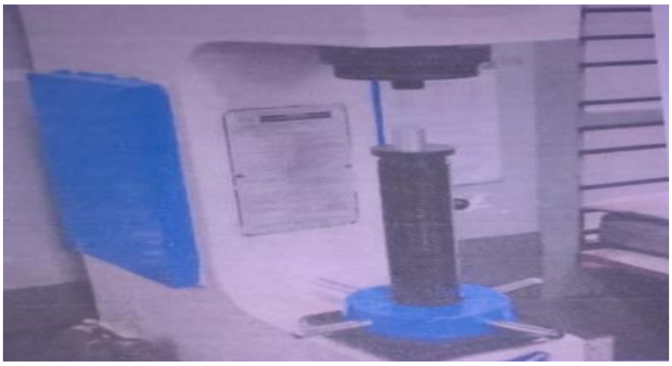

**Fig.6.Brinell Hardness testing Machine**

## Tensile Test:

The room temperature tensile test is conducted using Universal testing machine .The as cast Aluminium 5083 alloy composite samples for tensile test are prepared using CNC lathe according to ASTM E8.

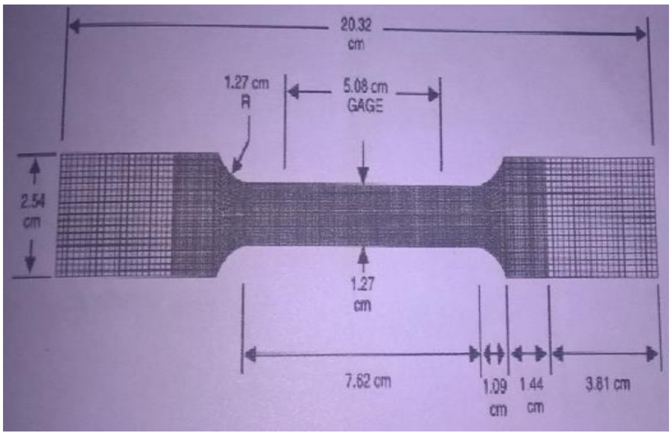


**Fig.7.Tensile specimen ASTM E8**

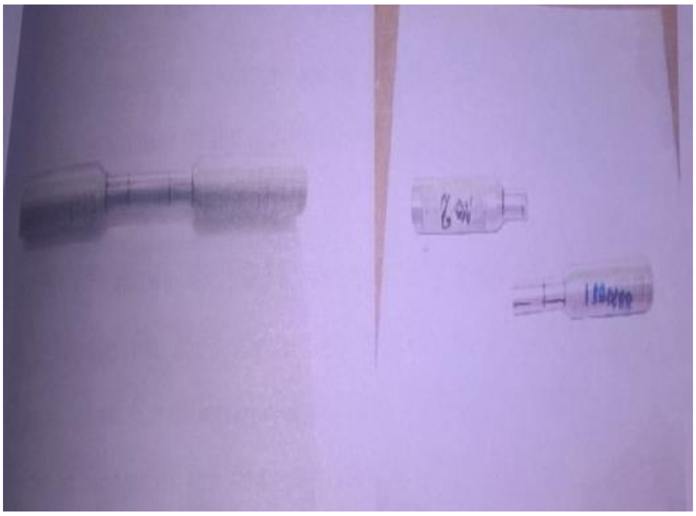

**Fig.8.Specimen for Tensile Test and Tested specimen**

The test is conducted trice to get the average response value.

The schematic diagram of Universal Testing Machine is given in the figure. 9.

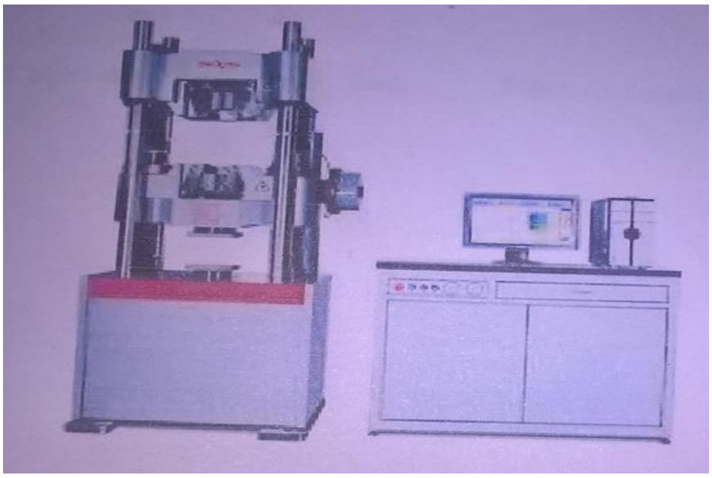

**Fig.9.Universal Testing Machine**

## 4.METHODOLOGY

The experimental work is planned as per the flow chart given in the figure 10.

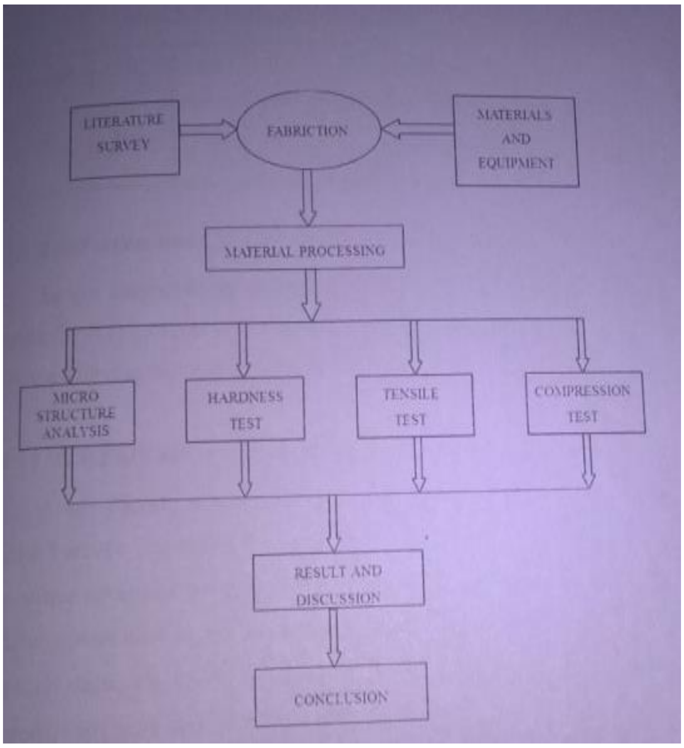


**Fig.10. Work flow chart**

## MATERIALS/MACHINES/EQUIPMENTS USED

For performing the experiment and testing of composites, the following.

Materials/ machines/ equipment's are used.

- Matrix(Al alloy 5083)
- Reinforcements(Fly ash)
- Digital control Electric resistance Muffle Furnace
- Weighing Machine
- Graphite crucible
- Graphite stirrer
- Mild steel Mould
- Power hacksaw
- Lathe Machine
- Emery papers grid sizes- 100,300,600,1000,0/1,0/2,0/3,0/4
- Double disc polishing machine
- Scanning Electron Microscope (SEM)
- Hardness Testing Machine
- Computerized UTM

## RAW MATERIALS:

- **Matrix**

Aluminium alloy 5083 is used as matrix in the synthesis of composite in the form of ingots and then cut into smaller pieces with the help of power hacksaw in order to keep the alloy inside the crucible properly.

## 5. RESULT AND DISCUSSION

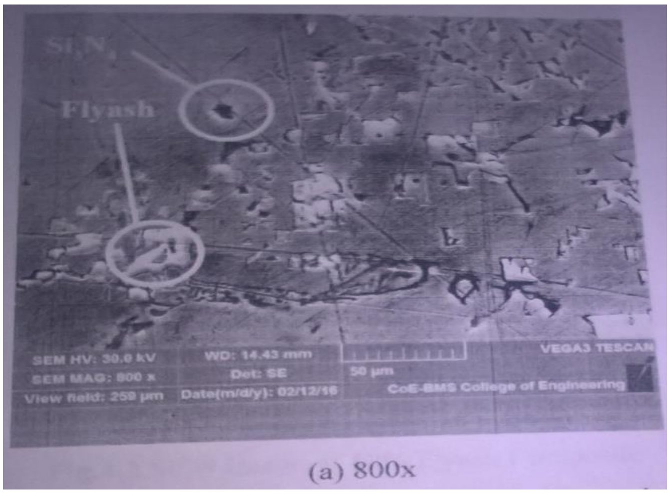


**Fig.11. SEM Image of 5% Flyash composite**

The scanning electron micro graphs are taken for analyzing the bonding ,grain size of the reinforcement and the formation of pores ,clusters and inter metallic formation. Figure 11 shows the SEM image of the composites of the different combinations for 250x zooms .

## HARDNESS:

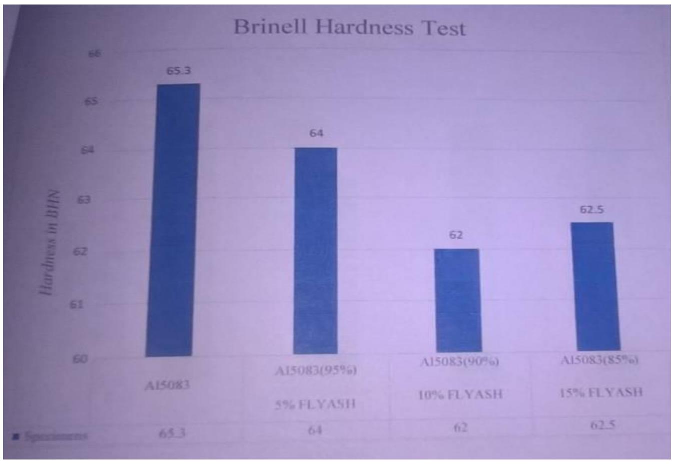


**Fig.12.Brinell Hardness Test**

Figure. 12.shows the hardness result in terms of BHN along Y axis .The composite sample having 5 wt.% of $Si_3N_4$ have greater hardness value.The curve decreases on further addition of $Si_3N_4$ and Fly ash particles.The hardness value is seen increasing when 15 wt.% of $Si_3N_4$ and 5 wt.% flyash particles are added .

**TENSILE STRENGTH:**

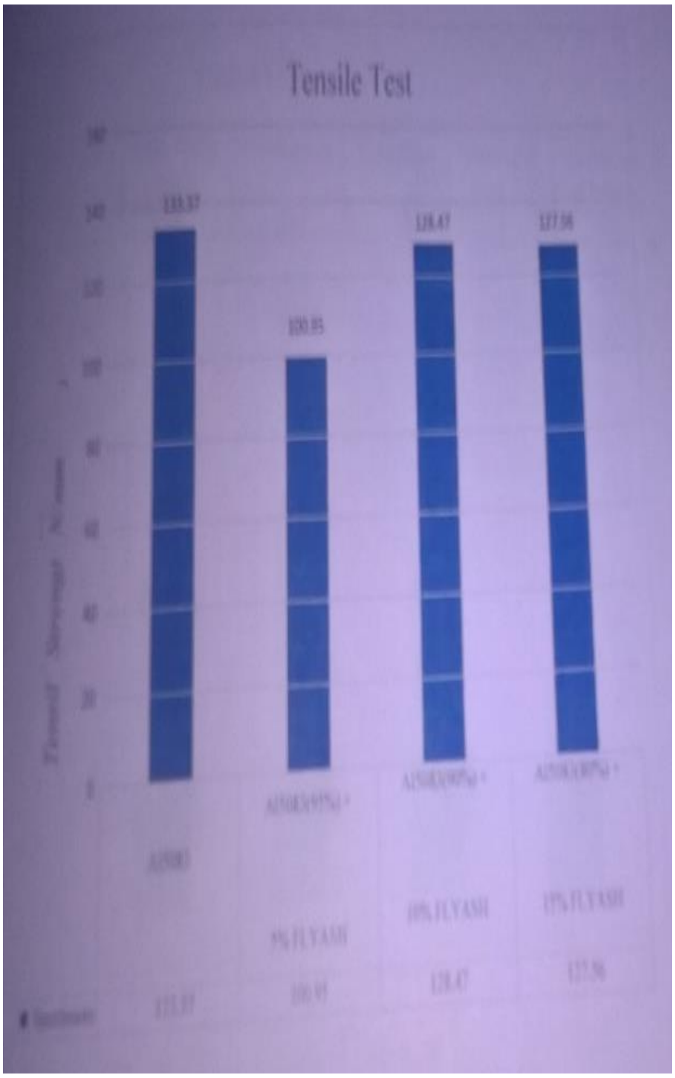


**Fig.13.Tensile strength graph.**

Figure 13.shows the tensile curve for the composites according to their combinations .Usually the tensile property of the composite will get loose on the zircon sand and Boron carbide reinforced composites .As compared to the 10% Flyash & 15%Flyash composite ,the resultant graph shows the peak value in the 5%flyash composites having higher tensile strength over the flyash reinforced composites.

**Table.4.parameters**

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

The resultant graph shows the peak value in the 5% flyash composites having higher tensile strength over the flyash reinforced composites.

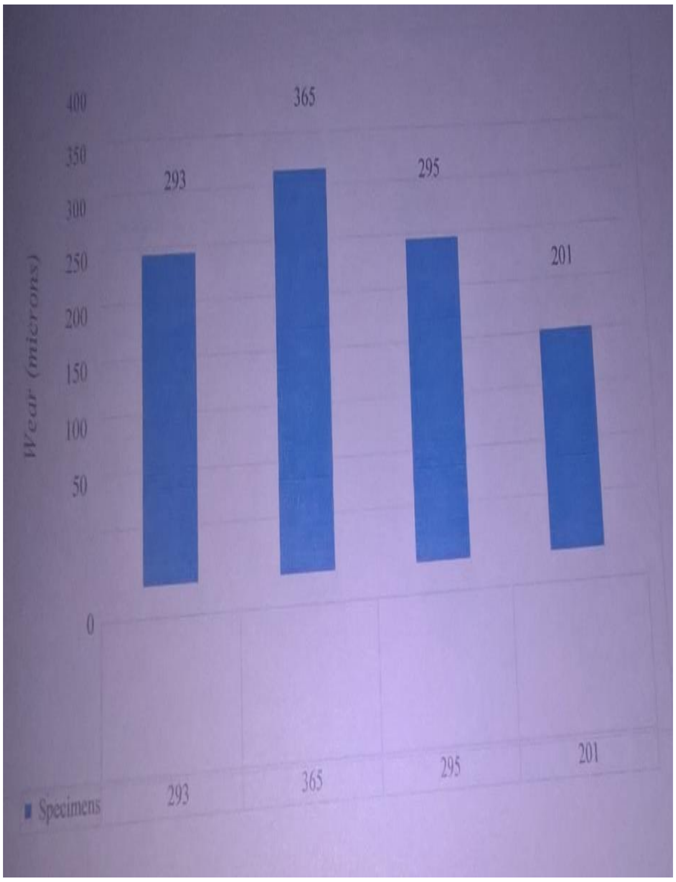


**Fig. 14 .wear test result**

## 6.CONCLUSION

1) Al5083 alloy matrix hybrid composites are reinforced with flyash particles can be successfully synthesized by the stir casting method.
2) SEM reviews that the cast composite shows uniform distribution of reinforcement particles.
3) Good interfacial bonding between the particles and the matrix.
4) Incorporation of flyash particles (upto 15wt% led) are marked with improvements in the resistance of the Al alloy without much effect in tensile strength and hardness.
5) Wear test result of co-efficient of friction is 0.08.

## REFERENCE

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