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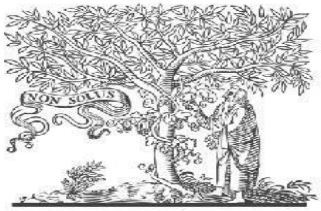

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Paper Authors **Mr.Ch. Raju, K. Prakash, G.Abhishek, M. Harsha vardhan , P. Pavan**

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MICROSTRUCTURE AND MECHANICAL PROPERTIES OF ALUMINIUM METAL MATRIX COMPOSITES WITH ADDITION OF SUGARCANE BAGASSE ASH

Mr.Ch. Raju*1, K. Prakash* 2, G.Abhishek*3, M. Harsha vardhan *4, P. Pavan*5

Assistant Professor, Mechanical Department, ACE Engineering College, Hyderabad, Telangana, India.
2,3,4,5 Students, Mechanical Department, ACE Engineering College, Hyderabad, Telangana, India.

ABSTRACT: Metal Matrix Composites (MMCs) are highly attractive for large range of hi-tech engineering applications because of their useful properties. However the methods used to produce these composites are constantly evolving particularly in getting rid of non-uniform distribution of the reinforcement. Manual Stir casting is the most commonly used method for production of particulate reinforced cast metal matrix composites. Stir casting has been used in the present investigation to produce aluminum matrix composites reinforced with fly ash. The composites are prepared by adding the fly ash 5%, 10% by weight than the mechanical properties are compared by pure Aluminium. The properties of the resulting composites are measured.

INTRODUCTION

The importance of composites as engineering materials is reflected by the fact that out of over 1600 engineering materials available in the market today more than 200 are composites. These composites initially replaced Cast Iron and Bronze alloys but owing to their poor wear and seizure resistance, they were subjected to many experiments and the wear behavior of these composites were explored to a maximum extent and were reported by number of research scholars for the past 25 years [1]. Bagasse is a by-product from the sugar industry and it is usually burnt at the mill to provide process power or steam that provides energy for process machineries. The use of sugar cane bagasse as a source of energy, because of its appreciable calorific value, leads to production of ash as waste which has no specific economic application. The aim of this work is to utilize abundant bagasse ash as agricultural wastes as reinforcement in the production of Aluminium matrix composites so as to reduce the environmental impact of the solid wastes to the society and improve economic utilization of bagasse waste and Aluminium matrix composites.

LITERATURE REVIEW

G. Siva karuna et. al., conducted a survey was made on effects of reinforcement on Aluminium metal matrix composites. The reinforcements are ceramics materials like Silicon Carbide, Aluminium-dioxide, Boron Carbide & Tungsten Carbide which are reinforced with Aluminium& their properties were studied. The survey results the ceramic reinforcement materials improves the mechanical properties like Tensile strength & Hardness compared with base metal Aluminium [1].

H. Md. Arif Mahmud, Ferdausee Rahman Ananya, concluded that Sugarcane bagasse is an excellent source of cellulose as it is a waste material, It has a rind part, which is quite strong. But its applications are not limited to only paper industries. Bagasse fibers are a source of cellulose thatused for various applications. The diverse field of application includes bothfully and partially biodegradable materials that match the currently ongoing trend of making a substitute for synthetic materials. So, sugarcane bagasse can be an excellent source or raw material for making environmentally friendly products [2]

RELATED WORK

To prepare MMC of Aluminium and fly ash there are number of casting techniques which can be used but the Manual casting technique is most economical and less time consuming. In this research the preparation of MMC Aluminium with SCA with different mesh size and different weight. we uses reinforced particles size of SCA respectively and mix it to Aluminium by weight of 5%, 10%, Then the calculate mechanical properties of the sample and find the best one. In this research We used Sugar Cane-Bagasse Ash, which contains Aluminium ion and silica, in concrete with cement by weight of 0%, 5%,

10%, By this we can minimize the industrial waste and also used to minimize the use of cement in concrete by replacing it to bagasse ash.

EXPERIMENTAL DETAILS

ALUMINIUM ALLOY 6061

6061 (Unified Numbering System (UNS) designation AAL6061) is a precipitation-hardened Aluminium alloy, containing magnesium and silicon as its major alloying elements.

Originally called "Alloy 61S", it was developed in 1935. It has good mechanical properties, exhibitsgood weldability, and is very commonly extruded (second in popularity only to6063). It is one of the most common alloys of Aluminium for general-purposeuse.

Constituentelement	Minimum (% by weight)	Maximum (% by weight)
Al	95.85	98.56
Mg	0.80	1.20
Si	0.40	0.80
Fe	0	0.70
Cu	0.15	0.40
Cr	0.04	0.35
Zn	0	0.25
Ti	0	0.15
Mn	0	0.15
others	0	0.15(total) (0.05 each)

CHEMICAL COMPOSITION OF AL6061

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SUGARCANE BUGASSE ASH

Sugarcane bagasse ash (SCBA) is a byproduct obtained from the burning of sugarcane bagasse,which is the fibrous residue left after extracting juice from sugarcane in the sugar production process.SCBA is composed mainly of silica, but it can also contain other elements and compounds dependingon the specific conditions of bagasse combustion. Here is a general overview of the composition andproperties of sugarcane bagasse ash:

Sugarcane Bagasse and Sugarcane bagasse Ash

Composition:

Silica (SiO2): This is the predominant component in SCBA, typically accounting for around50-80% of its composition.

Carbon (C): Bagasse ash may contain a small amount of residual carbon from incomplete combustion.

Alumina (Al2O3): Some bagasse ash samples may contain a minor amount of alumina.

Other Elements: SCBA can contain trace amounts of various elements, including calcium (Ca), potassium (K), magnesium (Mg), sodium (Na), iron (Fe), and others. The specific composition can vary depending on the source and combustion conditions.

SPECIMEN PREPARATION

IZOD TEST:

The specimens for the IZOD test were prepared on shaper machine. The IZOD test specimen was 75mm long with 10×10 mm2 cross section, having a standard 45o notch 2mm deep.

HARDNESS TEST:

The samples for the bending test were prepared on lathe machine. The samples were prepared according to ASTM E10. The dimensions for samples were 10mm diameter and 15mm length. After this, with the help of microscope, indent caused by the ball indenter is measured, a inbuilt micrometer scale is present in the microscope, which is adjustable according tothe position of indent we can adjust it to measure the diameter of indent.

COMPRESSION TEST:

The specimen for the compression test were prepared on shaper. The compression test specimen was 50*50mm cross section area

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MICROSTRUCTURE:

Microstructural characterization studies were conducted to examine distribution of reinforcement throughout the matrix. This is accomplished by using scanning electron microscope. The composite samples were metallographically polished prior to examination. Characterization is done in etched conditions. Etching was accomplished using Keller's reagent. The SEM micrographs of composites were obtained using the scanning electron microscope. The images were taken in secondary electron (SE) mode.

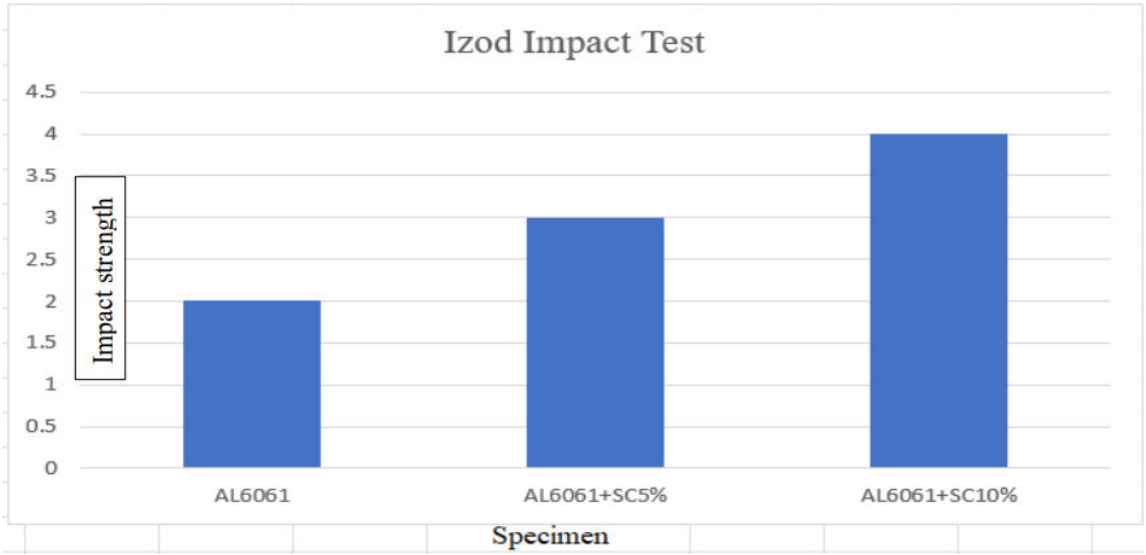
IZOD IMPACT TEST :

The table shows the impact strength that the specimen (Aluminium) alloy 6061 reinforced with the sugarcane bagasse ash) is having at 0%, 5% and 10% of SCBA as reinforcement in aluminium metal matrix

S.NO	SPECIMEN	LOAD(Kg)	PENDULUM ANGLE IN(Deg)	IMPACT STRENGTH
1	AL6061	82	90	2
2	AL+5%SCB	82	90	3
3	AL+10%SCB	82	90	4

Izod impact strength of aluminium 6061 alloy and SCBA reinforced composites

Graph showing the impact strength of AAl6061 with SCBA as reinforcement



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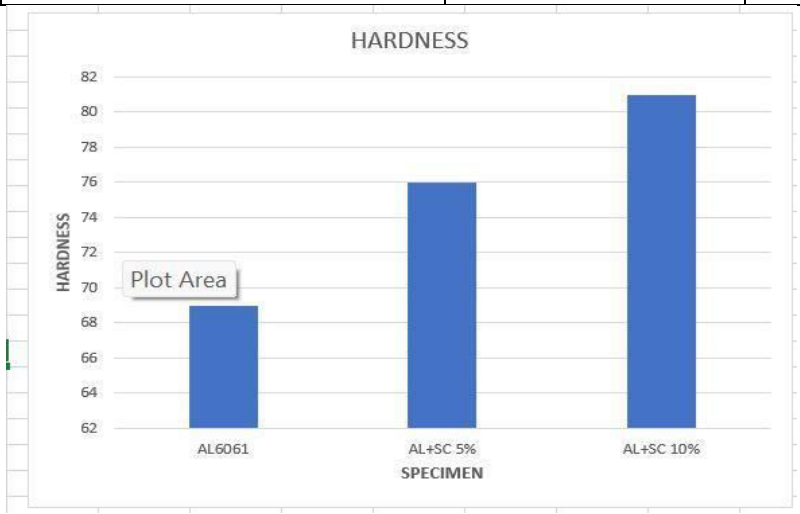
ROCKWELL HARDNESS TEST:

The Rockwell hardness test is a commonly used method for measuring the hardness of a material. It involves measuring the depth of penetration of an indenter into the material under a specific load. The Rockwell hardness test is quick, easy to perform, and provides reliable hardness values.

S.NO	SPECIMEN	LOAD	HARDNESS
1	AL6061	100	69
2	AL+5%SCB	100	76
3	AL+10%SCB	100	81



COMPRESSION TEST:

Compression strength of aluminium 6061 alloy reinforced with SCBA particles is presented in Table 2. It is evident that reinforcement of SCBA particles improved the compression strength of aluminium 6061 alloy and strength improvement is observed for 5% and 10% of SCBA particle reinforced metal matrix composites.

S.NO	SPECIMEN	LOAD(N)	AREA(MM)	STRESS	CHANGE IN LENGTH
1	AL+5%SCB	430000	2500	172	0.5
2	AL+10%SCB	484000	2500	193	0.7

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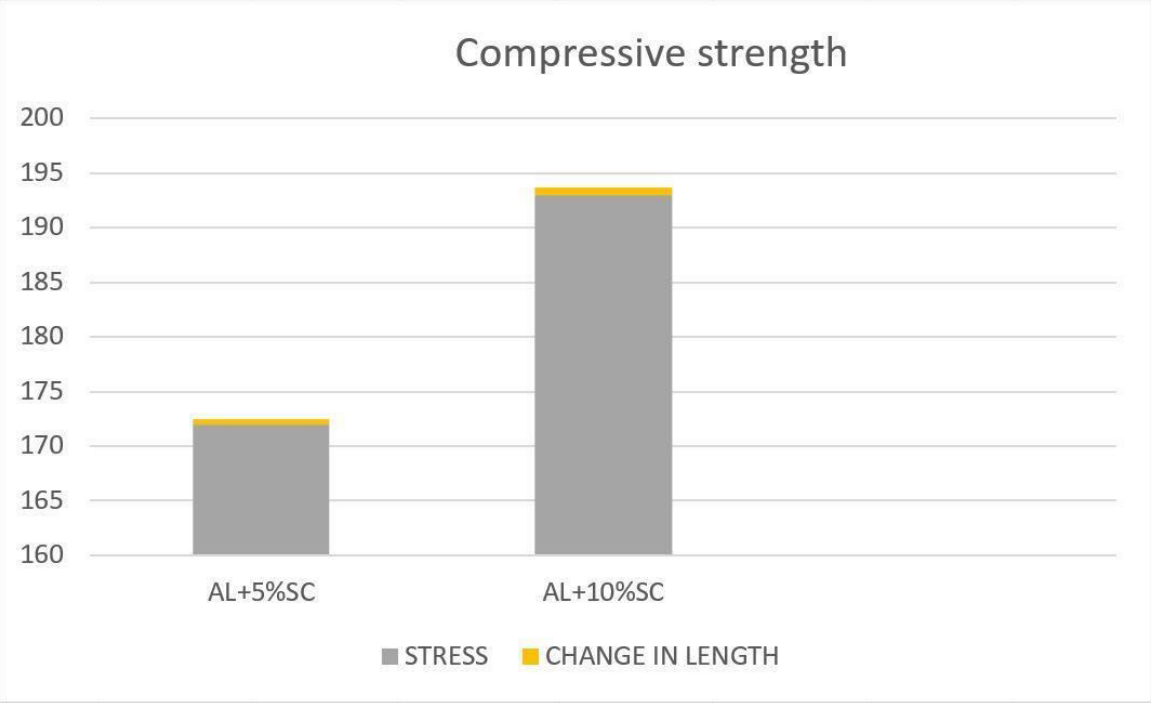
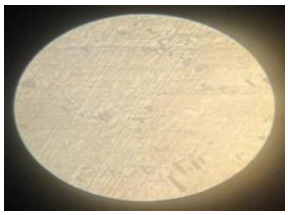
The graph showing the change in length and stress values of the specimen of aluminium alloy 6061 reinforced with the sugarcane bagasse ash, with 5% and 10% weight ratio of SCBA with respect to Aal6061.

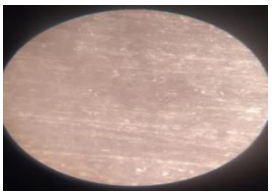


MICROSTRUCTURE:

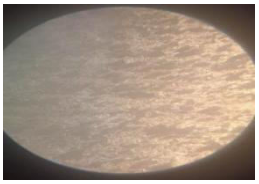
The below micrographs showing the microstructure of aluminium alloy 6061 reinforced with the sugarcane bagasse ash of varying percentage 0%, 5% and 10% respectively to weight ratio of aluminium alloy metal.



Microstructure of AAl6061



Microstructure of AAl6061r Reinforced with 5% SCBA



Microstructure of AAl6061r Reinforced with 10% SCBA

CONCLUSION

- SCBA of 5% and 10% by weight with respect to AAl6061 can be successfully added to AAl6061 by manual stir casting to produce composites.
- The Izod Impact Strength of AAl+SCBA composites have decreased with increase in addition of fly ash.
- In the Compression Strength of AAl+SCBA composites, Stress has increased from 172 N/MM² at 5% SCBA to 193% N/MM² at 10% SCBA. By this we can say that, its strength has increased with addition of SCBA.
- The Hardness of Aluminium MMCs increased from 69 to 76 and to 81, at 0%, 5% and 10% of SCBA. So we can say that the strength is increasedb by increasing the weight percentage of reinforcement.
- With the help of micrographs, we can say that the Bagasse fly ash is evenly mixed in the aluminium.
- With the help of micrographs, we can say that when we added the Bagasse fly ash and increased the quantity of fly ash than the molecules of aluminium get closer and that's why the mechanical properties increased.

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