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# Study on mechanical properties of Aluminium, Coconut Ash and Graphite reinforced composites

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***Abstract:--*** **As the world is focused on development and production, we fail to notice there is a lot of waste that is getting created in our environment and causing it harm. Now a day's people are finding ways to use these waste materials to reinforce Aluminium. To determine whether Graphite and Coconut Shell Ash can also be used to reinforce the Aluminium.**

**Index Terms:- Aluminium, Coconut Shell Ash, Graphite, MMC**

## 1. INTRODUCTION

Aluminium, Coconut Ash and Graphite reinforced composites is a Metal Matrix Composite made of Graphite, extracted from waste dry cell which is most common e-waste, Coconut Shell Ash which is the waste produced from biorefineries, where all are stir casted with Aluminium is base metal without any type of binders. The objective of this study is to look into the Mechanical Properties of Aluminium after reinforcing it with Graphite and Coconut Ash.

## 2. LITERATURE SURVEY:

In the work conducted by J W Pinto et al [1] when Coconut Shell Ash and E-fibre were reinforced with Al-6061 alloy using the stir casting technique, an appreciable increase in various mechanical properties like micro hardness and Ultimate Tensile strength was noticed. Moreover, the tribological property i.e. the specific wear rate showed a decreasing trend with the increase of the reinforcements. Prakash Kumar Dalai et al [2] studied about the influence of machining process parameters of Argo waste reinforced aluminium metal matrix composites. They clearly stated that, the introduction of agricultural wastes like fly ash and coconut shell ash has increased the hardness and tensile strength of prepared composites. The silicon content present in the ash has helped in increased in the strength of the composites but when the amount of ash was increased the ductility of the specimen decreased. The cutting forces involved showed a decreasing trend with the increase of cutting speed. M P Navin et al [3] investigated about the changes in the properties of the Al 360 alloy when it was reinforced with Coconut Shell Ash and SiC particles. The composites were prepared using stir casting technique with various proportions of the reinforcements and were tested for hardness and tribological properties so that it can be used for clutch plate. It was observed that, the hardness of the composite prepared using the coconut shell ash was lower than that of the base alloy but with the addition of SiC particles a considerable increase in the hardness was obtained. The coefficient of friction and the wear resistance was found to be increasing with increase of SiC content in the composite. Ankesh Kumar et al [4] inspected the physical, mechanical and tribological properties of aluminium with coconut shell ash. The density and the hardness of the samples revealed that with the increase of percentage of ash in the matrix reduced the density but increased the hardness of the composites. The machining parameters like depth of cut, speed and feed rate against the surface roughness was compared and the reinforced composites exhibited better properties than the unreinforced base alloy. Poornesh M. et al [5] Studied the effect of Coconut Shell Ash and SiC Particles on Mechanical Properties of Aluminium Based Composites and also the mechanical properties taken in this paper are based on his experiments.

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## 3. EXPERIMENTAL SETUP

Composition of Coconut Shell Ash is Given in Table No. 1 [5]

| **Element** | SiO | MgO | $Al_2O$ | $Fe_2O$ | MnO | ZnO | $Na_2O$ | $K_2O$ |
|---|---|---|---|---|---|---|---|---|
| **%** | 46 | 18 | 16 | 14 | 0.5 | 0.6 | 0.9 | 1.2 |

The samples are prepared using the following configuration

| | **Aluminium in Percentage** | **Coconut Ash in Percentage** | **Graphite in Percentage** |
|---|---|---|---|
| **Sample 1** | 92% | 3% | 5% |
| **Sample 2** | 90% | 5% | 5% |
| **Sample 3** | 92% | 5% | 3% |

The castings were synthesised by means of a stir casting machine which had a flange that was linked to a shaft of synchronous DC motor. The speed could be varied from 200 rpm to 1000 rpm. The speed used in this process is 600 rpm. The casting was made by liquefying Al to a temperature of 750°C.

**Figure No. 1 Stir casting of specimen**

**Figure No. 2 Impact strength testing specimen before testing**

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**Figure No. 3 Impact strength testing specimen before after testing**

**Figure No. 4 Tensile strength testing specimen before testing**

**Figure No. 4 Tensile strength testing specimen after testing**

## 4. RESULTS AND DISCUSSION

### 4.1 Hardness Test

The hardness of the prepared composites was found using Vickers Hardness Test. Fig 1 gives the variation of hardness value of the samples. An increasing trend of hardness is observed with increase in wt. fraction of coconut shell ash mixed with Graphite.

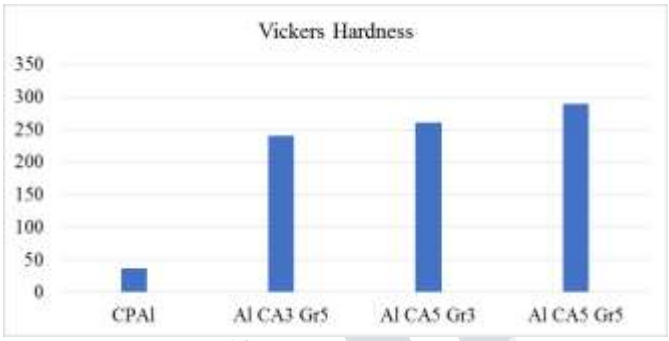


**Figure No. 1 Comparison of hardness for different composition of coconut shell ash and Graphite.**

Comparing the results from Figure No. 1 as the Coconut Ash and Graphite increases in the CPAL the hardness of the material also increases.

### 4.2 Impact Test

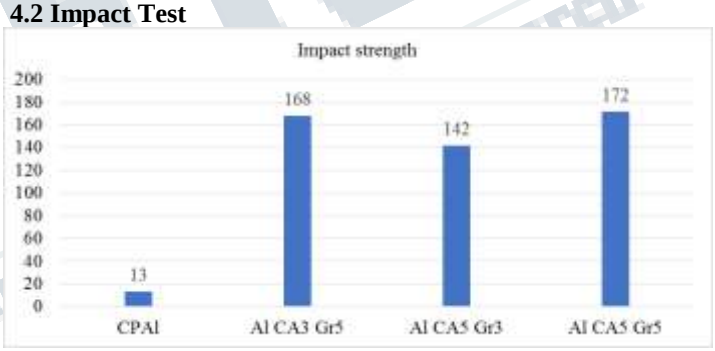


**Figure No. 2 Comparison of hardness for different composition of coconut shell ash and Graphite.**

Because of the addition of Graphite and Coconut Ash, the impact strength of CPAL has increased over 10 times. As we can observe from Figure No. 2 increase in Graphite content increases the impact strength of the CPAL.

### 4.3 Tensile Test

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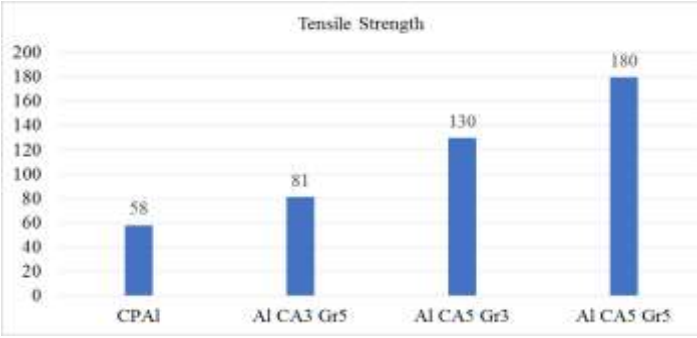


**Figure No. 3 Comparison of tensile strength for different composition of coconut shell ash and Graphite.**

Because of addition of coconut ash and graphite the tensile strength of the material increases and at the same time the material gets brittle as the additive quantities increase.

## 5. CONCLUSIONS

The following conclusions can be drawn based on the experimental results,

i. The composite was successfully cast using the stir casting technique under a teeming temperature of 750°C and a stirring speed of 600 rpm.

ii. From the results of Vickers Hardness Test, it was noticed that inclusion of reinforcing particles has helped in increasing the hardness of the composites. A significant increase from 37 HV to 290 HV was found when the composite was reinforced with 5% coconut ash and 5% of graphite.

iii. The impact energy of the composites showed the decreasing trend because of inherent properties of the additives.

iv. The tensile test revealed that the tensile strength of the material increases at the same time the material gets brittle as the composition of additives is increased.

## 6. SCOPE OF FUTURE WORK

The binders can be added during stir casting to increase overall strength of the material since the binders adheres to the additives which in turn makes the material much stronger.

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