Impact Strength of RHA and Fly Ash Based Aluminum Composites

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Abstract
In recent years, several research efforts have been directed at developing aluminum alloy MMCs. Research has to be intensified to produce inexpensive aluminum MMCs with similar or possibly better, engineering applications. The present study is motivated by the limited knowledge of fly ash-rice husk ash reinforced aluminum MMCs. Studies on A356, A360 and 443 fly ash-reinforced aluminum MMCs have shown great promise especially in automotive applications. There is, therefore, a reasonable ground to carry out more research on other aluminum alloys in order to improve our understanding of fly ash- rice husk ash reinforced aluminum MMCs. In this paper the effect of both Rice husk ash and Fly ash on Impact strength has been studied experimentally. Impact Strength increases with the increases in the content of rich husk ash (RHA) as well as the mixture of fly ash and rice husk ash up to 15% by weight.

Keywords
Composites, Rice Husk Ash, Fly Ash, Impact Strength

I. Introduction

In recent years, several research efforts have been made at developing aluminum alloy MMCs. Low-cost and low-density fly ash particulate reinforcements are being investigated as replacements for the relatively more expensive reinforcements [5]. Fly ash is a lightweight coal combustion by-product. Currently, research on the use of fly ash as a reinforcement in both MMCs and polymer matrix composites (PMCs) has been growing. Prior studies show that fly ash can be used in forming inexpensive aluminum alloy MMCs with improved mechanical properties that can compete favorably with other available composites. Using fly ash to reinforce aluminum alloy MMCs offers advantages of reducing disposal volumes for coal-powered utility plants [2]. This provides a high value-added use of fly ash in producing composites with improved material properties such as high wear resistance and low density at a reduced cost.

Similarly an agricultural waste i.e. rice husk ash, can also be used as particulate as it has similar composition as fly ash. Rice milling generates a by-product know as husk. During milling of paddy about 78% of weight is received as rice, broken rice and bran. Rest 22% of the weight of paddy is received as husk. This husk contains about 75% organic volatile matter and the balance 25% of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA) [3]. This RHA in turn contains around 85%-90% amorphous silica. So for every 1000 kg of paddy milled, about 220 kg (22%) of husk is produced and when this husk is burnt in the boilers, about 55 kg (25%) of RHA is generated. Hence RHA & Fly ash both can be used in combination as reinforcements in Al Alloy. These composites can be used were moderate impact strength is required.

II. Materials & Methodology

LM 24, a die casting alloy was used. Chemical composition of the Al alloy was confirmed by a chemical test. Fly ash was obtained from Trident (Abhishek Industries) Barnala. Rice husk ash was received from Amrit Banaspati Company Ltd Rajpura. Ball milling operation was done on raw rice husk ash and fly ash. Some of the particles of raw powders were coarse and some may adher to each other. In order to refine and make the particle finer ball milling was done to the both powders. It also helps in making the powder uniform. 500 gms of both powders were ball milled. Ball milling is a machine in which cylindrical container of having the axis horizontal is rotating at constant speed. In that container steel ball of different diameters are present and when container rotates the steel balls crushes the particles in to fine grain particles. Sieve method was used to sieve fly ash and rice husk ash of grain size 1-106 µm. Then the fly ash and rice husk ash particles were treated by 1 M HCL solution. Scanning Electron Microscopy (SEM) of fly ash and rice husk particle was done. X Ray Diffraction and Fourier Transform Infrared (FTIR) were done of the untreated/treated fly ash and rice husk ash particles.

Metal matrix composites were prepared by stir casting method by following the below given five compositions:-

LM24 Alloy
LM24 Alloy+5% by wt of Rice Husk Ash (106 µm)
LM24 Alloy+10% by wt of Rice Husk Ash (106 µm)
LM24 Alloy+5% by wt of Fly Ash+5% by wt of Rice Husk Ash(106 µm)
LM24 Alloy+5% by wt of Fly Ash+10% by wt of Rice Husk Ash(106 µm)

These samples were prepared using die casting method as shown in figure 1. LM 24(Al-7.6Si-2.35Cu) alloy in measured quantity was put into the apparatus and motor was switched on. Fly ash and Rice husk ash (106 µm) in planned proportion by weight was put in to molten metal. Stirring was done for ten minutes in each case. 2% magnesium as added to increase the wet ability of FA and RHA particles in molten alloy.

Fig. 1: Die Casting of the Specimen

Samples for the Charpy impact test were prepared according to the ASTM standard E23.The specification of the sample is shown in the fig. 2. Fig. 3 shows the specimen size for Izod Test. The samples were prepared by milling operations. Figure 4 shows the specimens ready for the test. Fig. 5 shows the impact strength machine used.

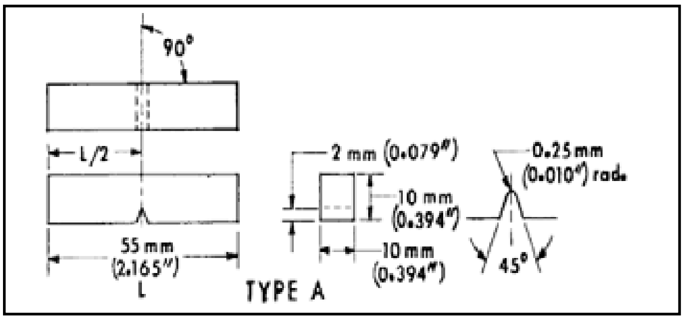

Fig. 2: Specimen for Charpy Test

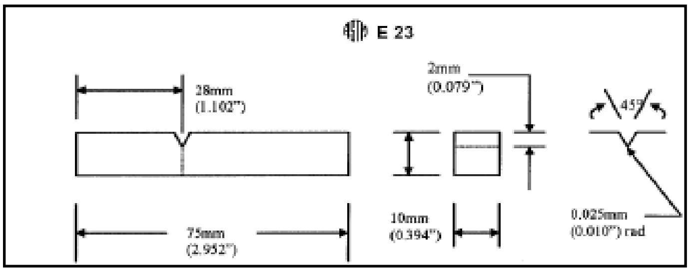

Fig. 3: Specimen for Izod Test

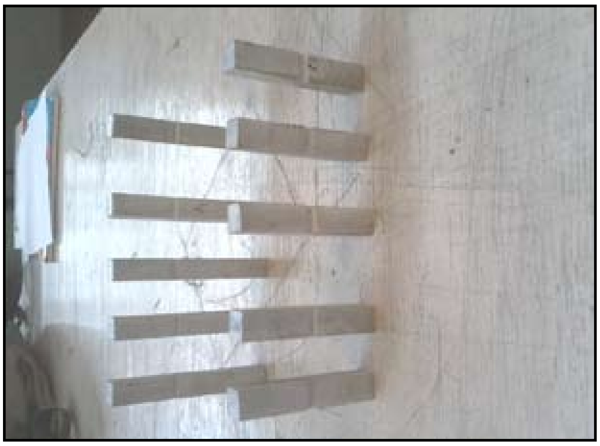

Fig. 4: Specimen for Impact Strength

Fig. 5: Impact Strength Testing Machine

III. Results

The results of the all the five cases are shown in the Table 1 The results show that with the increase of RHA and FA (106 μm) content the Impact Strength increases. Graph in figure 7 shows the variation of impact strength with the variation of fly ash and rice husk ash % content.

Table 1:

S.No	Sample	Izod(J)	Charpy(J)
1	LM24	4.2 J	5.5 J
2	LM24+5% RHA	4.9 J	5.7 J
3	LM24+10% RHA	5.2J	6.1J
4	LM24+5% RHA+5% FA	5.6J	6.3J
5	LM24+10% RHA+5% FA	6.2J	6.5J

Impact strength for LM 24 was 4.2 joules. With the addition of 5% of Rice Husk Ash the impact strength was 4.9 joules. With the addition of 10 % of Rice Husk Ash impact strength was 5.2 joules. When the 5% FA and 5 % RHA was added impact strength was 5.6 and with 5% FA +10%RHA the impact strength investigated was 6.2 joules

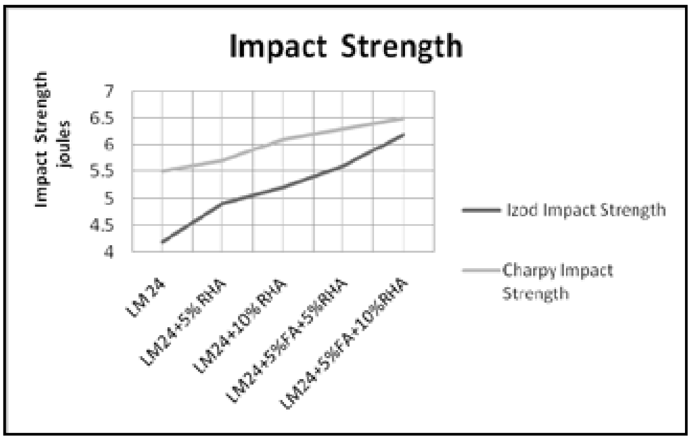

Fig. 7: Specimens for Izod and Charpy Test

VI. Conclusion

Though problem of agglomeration is a major problem in stir casting method, in this research work it has been found that agricultural wastes such as rice husk ash and fly ash can be used as particulate in Al alloys to form metal matrix composites, thus resulting in improved mechanical and physical properties like impact strength .

Aluminium-fly ash/rice husk ash composites have potential applications as covers, pans, casings, pulleys, manifolds, valve covers, brake rotors, and the electromechanical industry sectors. Impact Strength increases with the increases in the content of rich husk ash as well as the mixture of fly ash and rice husk ash of 106 μm up to 15% by weight when taken in different ratios. Hence LM24 which is used for various applications where moderate impact strength is required can be replaced by RHA –Fly Ash based MMCs therefore reducing the cost and weight.

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