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SYNTHESIS OF HYBRID COMPOSITE MATERIALUSING Al-7075,TiC&RHA.

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ABSTRACT

In this present study,Al-7075,TiC&Ricehuskash(RHA) metalmatrixcomposites(MMCs) were fabricated by stir casting method. Differentweightfractionsofreinforcementwereused to fabricate thecomposites.Theproperties likedensity, hardness,andultimate tensilestrengthwere investigated. The additionof rice husk ash particles reduces thedensityof composite while increasingthe mechanicalproperties. In demand to achieve good compulsory between the matrix and reinforcement particle, 1% of magnesium is added. The hardness of the sample at room temperature was measured by Rockwell hardness test machine. When The volume fraction of TiC and RHA reinforcement increases, the scale of hardness also upsurges. This study summaries that 7075 hybrid composite with high hardness can substitute the conventional material used in automobile components for better performance and longer life. The specimens without any post-weld heat treatment belongingto a different set of parameters tested, exhibited a high joint efficiency (most of them ranging from 90% to98%) with respect to the ultimate tensile strength of the base material Al-7075.

Keywords: Al-7075,TiC,Rice husk ash and 3%Mg,

INTRODUCTION:

The particle–matrix interface in metal matrix compositesis very important since it is across this regionthat the load is transmitted. The chemical reaction between thereinforcement and the matrix can affect the way thatthe load is transferred at the interface and can drasticallyaffect composite mechanical performance.It has been observed that although a smooth, thin,continuous layer of reaction products may increase theinterfacial bond strength; as the reaction layer thicknessincreases and exceeds an optimal value, of the order ofa few microns, composite strength decreases.The finest part of strength in Al matrix composite has been directed towards growth of high performance composite with high strength and

Characterize for using in aerospace and automotive application.

In overall, a hard material is working as reinforcement since of potential development in mechanical properties.Thishighestdevelopment in mechanical properties is usually obtained by means of reinforcement with suitable particulates.Metal matrix composites have many potential applications, because of the unique property combinations that can be achieved. Metal matrix composites (MMCs) have been developed to respond to the demand for materials with high specific strength and stiffness. Aluminium is preferred as a matrix material in MMCs because of its low density, easy fabricability and good engineering properties. The fabrication of MMCs can be achieved by the accumulation of reinforcement phase to the matrix.

The engineering materials, the MMCs can be manufactured by a unique technique such as casting as it is inexpensive and proposes many other options for materials and processing condition. Particulate reinforced aluminium matrix composites are alternative materials due to their strength, ductility and toughness as well as their ability to be processed by conventional methods. AMCs are applied successfully to structural components largely in automotive and aviation industries. AMCs can be

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reinforced with SiC, Al_2O_3, B_4C, TiC, TiB_2, MgO, TiO_2 and BN, while many researchers have used SiC and Al2O3 as reinforcing materials.

Here we are using the material of aluminium as a matrix and titanium carbide, Rice husk ash are used as a reinforcement to reduce the density and weight fraction of the composite and increases the strengthand hardness of the composite. We have added 3% of magnesium to keep the wettability between rice husk ash and titanium carbide. Rice husk ash is used to maintain and improve the temperature of the composite while it is in the casting process.

TiC is an attractive reinforcement material because of its good chemical and thermal stability. Titanium Carbide has lower density and higher hardness compared to Al_2O_3 and SiC. Al–TiC composites can be processed by low cost casting routes. But it is difficult to fabricate Al–TiC composites by mixing particles into the liquid phase, because of the poor wetting between Al,TiC& RHA below 1100°C.

Aluminium is melted at the temperature of 1200-1300^{0}C.After that the melt is poured into the mould in the casting process. Then the TiC fine powder is added with 5% and 10% of combinations at the temperature of 700^{0}C to merge with the aluminium as a reinforcement. After that the Rice husk ash is added to the mixing of Al-7075 and TiC. The addition of rice husk ash increases the temperature of the mould. So it leads to reduces the adherence capacity of the composite. For that 3% of magnesium is added to maintain the usability and adherence capacity of the material particles. The composite will be hold at the room temperature to get a solid form.

EXPERIMENTAL PROCEDURE

Sand Casting Fabrication Method

Among the variety of manufacturing processes available for discontinuous metal matrix composites, sand casting is generally accepted, and currently practiced

Commercially. Its advantages he in its simplicity, flexibility and applicability to large scale production and, because in principle it allows a conventional metal processing route to be used, and its low cost This liquid metallurgy technique is the most economical of all the available routes for metal matrix composite production allows very large sized components to be fabricated, and is able to sustain high productivity.

Fabrication Process

In general stir casting of MMCs involves producing a melt of the selected matrix material, followed by the introduction of a reinforcing material into the melt, obtaining a suitable dispersion through stirring The next step is the solidification of the melt containing suspended particles to obtain the desired distribution of the dispersed phase in the cast matrix The schematic diagram of this process is as shown in Figure .

The Aluminum metal is melted around 750ºC.Thus the aluminum is in molten stage after the composition of TiC and Mg Reinforcement are added to the molten matrix now the stirrer speed is increased gradually up to 650 rpm And also the stirring time is maintained to 7 minutes and solidification stages of the process

The melt particle slurry prepared by stirring will have to be transported to a die or casting bay either by using a slurry pump.

The molten metal are poured in to split pattern in rod shaped pattern with 25 mm diameter and 170 mm length.

After 4 hour the work piece is removed from the split pattern and remove the slags covered the work piece

RESULT AND CONCLUSION

4.1. Properties of RHA

The husk was burned at a temperature not exceeding 690 °C. The heating and cooling ramps, burning duration, in addition to the temperature inside the furnace . According to the XRD graph the ash was mainly in amorphous form due to the broad peak on 2θ angle of 22°. The X-ray diffractometer graph, many researchers showed that the minimum temperature for crystallization of the silica in RHA is to be 800 °C[3,5,10].

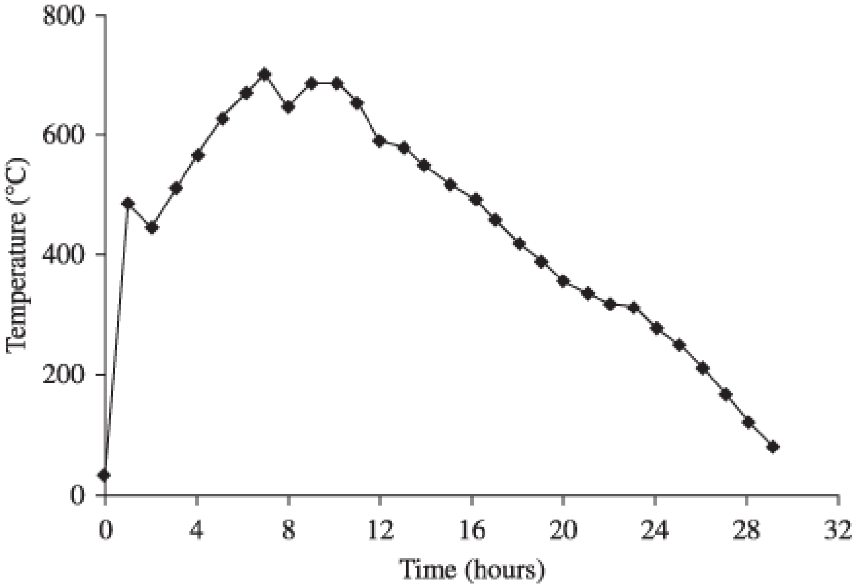

Figure 3. The burning temperature and duration for RHA.

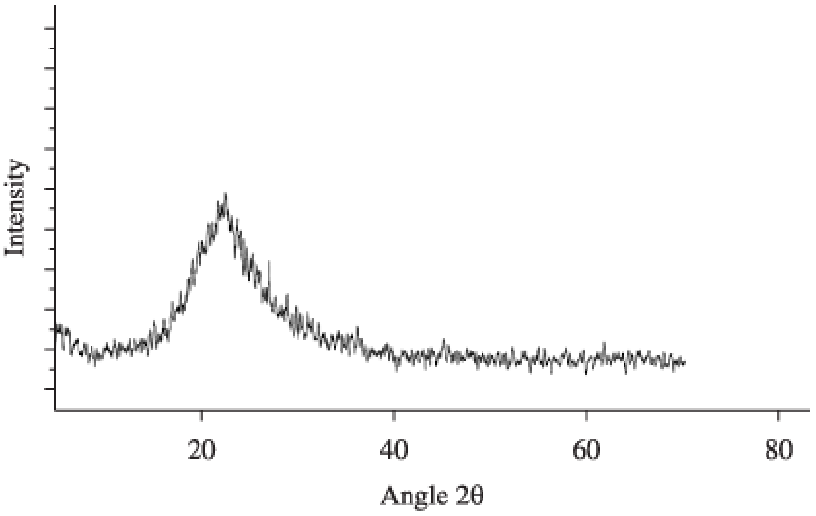

Figure 4. The X-Ray spectrum of RHA.

When RHA samples were scanned by electron microscope, the pictures showed the RHA's multilayered, angular and microporous surface, thus explaining its high specific surface area, the ash was grey in colour and the loss on ignition was relatively high due to the amount of unburnt carbon in the ash.

4.2. The effect of grinding RHA on its APS and specific surface area

When RHA was ground using the LA machine, the size decreased from 63.8 to 11.5 µm for a grinding time of 90 to 360 minutes respectively. The specific surface area of the ashes are also shown in it can be clearly seen that the surface area only slightly increased by increasing the grinding time, this indicates that the high surface area of RHA is resulted from its microporous and multilayered surface. Thus, the APS has no significant effect on its surface area.

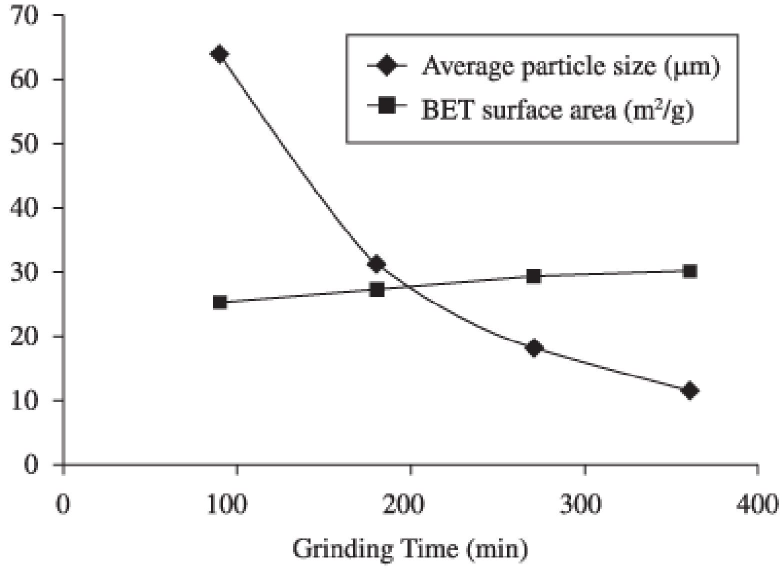

Figure 6. Average particle size and specific surface area of RHA against grinding time.

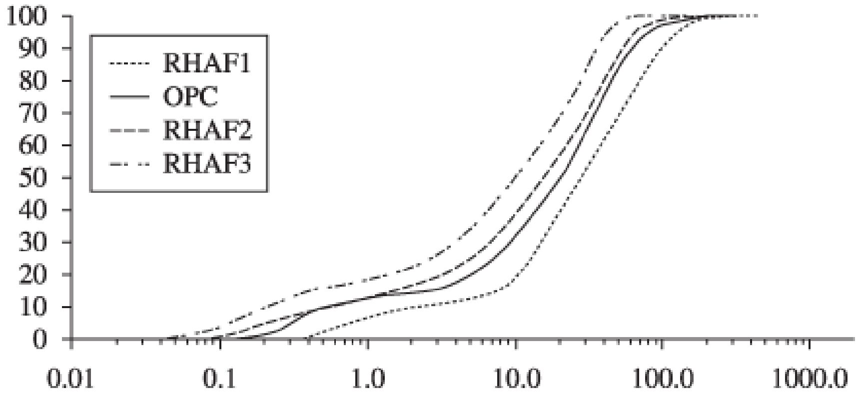

Figure 7. Grading curves of RHA and cement shown by laser particle analyser.

4.3. The effect of RHA APS and percentage on workability and density of concrete

The slump was in the range of 200 - 240 mm, bleeding was negligible for the control mixture. For concretes incorporating RHA, no bleeding or segregation was recorded. The fresh density was in the range of 2253 to 2351 kg.m^{-3}, the lowest density values were for 20F1 mixture, and this is due to the low specific gravity of RHA which leads to the reduction in the mass per unit volume. The concretes incorporating finer RHA resulted in denser concrete matrix. The SP content had to be increased along with the RHA fineness and content due to the high specific surface area of RHA which would increase the water demand[5,12], therefore, to maintain high workability, SP content rose up to 2% for the 20F3 mixture.

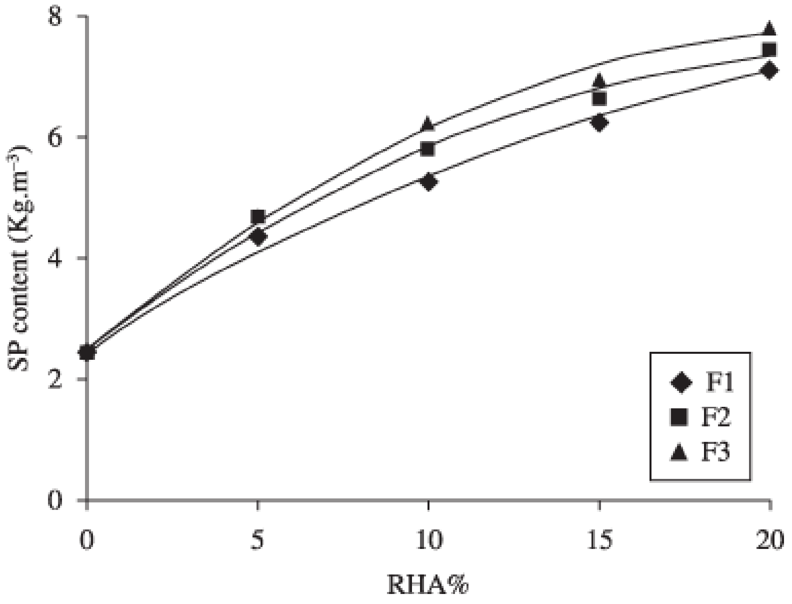

Figure 8. The effect of RHA percentage and APS on the SP content.

4.4. The effect of RHA APS on compressive strength of concrete

The results showed that at early ages the strength was comparable, while at the age of 28 days, finer RHA concrete exhibited higher strength than the concrete with coarser RHA. For example, at replacement level of 10%, the percentage of increment for RHA concretes compared to the control OPC mix were 22.2, 26.7 and 30.8% for 10F1, 10F2 and 10F3, respectively. This is due to the fact that the higher fineness of RHA allowed it to increase the reaction with $Ca(OH)_2$ to produce more calcium silicate hydrate (C-S-H) resulting in higher compressive strength, in addition to that, the fine RHA particles contributed to the strength development by acting as a microfiller and enhancing the cement paste pore structure. Similar results were found by Ismail and Walliuddin[13], that studied the effect of RHA on high strength concrete and found that RHA fineness can enhance the strength.

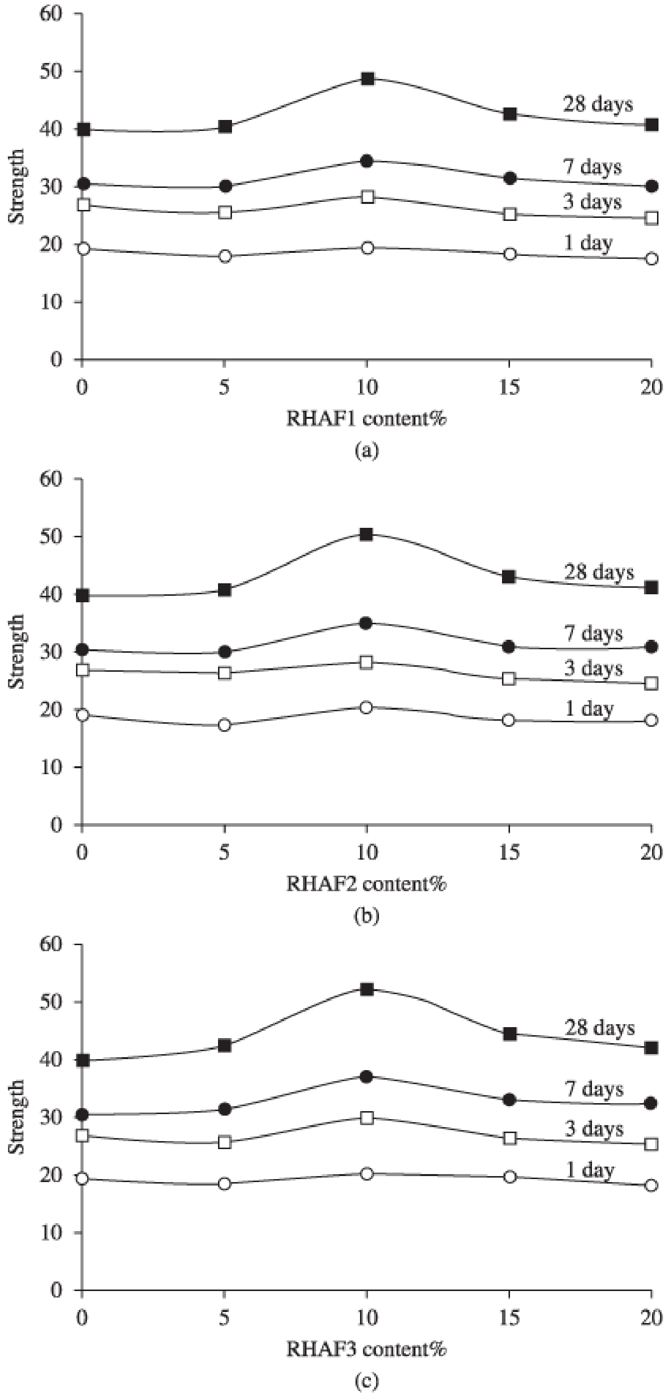

Figure 9. Relation between strength and RHA level of replacement, a) RHAF1; b) RHAF2; and c) RHAF3.

4.5. The effect of RHA percentage on compressive strength of concrete

In terms of the replacement level, the 5% replacement level achieved slightly lower values of compressive strength at early ages for up to 7 days except for the 05F3 mixture where the compressive strength was higher due to the increased reactivity and the filler effect of RHA. Based on that, it can be noticed that the amount of RHA present when 5% replacement used is not adequate to enhance the strength significantly. The available silica from the addition of 5% RHA reacted with only a small portion of C-H released from the hydration process and thus, the C-S-H released from the pozzolanic reaction was relatively limited. However, this was overcome by the age of 28 days where the strength achieved higher values than the control.

The strength increased with RHA for up to 10% which resulted in achieving the maximum value. For example, 10F3 mixture resulted in 30.8% increment compared to the OPC control mix tested at 28 days age, that is due to the pozzolanic reaction of the available silica from the RHA and the amount of C-H available from the hydration process and also due to the microfiller effect when fine RHA is used.

The strength values when RHA was replaced by 15% were found to be similar to 5% replacement except that at the age of 7 days, the strength was higher than the control for all RHA mixtures, in this case, the amount of silica available in the hydrated blended cement matrix is probably too high and the amount of the produced C-H is most likely insufficient to react with all the available silica and as a result of that, some amount of silica was left without any chemical reaction.

When 20% of OPC was replaced for RHA, the strength of concrete achieved equivalent values to the OPC control mixture. Increasing the replacement to a level above 20% was avoided in this study due to the fact that the increased water demand would lead to SP content higher than the manufacturer recommendations (maximum of 2% by weight of the cementitious materials) which can give an adverse effect on the produced concrete by acting as a retarder and increasing cost. Furthermore, the strength would decrease to a value that is lower than the control. The decrease in the strength by increasing the RHA replacement level is due to the reduction in the cement amount and as a result of that, the released amount of C-H due to the hydration process is not sufficient to react with all the available silica from the addition of RHA and thus, the silica will act as inert material and will not contribute to the strength development except for the fine RHA where it can be considered as a microfiller.

4. Conclusions

The conclusions of the studies carried out on Al7075–TiC,RHA MMCs are as follows.

The Liquid metallurgy technique (stir casting) was effectively adopted in the preparation of Al7075–TiC composites containing the filler filling up to 8 wt%. The density of the composites was found to have superior than the matrix material. The micro structural studies exposed the homogeneous distribution of the particulates in the matrix. Hardness of the composites was found to increase with increased the reinforcement content. The ultimate tensile strength of the composites are found to be higher than that of base matrix (Al7075) and Al7075–8 wt% TiC composite tensile strength property is better than that of other composite samples. The wear resistance of the composites is higher than that of base alloy (Al7075). Increased applied load and sliding distances resulted in higher wear loss. Further, the TiC reinforcement contributed extensively in improving the wear resistance of Al7075–TiC composites. Overall, it can be concluded that Al7075–8 wt% TiC exhibits higher mechanical and tribological properties compared with Al7075, Al7075–2 wt% TiC to Al6061–6 wt% TiC composite samples.

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