International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

FABRICATION AND PROPERTY EVOLUTION OF HYBRID COMPOSITE AL 6061 WITH 3% RHA & 4% SSP

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ABSTRACT *Alloy and composite materials are both made up of a mixture of at least two components. The waste particles improve the hardness of the base matrix so we are varying the weight fraction 3% rice husk ash (RHA) and 4% snail shell powder (SSP) in aluminum alloy as a base material. With this combination, the hybrid material is prepared for machining. This hybrid composite is prepared by using agro industrial waste particles in general to improve the properties of the base material people using ceramics. These ceramics are expensive and environmental pollutions. To avoid this, many researchers are focusing the agro industrial waste as hybrid composites. These are less expensive and environment free and also ductility of the matrix will reduce. This material improves Mechanical properties of the material. Using stir casting process, the hybrid composite material is prepared and Mechanical properties are evaluated so we conducting four experiments tensile test, flexural test, hardness test and microstructure. The agenda of this hybrid material is to improve mechanical properties compare to base material.*

Keywords: - stir casting, aluminum alloy, rice husk ash (RHA) and snail shell powder.

1. Introduction to metals

Metals are commonly hard, hazy, and gleaming materials that show great electrical and warm conductivity. Albeit roughly 91 of the 118 components of the occasional table are metals, they can be either components, mixes, or amalgams. They are commonly flexible so they can be molded by pounding or squeezing without breaking or splitting. Metals are likewise fusible, which means they can be melded or softened and display a malleability that makes it conceivable to extend them into a flimsy wire. Therefore, metals are a significant piece of our lives and can be found at each aspect where they are utilized in tall structures, connect development, vehicles, home apparatuses, adornments, devices, channels, railroads, and numerous different spots.

1.1 Alloy

An alloy is a homogeneous material which can be made by softening at least two components, of which one is a metal. Participatory metal is known as parent metal, which fills in as a base metal for the alloying component and is considered alloying operators for most of the substances. The alloying operators can either be a non-metal or metal in which their commitment or extent is extremely little. Compounds will in general have better/more attractive properties when contrasted with the properties of the constituent substance they are made of. Practically all the compounds are glossy (which can be clarified by the nearness of the metallic part in their creation). Steel, metal, bronze, and so forth are not many instances of compounds.

1.2 Composite

Composites are regularly a mix of at least two components however their structure does exclude metals. Composites are heterogeneous, as opposed to amalgams. Most composites are normally experienced while others are designed. Composites are made out of segments which have distinctive physical properties. A couple of other characteristic composite models are wood, human body bones, and so on. Numerous instances of modern composites incorporate steel, fiber glass, etc.

1.3 Difference Between an Alloy and a Composite

As mentioned, the main difference between alloys and composites are its composition. Here in the tabular column given below let us look at the other differences between the two.

Alloy	Composite
An Alloy is a mixture of one or more metals with other elements.	Composites are also a mixture of two or more elements, but it does not contain metals.
An alloy can either be a homogeneous or a heterogeneous mixture.	A composite is always a heterogeneous mixture.
Alloys are lustrous due to the presence of metals in their composition.	Composites are not lustrous as they do not contain metals in their composition.
Most alloys can conduct electricity.	Composites do not conduct electricity except for polymeric composites.
Alloys always contain a metal.	Composites do not contain metals.

1.4 METAL MATRIX COMPOSITES (MMCs)

Metal matrix composites (MMCs) is known as composite material which comprises of in any event two constituent parts and one of it ought to be necessarily a metal, the other one ought to be an alternate material, similar to a fired or natural compound. In the event that it comprises of three materials, at that point it is known as mixture composite.

Regular solid materials have impediments in accomplishing great blend of solidarity, solidness, strength and thickness. To conquer these weaknesses and to satisfy the ever-expanding need of cutting edge innovation, composites are most encouraging materials of ongoing interest.

Metal matrix composites (MMCs) have altogether improved properties including high explicit quality; explicit modulus, damping limit and great wear opposition contrasted with unreinforced combinations. The fortification can be metallic or fired. There are four sorts of metal lattice composites

- particulate reinforced MMCs
- short fiber or whisker reinforced MMCs
- continuous fiber or sheet reinforced MMCs
- laminated or layered MMCs

1.4.1 Classification of Metal Matrix Composite

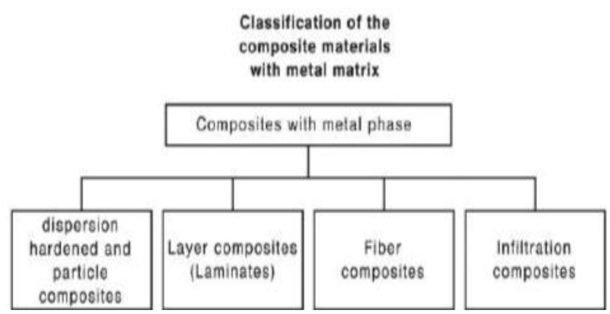

Fig 1.1: classification of MMC

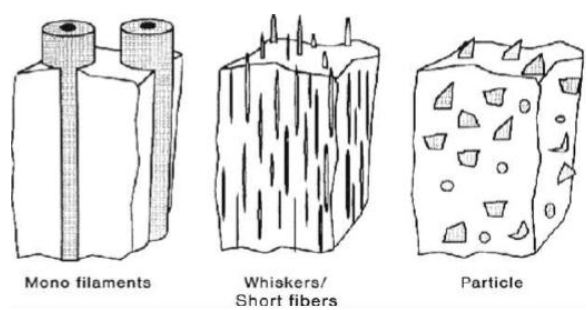

Fig: different MMC s

1.4.2 Matrix

The network is the solid material into which the fortification is installed, and is totally persistent. This implies there is a way through the grid to any point in the material, not at all like two materials sandwiched together. The framework is typically a lighter metal, for example, aluminum, magnesium, or titanium, and offers a consistent help for the support.

1.1.3 Reinforcement

The support material is implanted into the framework. It is utilized to change physical properties, for example, wear obstruction, grating coefficient, or warm conductivity. The fortification can be either consistent, or broken.

Fortifications for metal lattice composites have a complex interest profile, which is dictated by creation and handling and by the framework arrangement of the composite material. The accompanying requests are commonly pertinent:

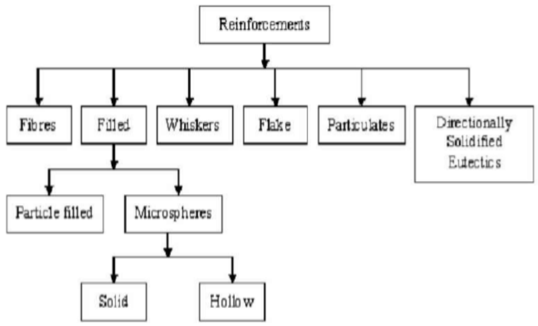

Fig: reinforcement classification

1.5 Stir casting

Stir casting is a type of casting process in which a mechanical stirrer is introduced to form vortex to mix reinforcement in the matrix material. It is a suitable process for production of metal matrix composites due to its cost effectiveness, applicability to mass production, simplicity, almost net shaping and easier control of composite structure. Stir casting setup as shown, consist of a furnace, reinforcement feeder and mechanical stirrer. The furnace is used to heating and melting of the materials. The bottom poring furnace is more suitable for the stir casting as after stirring of the mixed slurry instant poring is required to avoid the settling of the solid particles in the bottom the crucible. The mechanical stirrer is used to form the vortex which leads the mixing of the reinforcement material which are introduced in the melt. Stirrer consist of the stirring rod and the impeller blade. The impeller blade may be of, various geometry and various number of blades. Flat blade with three number are the preferred as it leads to axial flow pattern in the crucible with less power consumption. This stirrer is connected to the variable speed motors, the rotation speed of the stirrer is controlled by the regulator attached with the motor. Further, the feeder is attached with the furnace and used to feed the reinforcement powder in the melt. A permanent mold, sand mold or a lost-wax mold can be used for pouring the mixed slurry.

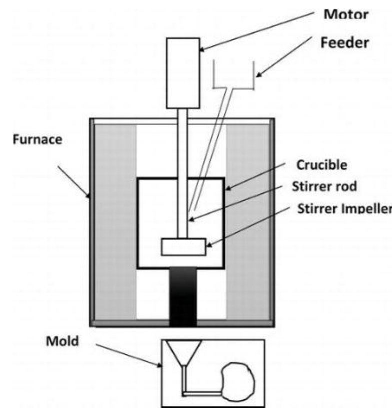

Fig: stir casting equipment

2. Literature survey

Mohit Kumar Sahu et.al., The experimental studies states that the based on the properties of the matrix material and reinforcement, chemical properties and wettability the stirring speed varies in the range of 200 to 1000 rpm. The optimal value of 1000 rpm is suggested for multistage impeller stirring. In single stage impeller stirring, the higher speed causes excessive tabulation so the optimal speed is given as 550 rpm. By consuming lower power to get required combination axial flow and shearing action the blade angle is optimized at 30 angles, the optimal stirring time is adjusted to 10 min by maintaining the impeller Position more the 25–30% of the height of the liquid from bottom the crucible. to avoid the accumulation of reinforcement particles, the reinforcement federate is maintained in the range of 0.8–1.5 g/s and the impeller diameter should in the range of 50–55% of the crucible diameter. By this study it was observed that in the fabrication of HAMCs and AMCs by using stir casting process by maintaining the optimal parameters provides low cost, high strength and light weight composites. Shailesh Singh et.al., The author observed through this experimental study is by using mechanical stir casting method to produce defect free aluminium matrix SiC reinforced composite. By the increasing the percentage of SiC adding into the composite will improves the tensile strength. To produce Al–SiCp composite this method is the most economical and effective. By increasing the percentage of SiC, wear rate decreases within the test parameters range. Rajeshkumar Gangaram Bhandare et.al., The author stated that to obtain uniform dispersion of material the blade angle should be at 45° or 60 ° & no of blade should be 4. For Al (606) to get good wettability, the operating temperature at semisolid stage should be $630^{o}C$. At full liquid condition of the molten metal it is difficult to achieve the uniform distribution of the reinforcement. To reduce porosity, we need to preheating of mould as well as it helps to increases mechanical properties also.

3. Introduction – Experimentation

3.1 Preparation of Rice Husk Ash (RHA)

The rice husk (fig: a) is gathered from Guntur locale, Andhra Pradesh, India. Rice husk is washed with water to evacuate the residue particles and earth assuming any and dried at room temperature for 1 day. To evacuate the dampness and natural issue, rice husk is set inside mute heater for 1 hr at a temperature of 210 °C. In this manner, the gathered debris is ball processed for 16 hr. The various phases of rice husk to RHA are appeared.

Fig: Rice husk

Fig: RHA

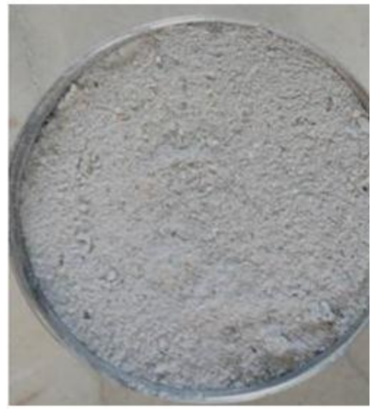

Fig: process of RHA

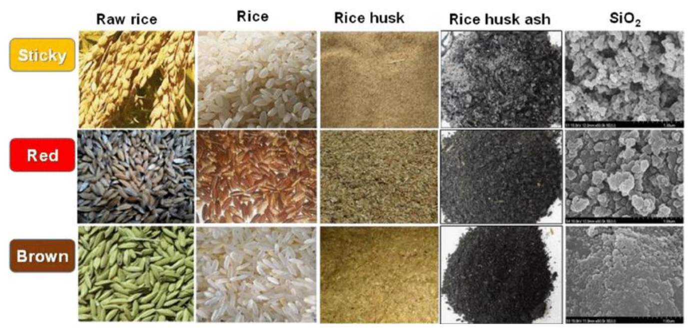

Fig: different kinds of RHA

3.2 Snail Shell Powder (SSP)

The restricted accessibility and significant expense of ordinarily utilized manufactured fortification material in metal network composites (MMCs) had obstructed the mechanical creation of MMCs for a huge scope for example, in the car business (Kolawole, et al 2017). In this manner, scientists are presently concentrating on the utilization of modern and agro united waste items as an elective wellspring of support materials in the MMCs creation at low costs that are future guaranteed as an exit from the current constraint.

Fig: different kinds of SSP

3.2.1 Preparation of SSP

Step 1: collection of SSP from the sea shore

Fig: different SS from sea shore

Fig: Selecting a suitable SS

Step 2: By using ball milling method, the snail is making into small pieces for a long period.

Fig: after ball milling- SSP Powder

3.3 Aluminium 6061 Properties

- The 6061 combination is fundamentally made out of aluminum, magnesium and silicon. Its other metallic components incorporate iron, copper, chromium, zinc, manganese and titanium, in sliding request of amount.

- Alloy 6061 set the norm for a medium-to-high quality, lightweight, affordable material. Prior amalgams had been helpless to push erosion breaking, yet the expansion of a modest quantity of Chromium made this combination profoundly impervious to consumption.

- 6061 aluminum properties incorporate its auxiliary quality and durability, its great surface completion, its great consumption protection from environment and ocean water, its machinability, and its capacity to be handily welded and joined.

Fig: stir casting process

Fig: molten metal is pouring in the dies

Fig: casting pieces

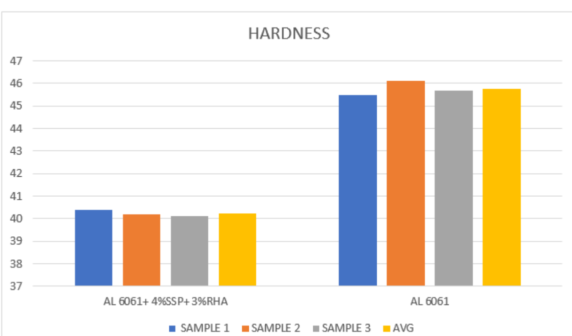

Fig: hardness of the al MMC

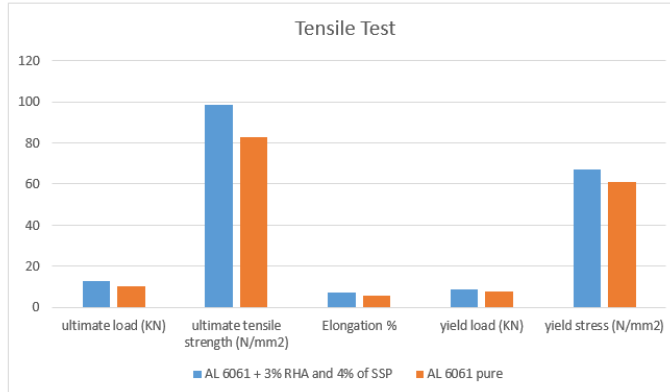

Fig: tensile test for al MMC

CONCLUSIONS

This study was carried out to produce and analyses the properties of Aluminum Alloy-Rice Husk Ash and snail shell powder composites. Rice husk ash (RHA) with high silica content of up to 97% was used for the study with the RHA varied with 2% and 2% of SSP. RHA &SSP are prepared with ball milling process to get micron size and mixed with AL 6061 in the casting process.

The following results are obtained from the experimentation

1.Rice husk ash can be successfully incorporated into aluminium alloy as reinforcement at a temperature of 800°C.

2. Incorporating rice husk ash into the aluminium alloy improves its mechanical properties

3. The maximum ultimate tensile strength of Al 6061+ 3% RHA and 4% of SSP is 98.701 MPa and for aluminum is 82.799 MPa.

4.The maximum yield stress of Al 6061+ 3% RHA and 4% of SSP is 67.058 MPa and for aluminum is 61.134 MPa.

5.The elongation for Al 6061+ 3% RHA and 4% of SSP is 8.8 and for aluminum is 7.28.

6. The maximum hardness for aluminum 6061 when compared with Al-3% RHA and 4% of SSP.

Based on the above results, we can conclude that Al 6061+ 3% RHA and 4% of SSP has best mechanical properties when compared with pure aluminum

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