Effect on the mechanical properties of Copper composite by reinforcement and its Fabrication

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Abstract - *The goal of this review paper is to discuss about the mechanical properties of copper composite and its fabrication process by Stir casting process. Stir casting is used so as to mix the reinforcement and matrix uniformly to get desired properties. We can vary the composition of reinforcement in the matrix and can get variation in the properties like electrical conductivity, corrosion rate, wear rate and hardness of the composite material. These various properties of material in turn greatly improve the performance and maintenance aspect of the system in which it is used in accordance with the requisite application.*

***KeyWords*: Composite material, stir casting, Mechanical Properties, Reinforcement, Matrix**

1.INTRODUCTION

Fibers and particles mixed uniformly in matrix of another material are the best example of modern-day composite materials. In matrix-based structural composites, the matrix serves two relevant purposes i.e. binding the reinforcement phases in place and distributing the stresses among the constituent reinforcement materials under an applied forcedistributes the stresses among the constituent reinforcement materials under an applied force.

The classification is generally made with respect to the matrix type. The major composite classes include Organic Matrix Composites (OMCs), Metal Matrix Composites (MMCs) and Ceramic Matrix Composites (CMCs). The termorganic matrix composite is generally assumed to include two classes of composites, namely Polymer Matrix Composites (PMCs) and carbon matrix composites commonly referred to as carbon composites.

Metal Matrix composites (MMCs) are the kind of materials which employs particles as reinforcement and ductile metal or alloy is taken as a matrix. The addition of reinforcement in the metal matrix improves strength, stiffness and various other properties as compared to the conventional metal. Copper is one of the most popular matrix material due to its good thermal conductivity, electrical conductivity and corrosion resistance.

Metal matrix composites are generating a wide interest in research field nowadays. High strength, fracture toughness and stiffness are offered by metal matrices than those offered by their polymer counterparts. They can withstand elevated temperature in corrosive environment than polymer composites. Many metals and alloys can be used as matrices. They require reinforcement materials which need to be stable over a range of temperature and non-reactive too. However the guiding aspect for the choice depends essentially on the matrix material.

Most metals and alloys make good matrices. However, practically, the choices for low temperature applications are not many. Only light metals are considered better and low density proves to be an advantage. Titanium, Magnesium and Copper are the popular matrix metals currently in demand which are particularly useful in aircraft applications. If metallic matrix materials have to offer high strength we may use high modulus reinforcements. The strength-to- weight ratios of resulting composites can be higher than most alloys.

The matrix and reinforcement are the most integral part of composites.

The matrix is the material into which the reinforcement is embedded, and is completely continuous. means that there is a path through the matrix to any point in the material, unlike two materials sandwiched together. The matrix is usually a lighter metal such as aluminum or copper and provides a compliant support for the reinforcement.

The reinforcement material is embedded into the matrix. It is used to change physical properties such as wear resistance, friction coefficient, or thermal conductivity. The reinforcement can be either continuous, or discontinuous.

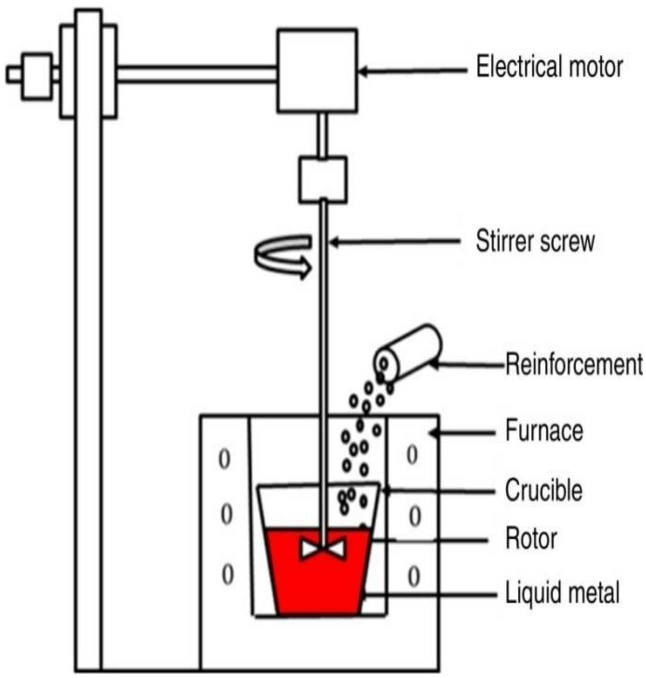
Composites are cost effective and can be manufactured by various processes like powder metallurgy, Spray deposition and Stir casting.

Conventional stir casting process has been employed for producing discontinuous particle reinforced metal matrix composites finely. The major task of this process is to obtain sufficient wetting of particle by liquid metal and to get a homogenous dispersion of the ceramic particles. In the present study aluminum metal matrix composites were fabricated by different processing temperatures with different holdingtime to understand the influence of process parameters on the distribution of particle in the matrix and the resultant mechanical properties.[7] The distribution of the composite material is examined by microstructure analysis, hardness distribution and density distribution.[8]

Sic reinforcement requiring the light weight in combination of high strength and high stiffness.[1] This is because copper is lighter weight which is first requirement in most of the industries. In additionally, it provides impressive strength improvement and the thermal expansion coefficient of Cu matrix composites can be adjusted and improved by using silicon carbide, carbon and boron carbides. As a result, these materials are now frequently utilized in industries that traditionally used metals, and these are now the area of research and development activity [9]. We studied the processing parameters such as processing temperatures, holding time, Rotating speed and Gas environment in liquid melts during stir casting.[3]

1.1 EFEECT OF HOLDING TIME

Effect of the holding time helps in the Cu-SiC composites mainly in two ways: to distribute the particles in the liquid and to create perfect interface bond between reinforcement and matrix. The holding time between matrix and reinforcement is considered as important factor in the processing of composites [10]. When the holding time is 10 minutes, the particles are distributed uniformly in the matrix at 700˚C, 750˚C and 800˚C. The liquid matrix has sufficient viscosity in the temperature range, and velocity of particles flow is small. The similar results are observed in the 20 minutes holding time. In the case of 30 minutes holding time, the liquid has sufficient viscosity at lower temperature (<800˚C) but the contacts time between matrix and reinforcement too large. During this period, the particles are distributed uniformly in liquid even though some of particles form cluster which could be also are located in the matrix region. A vortex created during the stirring can suck the air or gas bubbles in to the liquid metal. As the results, the particles were attached with air bubbles to form the particles cluster in the matrix. At higher temperature (>800˚C), more particles cluster are found in the composite.[11]



An open hearth furnace is used for melting and mixing the materials in flat bottom, cylindrical graphite crucible. The fabrication process is conventional mechanical stirring for the distributive mixing of the reinforcement in the matrix [7]. The mixing equipment for this stage consisted of a driving motor capable of producing a rotation speed within the range of 600rpm, a control part for the vertical movement of the impeller and a transfer tube used for introducing the ceramic powders in the melt.[11]

In preparing metal matrix composites by the stir casting method, there are several factors that need considerable attention, including the difficulty of achieving a uniform distribution of the reinforcement material, wetability between the two main substances, porosity in the cast metal matrix composites, and chemical reactions between the reinforcement material and the matrix alloy.[2]

Copper composite systems have been used extensively in the electrical industry to manu facture contact brushes for electrical machines in view of their favorable mechanical and electrical properties. These composites also have a great potential for applications in other fields using graphite electrodes of improved quality: e.g. in primary cells, electrical arc furnace, cathodic and anodic protection.[9] Furthermore, graphite/copper composites can be used with advantage in lining steel storage tanks and chemical reactors handling corrosive fluids. The presence of copper in the composite improves its electrical conductivity and thermal conductivity with a consequent increase in the stability of the composite against thermal shock and mechanical failure[2].

Adding reinforcement particles also greatly affect the wear property of the composite. To evaluate the wear and friction coefficient Composite is compared with the pure matrix.

2. CONCLUSIONS

1. Balanced composites were prepared successfully using liquid metallurgy technique like Stir casting

2. Hardness of the composites found increased with increased grit size of Sic

3. Thermal conductivity of the composites found increased with increased grit size of Sic

4. The tensile strength of the composites found increased with increased grit size of Sic

5. The pouring temperature at 725°C which gave the best optimum value of hardness,impact strength and ultimate tensile strength.

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