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COMPOSITE MATERIAL BY STIR CASTING PROCESS

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ABSTRACT

This paper will cover the study & conclusions on the unceasing upgrading of processes and techniques to produce high purity carbon nanotubes (CNTs) and the improvement in the available techniques to produce high performance matrix materials, have fostered the way to improved composite materials and their properties, either mechanical, electrical, thermal or magnetic. CNTs have been introduced into polymers, ceramics, cement-based materials and metals for reinforcements. Polymers were the first material to be used as matrix material to be reinforced by CNT material. Till now other materials have vastly been studied for that purpose, including metals. Today, many use of CNT reinforced composites are there but CNT reinforced metals are still rare and only found in very few applications. Several reasons can be identified but the still increasing demand for lighter and stronger metals build the way to more useful research on the topic of metal matrix composites (MMCs) reinforced by CNT. This review will describe the state of the art in this field and highlights the promising and excellent mechanical, thermal, electrical properties of CNT reinforced MMCs.

Keywords: *CNT, MMC, AMC, composite, matrix, reinforced*

I. INTRODUCTION

Now days the modern development needs the development in advanced engineering materials for various applications goes on increasing. To meet such requirements metal matrix composite is one of the reliable sources. Composite materials are one of the reliable solutions for such demands. In composites, materials are combined in such a way that to enable us to make superior use of their parent material while reducing some extent the effects of their deficiencies. The simple term ‘composites’ gives indication of the combinations of two or more different material in order to improve the properties. In the past few years, materials development has shifted from conventional to composite materials for adjusting to the need for reduced weight, low cost, quality, and high performance in structural materials. Driving force for the utilization of AMCs in areas of automotive and aerospace industries includes the parameters like performance, economic and environmental benefits are taken into consideration. A composite material is a material consisting of two or more physically and/or chemically distinct phases of the materials. The composite generally has better characteristics than those of each of the individual component materials. Usually the reinforcing component is distributed in the continuous or matrix component i.e., parent material. When the matrix material is a metal, the composite is known as a metal-matrix composite (MMC). In MMCs, the reinforcement usually takes the form of whiskers, particles, short or continuous fibers.

Objectives for Development are to produce the improved materials with the required characteristics. The reinforcement of metals can have many different objectives. The reinforcement of light metals opens up the possibility of application of these materials in areas where light weight is major priority. The main aim here is the improvement in the component properties. The development objectives for light metal composite materials are:

- Improvement in tensile strength and yield strength at room temperature and above while maintaining the minimum ductility or rather toughness,
- Increase in creep resistance at higher temperatures compared to that of conventional alloys.
- Increase in fatigue strength, especially at higher temperatures,
- Improvement of thermal shock resistance,
- Improvement of corrosion resistance,
- Increase in Young’s modulus,
- Reduction of thermal elongation.

In conventional casting processes, liquid metal is filled into a mould and solidifies as cooling occurs. The morphology of the improving solid–liquid interface is generally dendritic. The natural progression of poring followed by solidification often leads to internal structural defects, such as entrained oxide or shrinkage porosity, which combine to yield a casting of relatively poor mechanical properties.

Although the major concept of composite materials go back to antiquing, the technology was essentially build and most of the progress occurred in the last few decades. Composite having unique advantages over monolithic material, such as high strength, high fatigue life, stiffness, low density and adaptability easily. Now day's automobile and marine industries are need of superior class of materials that need all different uses. In this paper different composite of Mg–CNT prepared by stir casting. CNT has perfect physical and chemical properties and also mechanical properties. In this study, recent progress in magnesium matrix composite technology is reviewed. The conventional and new processes for the fabrication of magnesium matrix composites are summarized.

CNT's distribution with composite matrix was traced characterized. The standard specimens fabricated using different process followed by machining. Samples are prepared at different process was then tested their properties like mechanical, physical, chemical. In mechanical tensile, compression test studied. Microstructure was also studied using an optical microscope. And what happen when proper mixing of CNT with Mg their density will increases or not ,the density and hardness measurement show what happen about weight of Nano composite.

II. CASTING PROCESS

Experimental Method identified for the thesis work: Step 1: Preparation of sand mould

Green sand or Moulding sand as it is popularly known is used with binding material to form the cope and the drag or the cores of the mould.

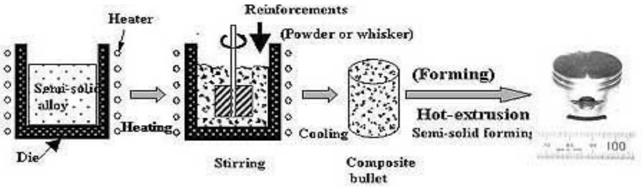

Fig. 1 Casting Process

Step 2: Preparation of Specimen of various compositions

The alloying element CNT is mixed in proper proportion by weight in the ratio of different percentage. The percentage of alloying element to be used is determined by literature review and history for development of this work

Step 3: Machining of specimen for test.

The material needs to be sized as a square section with a notch as specified in the relevant IS standard (for Charpy/ Izod Impact test later)

Step 4: Checking Hardness over `Hardness testing

Machine Brinell Hardness Test to be carried out over `Llyod' testing machine

Step 5: Checking Impact Strength using Charpy

Impact testing machine' Test for Impact Strength is carried out using the setup required for Izod Impact Test

Step 6: Analysis and graphs

As per DOE/ Optimization to be conducted using Taguchi Method/ Minitab Various Experiments are to be conducted on MMC samples by changing weight fraction of CNT(0.5%, 0.8% and one pure Mg) and size of CNT-Mg particles to analyse the casting performance characteristics of CNT/Mg-MMCs.

2.1 Hardness

The Brinell hardness test is carried out over Brinell hardness tester. Six samples of CNT/Mg-

MMC's for different sizes and weight fraction of Mg particles are prepared. After test and hardness value on dial, the Brinell hardness values with

reference to scale HRB are taken for all samples and shown by graphs.

What is Hardness?

Hardness is the property of a material that resist plastic deformation, generally by penetration. However, the term hardness may also refer to resistance to bending, scratching, abrasion or cutting.

Measurement of Hardness:

Hardness is not an intrinsic material property dictated by precise definitions in terms of fundamental units of mass, length and time. A hardness property value is the result of a defined measurement procedure. Hardness of materials has probably long been assessed by resistance to scratching or cutting. An example would be material B scratches material C, but not material A. Alternatively, material A scratches material B slightly and scratches material C heavily. Relative hardness of minerals can be assessed by reference to the Moh's Scale that ranks the ability of materials to resist scratching by another material. Similar methods of relative hardness assessment are still commonly used today. An example is the file test where a file tempered to a desired hardness is rubbed on the test material surface. If the file slides without biting or marking the surface, the test material would be considered harder than the file. If the file bites or marks the surface, the test material would be considered softer than the file. The above relative hardness tests are limited in practical use and do not provide accurate numeric data or scales particularly for modern day metals and materials.

The usual method to achieve a hardness value is to measure the depth or area of an indentation left by an indenter of a specific shape, with a specific force applied for a specific time. There are three principal standard test methods for expressing the relationship between hardness and the size of the impression, these being Brinell, Vickers, and Rockwell. For practical and calibration reasons, each of these methods is divided into a range of scales, defined by a combination of applied load and indenter geometry.

Vickers Hardness Test

The Vickers hardness test method consists of indenting the test material with a diamond indenter, in the form of a right pyramid with a square base and an angle of 136 degrees between opposite faces subjected to a load of 1 to 100 kgf. The full load is normally applied for 10 to 15 seconds. The two diagonals of the indentation left in the surface of the material after removal of the load are measured using a microscope and their average calculated. The area of the sloping surface of the indentation is calculated. The Vickers hardness is the quotient obtained by dividing the kgf load by the square mm area of indentation.

Fig. 2 Vickers hardness test

2.2 Impact Strength

Objective

To conduct Charpy V-notch impact test and determine the ductile-brittle transition temperature of steels. Impact Test to be carried out over Charpy Impact Testing Machine and results to be recorded. According to size and weight fraction of CNT particles Four Specimens CNT/Mg-MMC’s of Square/round cross-section of size with single V-notches are planned.

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Fig. 3 Impact hardness test

Notched-bar impact test of metals provides information on failure mode under high velocity loading conditions leading sudden fracture where a sharp stress raiser (notch) is present. The energy absorbed at fracture is generally related to the area under the stress-strain curve which is termed as toughness in some references. Brittle materials have a small area under the stress-strain curve (due to its limited toughness) and as a result, little energy is absorbed during impact failure. As plastic deformation capability of the materials (ductility) increases, the area under the curve also increases and absorbed energy and respectively toughness increase. Similar characteristics can be seen on the fracture surfaces of broken specimens. The fracture surfaces for low energy impact failures, indicating brittle behavior, are relatively smooth and have crystalline appearance in the metals. On the contrary, those for high energy fractures have regions of shear where the fracture surface is inclined about 45° to the tensile stress, and have rougher and more highly deformed appearance, called fibrous fracture. Although two standardized tests, the Charpy and Izod, were designed and used extensively to measure the impact energy, Charpy v-notched impact tests are more common in practice. The apparatus for performing impact tests is illustrated schematically in Figure-I. The load is applied as an impact blow from a weighted pendulum hammer that is released from a position at a fixed height h. The specimen is positioned at the base and with the release of pendulum, which has a knife edge, strikes and fractures the specimen at the notch. The pendulum continues its swing, rising a maximum height h' which should be lower than h naturally. The energy absorbed at fracture E can be obtained by simply calculating the difference in potential energy of the pendulum before and after the test such as,

$$E = m.g.(h-h')$$

Where m is the mass of pendulum and g is the gravitational acceleration. The geometry of 55mm long, standard Charpy test specimen is given in Figure-2. If the dimensions specimens are maintained as indicated in standards, notched-bar impact test results are affected by the lattice type of materials, testing temperature, thermo-mechanical history, chemical composition of materials, degree of strain hardening, etc.

2.3 Microstructure

Metallographic samples are normally sectioned from the cylindrical cast bars. A 0.5 % HF solution is used to etch the samples wherever required. To see the difference in distribution of Mg particles in the CNT matrix, microstructure of samples are developed on Inverted type Metallurgical Microscope and weight fraction (0.5%, 0.8%) of CNT-Mg particles. Optical micrographs shows the distribution of CNT particles within the matrix.

Fig. 4 Microstructures study by SEM

III. CONCLUSIONS

Following conclusions were deducted from the study:

1) The Mg-CNT Nano composite have been successfully synthesized using the stir casting techniques.
2) It is observed that the density values of the composite increases with increasing weight % of CNT. This happens because, during & stirring the distribution within the matrix of the composite is uniform.
3) The hardness increases with the increase in % of CNT content increases. It distributes throughout the matrix in more uniform way & there is transfer of load from matrix to reinforcement.
4) The reason behind the increase in porosity is due to the clustering effect of CNT.

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