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CNT BLENDED NAVAL BRASS FABRICATION AND TESTING

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ABSTRACT

The Utilization of advanced technologies increased the scope of producing new materials drastically .as a result wide spectrum of nanomaterials are being produced these materials are manufactured as per the desired properties in the final material /composite. The aim of this study is to investigate the effect of CNT (Carbon Nano Tubes) reinforcement into naval brass (Cu-CNT 60%, Zinc 39%, and Tin 1%) naval brass is widely applied in the marine based objects preparation because of its excellent corrosion properties and its mechanical properties are further found to be enchased by blending CNT.

Keywords: Naval brass, CNT,Nanomaterials, Mechanical, Corrosion Properties.

1 INTRODUCTION

Metal/alloy matrix nanocomposites are one of the types of nanocomposites. The advancement in production technology has led to manufacture of wide varieties of nanomaterials. These nanomaterials when reinforced in alloy or metal matrix results in different properties of the nanocomposite.

Properties such as Young's modulus, rigidity, tensile strength, density, reactivity, electrical conductivity and thermal conductivity of these nanocomposites vary significantly from base metal or alloy. These nanocomposites have wide application in aviation technology, sporting, light weight sensors, structures requiring high strength to weight ratio and medical fields. Copper alloys are known for high thermal conductivity, electrical conductivity, corrosion resistance and ductility. Brasses, bronzes, copper-nickel and copper-beryllium are some of the copper alloys. There are many copper alloys used to produce marine and ship building objects [1]. Having good corrosion resistance and surface finish these alloys suit under water applications. Navalbrass is used in marine construction and for applications in fresh and salt water as it strong and has high corrosion resistant behaviour. It contains 60 wt % copper, 39 wt % zinc and 0.75 wt % tin. This is an alpha-beta two phase alloy and has high strength. It also has hot forgeability [3].

Carbon nanotubes (CNTs) are tube like structures of carbon atoms with diameter of the range 100 nm. CNTs have single walled tube and multi walled tube like structures. These materials are of high tensile strength, good electrical conductivity and thermal conductivity [4]. Because of these properties they have applications in making nanocomposites, optics and electronics. Studies conducted by Cho et al. [5] on the effect of CNTs reinforcement in copper metal have shown improvement in thermal conductivity at low volume percentage (1 vol %) of CNTs. CNTs blended Ni matrix nanocomposites achieved less coefficient of friction and wear rate values [6].

Cu matrix reinforced with CNTs has improved hardness by two times and wear resistance by three times [7].

Multi walled CNT (MCNT) blended brass (Cu 70%-Zn 30%) yielded improved micro-hardness compared to matrix material

It has been observed that reinforcement of CNTs in brass has increased hardness and tribological properties. It is also observed that no significant study was conducted on the effect of CNTs blending in naval brass. This is important for contributing to marine related materials as naval brass has wide applications in marine and other under water usage. Aim of this study is to reinforce CNTs in various wt% in to naval brass and finding hardness and ultimate strength values.

2. Materials and Methods

Small orange-browncoloured copper chips shown in Fig.1 are made out of recycled copper. These chips are mixed with CNT powder (shown in Fig. 2)and powder mixture is produced with the help of ball milling method. Fig. 3 explains the SEM image of carbon nanotubes powder.

Fig. 1 Formation of chips on lathe machine

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Fig. 2CNT powder

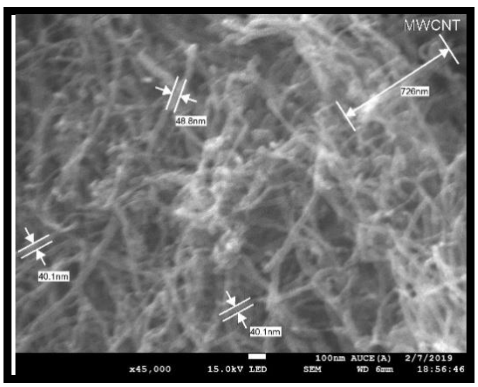


Fig. 3 SEM image of CNT powder

In ball mill the mixing is done by filling in the metal reinforcement phase together with some hard balls into mixing jars and rotating the jar with constant and speed

During the rotational movement the added balls or falling on top of the copper chips this leading the reduction of the particle size. The size, speed and material of ball are taken as mixing parameters and required CNT reinforced copper powder has been prepared. Steps in ball milling process are explained in Fig. 4.

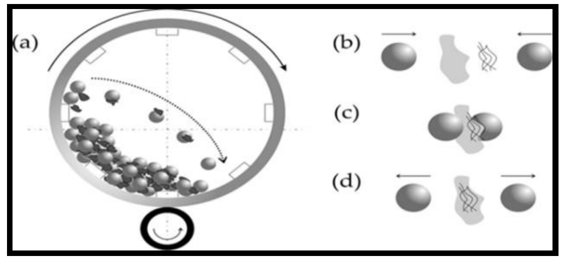


Fig. 4 Ball milling process

Stir casting has been used to cast the specimens for tensile test and hardness test. Fig. 5 shows the stir casting equipment.

Fig. 5 Equipment of stir casting furnace

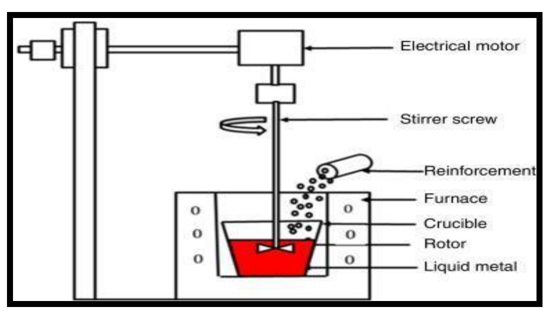


Fig. 6 Stir casting process

Fig.7 Metals melting at 919°C

Fig. 8 Casting the liquid alloy in die

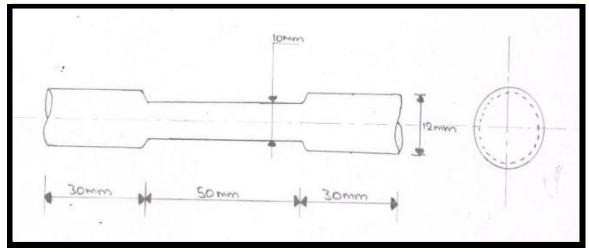


Fig. 9 Specimen prepared for tensile test

All samples have been made as per the ASTM international standard shown in fig 6 -9.

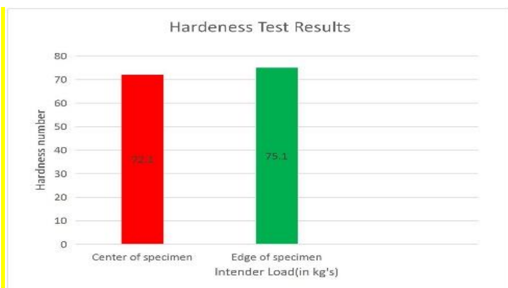
Table 1. Tensile test results

Specimen	Max. Load (KN)	Load at break	Ultimate tensile strength (MPa)	Tensile stress at yield
Naval brass specimen with carbon nano tube	23.53	21.01	299.65	215.34
Normal naval brass (Annealed (OS050) C23000 Brass	21.98	19.63	280	83

3. Results and discussions

From the hardness test we found out the hardness of sample without CNT reinforcement at the centre to be 72.1 HRB and on the surface to be 75.1 HRB. Upon the reinforcement of CNTs these values have changed to 83.5 and 87.5 HRB respectively shown in fig.10.

(a)



(b)

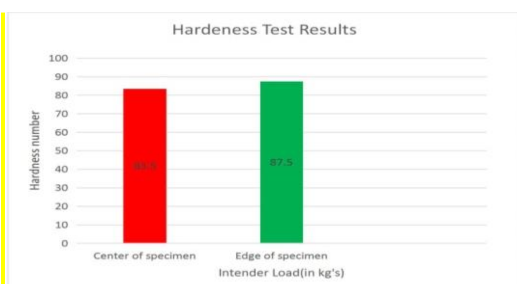


Fig. 10 Hardness of the samples at centre and at edge (a) without reinforcement and (b) with reinforcement

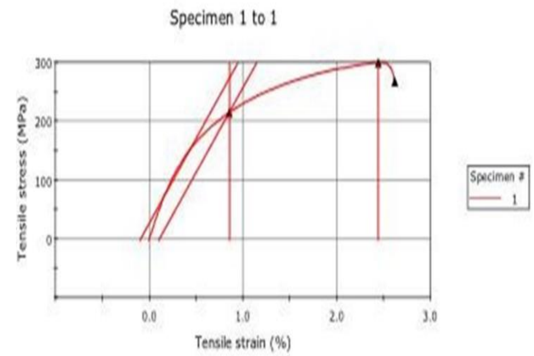


Fig. 11 Comparison of tensile test results of samples with and without reinforcement

The tensile test results have been tabulated in Table 1& fig.11. Tensile strength of CNT reinforced naval brass is observed to be 299.65 MPa where as that of the non reinforced naval brass is obtained as 280 MPa.

4. References

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