EFFECTIVENESS OF CARBON FIBER AND PHOSPHOR BRONZE USED IN THE FABRICATION OF MARINE PROPELLER

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Abstract-Fiber reinforced composites are finding wide spread use in naval applications in recent times. Traditionally marine propellers are made of manganese-aluminum-bronze (MAB) or nickel-aluminum-bronze (NAB) for high-yield strength, reliability, and affordability. This project concentrates on the performance test of a phosphor bronze metal which coated with CFRP (carbon fiber reinforced plastic) propeller. To validate the results, the bronze plate is prepared, coated with CFRB in a strict proportion .The corrosive resistance and hardness value of composite material were evaluated and compared with aluminium bronze propeller to found out the effectiveness. This report consists of brief details about Fiber Reinforced Plastic materials and the advantages of using composite propeller over the conventional metallic propeller.

Keywords: Phosphor bronze, Carbon fiber, Nickel Aluminium Bronze.

1.INTRODUCTION

A propeller is a rotating fan like structure which is used to propel the ship by using the power generated and transmitted by the main engine of the ship. Mostly, propellers made of Nickel-aluminium-bronze (NAB) are found to be used in most of the marine applications. Carbon fiber can be made to become stronger than steel and lighter than aluminium and as stiff as titanium. Carbon fiber is commonly used to reduce the weight of the structural components on aircraft and thereby improving fuel economy, reducing emissions and increasing carrying load. In current years, the increased need for the light weight structural element with acoustic insulation, has led to use of fiber reinforced multilayer composite propeller. The present work concentrated to found out the effectiveness of CFRP (carbon fiber reinforced plastic) propeller over the aluminium bronze propeller. For this small phosphor bronze plate is taken as specimen and carbon fiber is coated on the surface of bronze by using the technique of Chemical Vapour Deposition. Moreover, composites can offer the potential benefits of reduced corrosion and cavitation damage, improved fatigue performance, lower noise, improved material damping properties, and reduced lifetime maintenance cost.

2. PHOSPHOR BRONZE

Phosphor Bronze, or tin bronze, are alloys containing copper, tin and phosphorous. The phosphor bronzes contain between 0.5 and 11% tin and 0.01 to 0.35 % phosphorous. The addition of tin increases the corrosion resistance and strength of the alloy. The phosphor increases the wear resistance and stiffness of the alloy. . The phosphor bronzes are designated as UNS C50100 through C54200. Leaded phosphor bronzes combine good strength and fatigue resistance with good machinability, high wear resistance and corrosion resistance.
They are designated as UNS C53400 through C54400.

2.1 CHEMICAL COMPOSITION OF PHOSPHOR BRONZE

Alloy	Cu%	Sn%	Pb%	Zn%	Fe%	P%
C52100	Remainder	7.00-9.00	0.05	0.20	0.10	0.03-0.35

2.2 PHYSICAL PROPERTIES OF PHOSPHOR BRONZE

Melting Point –maximum	**1027° C**
Melting Point –minimum	882° C
Density	8.8 gm/cm3 at 20° C
Specific Gravity	8.80
Electrical Resistivity	13.27 micro-cm at 20° C
Annealing minimum	900°C
Annealing maximum	1250°C
Thermal Conductivity	62.3 W/m at 20° C
Specific Heat Capacity	377.1 J/kg at 293° C
Modulus of Elasticity in Tension	110310 MPa
Modulus of Rigidity	41370 MPa

3. CARBON FIBER

It is being utilized at a greater scale which is increasing the demands on automated production to improve productivity. Driving forces taking advantage of composite material properties are cost, environmental and technology benefits. Various industries are now using composites at a greater extent, especially in the aerospace industry.

3.1 TYPE OF CARBON FIBER

- Ultra-high-modulus (UHM)
- High-modulus (HM)
- Intermediate-modulus (IM)
- Poly acrylo nitrile (PAN)-based CF
- Pitch-based CF

4. EXPERIMENTAL PROCEDURE

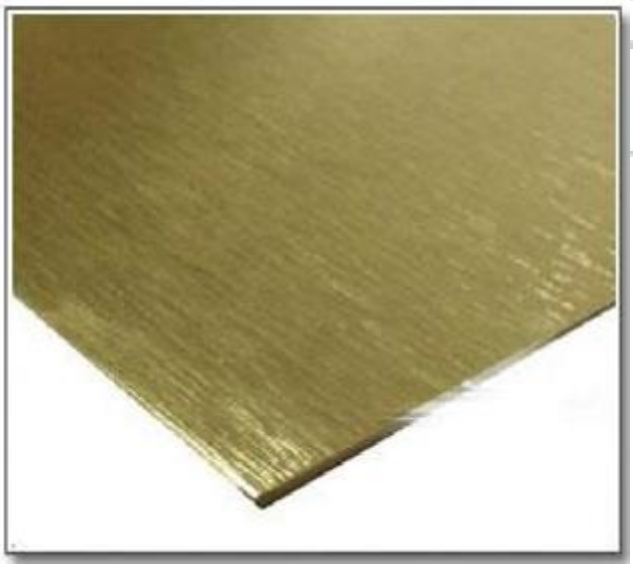
Small piece of phosphor bronze has been taken and it is coated with carbon fiber reinforced plastic by using chemical vapour deposition method by which small specimen is prepared . Since the specimen is prepared for evaluating the effectiveness of the propeller th performace measured by conducting two test such as corrosion test and knoop Hardness test.From that result the various mechanical properties compared with aluminium bronze propeller or existing propeller material**.**

5. COMPARISON TABLE

Properties	Composite material (Phosphor bronze, CFRB)	Nickel Aluminium bronze (C63200)
Tensile Strength	210 N/mm²	190 N/mm²
Yield strength	275 N/mm²	260N/mm²
Elongation	17%	25%
Hardness (HRC)	85	26
Density	8.157 gm/cm3	7.58 gm/cm3
Melting point	987°C	1035°C
General corrosion	0.023mm/year	0.074mm/year

6. PHOTOGRAPHY

a) PHOSPHOR BRONZE BEFORE COATING



b) PHOSPHOR BRONZE WITH CARBON FIBER COATING

7. CONCLUSION

It is concluded that from the results presented above, well designed composite propeller can replace a aluminum bronze propeller for enhanced performance from cavitations and efficiency point of view.From that result, in propeller manufacturing phosphor bronze and carbon fiber can be adopted to produce propeller to reduce cost, time and increase the mechanical properties, quality and productivity. In future this propeller can be used where the high strength/weight ratio is needed.

8. REFERENCE

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