DEVELOPMENT OF PARTICULATE REINFORCED MMC TO IMPROVE TRIBOLOGICAL PROPERTIES FOR BUSH BEARING

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Abstract- *Babbitt metal is the popular bearing material used for many bush bearing applications. In this study, Babbitt/ bronze particulate reinforced composite is developed with different compositions in the range of 1 – 5% of reinforcement by stir casting technique. In that the tribological properties is investigated for various compositions and compared with the pure Babbitt metal. The friction and wear characteristics in this MMC were determined under dry sliding conditions by pin –on – disk test rig. Loads in dry sliding conditions are applied in the range of 15N – 25N. The wear natures in the surface of the composites are observed by SEM (Scanning Electron Microscope). The results show that the higher volume fraction of reinforcement exhibits better resistance to abrasive wear. It is identified that the hardness also considerably increased with the increase in reinforcement volume. The newly developed composite exhibits better results in wear rate and hardness with stabilized COF (Coefficient of Friction) compare to pure Babbitt metal*.

Keywords: Babbitt metal, Tribology, pin-on-disc, wear, MMC, Scanning Electron Microscope (SEM).

1.0 INTRODUCTION

Journal bearings are one of the most important parts in rotating equipments, and its vitally important elements as rotor supports in most mechanical systems operating with high horsepower and high loads, such as turbines, centrifugal compressors, pumps, connecting rods in piston and motors.[1]. The materials used for journal bearings are commonly white metals (tin-based or lead-based), aluminum based and copper based alloys. These materials contain lead. Lead is widely perceived to have an inherent toxicity that causes acute and chronic effects and cumulative toxic effects on environments. However due to the environmental effects has been targeted to eliminate the usage of lead containing bearing materials.[2]. In general, a hard material is employed as reinforcement because of potential improvement in mechanical properties such as hardness and tensile strength which are the desirable properties in tribological application. Babbitt metal (tin-based) is used as the matrix of the composite.babbitt metal is highly compatible to avoid seizure and reduces operating costs considerably. [1-4]. Bronze is less brittle than iron. It's also corrosion and metal fatigue resistance. The density of composite metal is high, stiffness and its good wear characteristics and its application is to heavier duty parts in leaf spring bushing, connecting rod in pistons, high load in high speed etc., wear emissions are affected by a number of factors, which include materials, processing as well as operational factors, which has been the subject of investigations for a long period. [9]. Secondary processing operations performed to improve physical and mechanical properties may also affect the tribological performance of bush bearings. The affect is investigated and it's eliminated and to improved the mechanical and tribological properties of bush bearings. [10].

2.0 EXPERIMENTAL METHODS

2.1. Specimen preparation

The composite material was prepared by using casting process in the form of cylindrical castings (10 mm in diameter and 30 mm long). Stir casting process has been used to fabricate the Babbitt metal and bronze composites. An electric furnace was used at the first stage for melting the Babbitt in a crucible under atmospheric conditions. The melting of Babbitt takes place at 350˚C. After melting pure Babbitt, bronze particles are introduced into the melt .The particulate bronze metal is pre-heated up to 750˚C and it is mixed into Babbitt metal. Then the Babbitt metal with bronze cast is poured into the die to obtain the required shape (12mm diameter and 70mm length). Then the specimen is machined in centre lathe to obtain the exact dimensions that are required for tribological test.

Table No. 1. Composition of Particulate MMC

Materials	Bronze (wt %)	Babbitt
Specimen I	2	Remaining
Specimen II	3	Remaining
Specimen III	4	Remaining

3.0 HARDNESS TEST

The Rockwell hardness test is conducted at room temperature. The load of indenter is set as 150kgf.The average Rockwell hardness of pure Babbitt metal was 32 RHN. This value is similar than the Rockwell hardness obtained by gravity die casting. The Rockwell hardness result was calculated for three different compositions. The results were compared with pure Babbitt metal.

Table 2 Hardness Test For Composite Material At Various Percenntage of Reinforcement

Specimen	Percentage of Bronze	Hardness Number (RHN)
Pure	0	32
Specimen1	2	34
Specimen2	3	36
Specimen3	4	42

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4.0 PIN-ON-DISC APPARATUS

The pin on disc is an apparatus used to determine Tribological properties of composite materials. These properties include Frictional coefficient and wear rate. The specimen is placed on a rotating disc spinning at a variable angular speed. A ball held by a vertically reciprocating pin is pressed against the sample for a fixed amount of full rotations of the disc. The tangential force and the frictional coefficient are measured and the volume of removed material can be measured by additional techniques.

For each composition three specimens of dimensions 10mm diameter and 30mm length are prepared**.** Each sample is tested with three loads (15N, 20N and 25N) and for three sliding speeds (250rpm, 300rpm, 350rpm) in the pin-on disc apparatus 180 secs, 240 secs, 300secs during which the wear and frictional is obtained. The weight of the sample is found before and after the process.

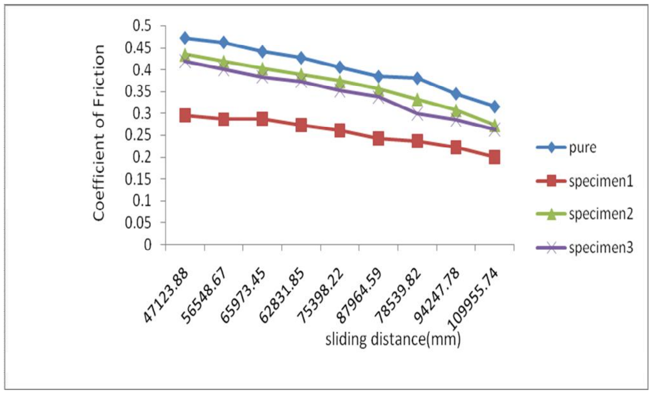
Fig.1 Overall View Of Pin On Disc Apparatus

5.0 Result and Discussion

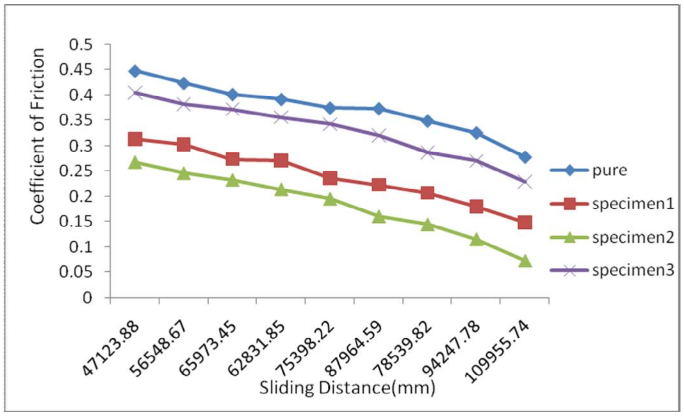
WEAR CHARACTERISTICS

5.1 Effect of Sliding Distance on Co-Efficient of Friction:

The relationship between co-efficient of friction and sliding distance under different load condition. In all the samples, the co-efficient of friction decreases with increase in sliding distance under different load conditions. The friction co-efficient is higher at the commencement of the test due to the elevated friction force between the disc and the pin surface. Friction co-efficient of test specimen was obtained from the frictional force during sliding condition. The variation of co-efficient of friction against sliding distance was studied for three different applied loads like 15N, 20N, & 25N for pure Babbitt metal and three different composite specimens with varying volume percentage particle reinforcement (2%, 3% & 4% of Bronze).



(a)



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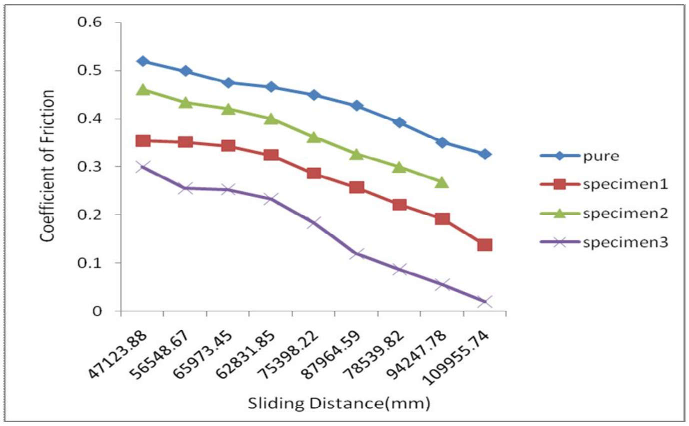
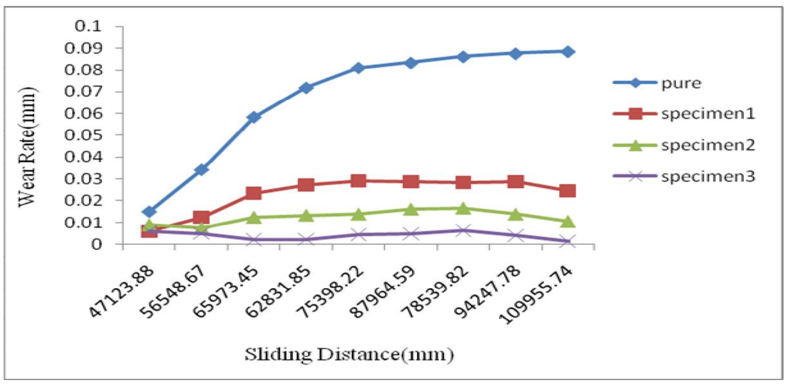


(c)

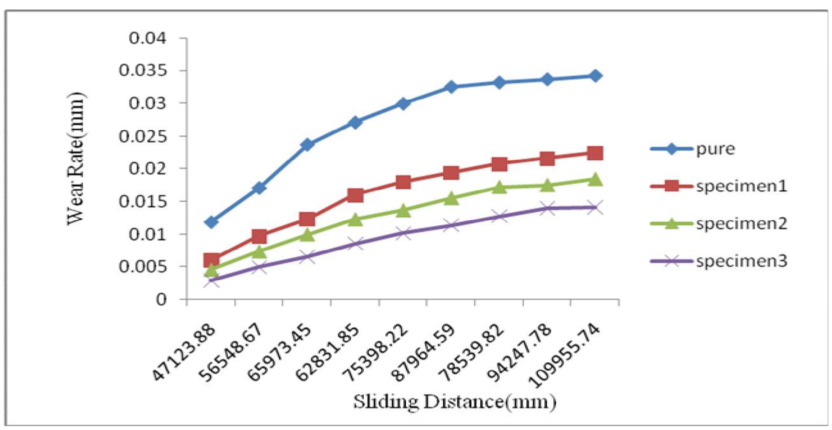
Figure.2. Coefficient Of Friction of Unreinforced Alloy and Composites at Applied Loads of (a) 15N, (b) 20N and (c) 25N As A Function of Sliding Distance.

5.2. Effect of Sliding Distance on Wear Rate:

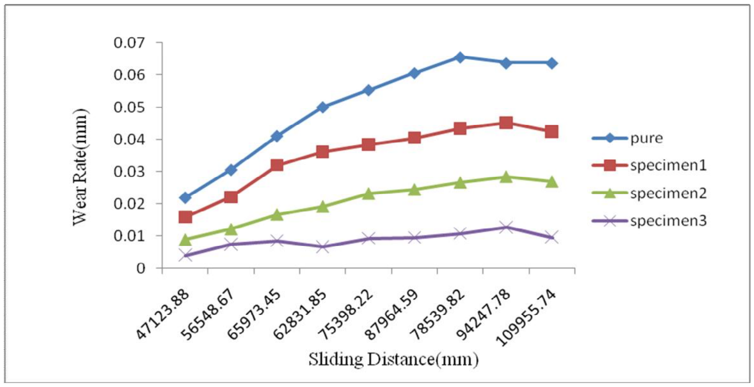
Figure clearly explains the correlation between wear rate and sliding distance. The wear rate increases and attains a higher steady value with the increase in sliding distance, in all the samples. Test specimen's wear rate was obtained from the ratio between volume loss and sliding distance. The variation of wear rate against sliding distance was calculated for three different applied loads like 15N, 20N, & 25N for pure and three different composite specimens with varying volume percentage particle reinforcement (2, 3 & 4% of bronze) and is depicted in figures.



(a)



(b)



(c)

Figure 3. Wear Rate of Pure and Composites at Applied Loads of (a) 15N (b) 20N and (c) 25N as a Function of Sliding Distance.

5.3 Wear Track Analysis

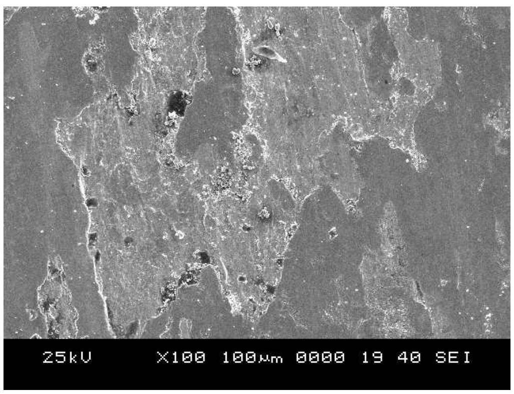


Fig (a)

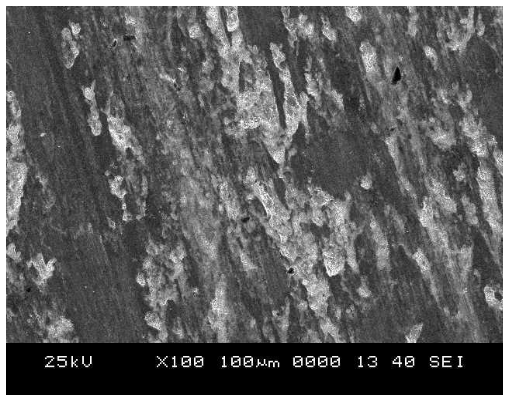


Fig (b)

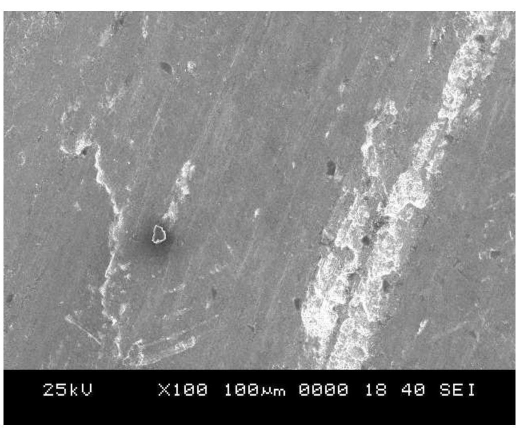


Fig (c)

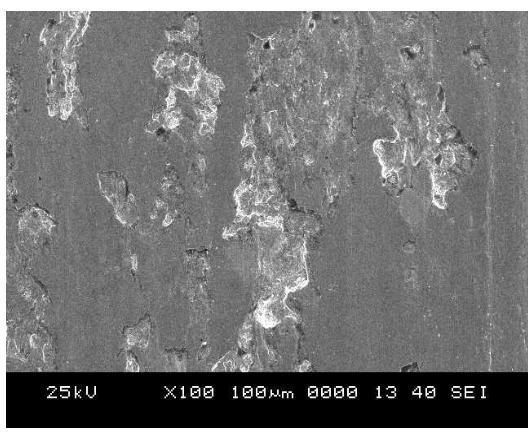


Fig (d)

Figure 4. Shows the SEM Photographs of the Worn Surface Of (A) The Pure White Metal and Bronze With (B) 2%, (C) 3% and (D) 4% Reinforcement

6.0 CONCLUSION

The newly developed Babbitt/Bronze metal matrixes composite which have better Tribological properties compare to the existing pure Babbitt bush bearings. The results show that the rate of wear is reduced in this composite. So this can be replaced for regular Babbitt bush bearing to achieve better performance. The Hardness of Babbitt/bronze composites is increased as reinforcement increased. The wear rate is reduced low compared with the pure Babbitt metal. Coefficient of friction is low when compared to pure Babbitt metal.

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