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WEAR MEASUREMENT OF TILTING PAD THRUST BEARING OF BRONZE MATERIAL HAVING CATENOIDAL PROFILE

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ABSTRACT

Tilting Pad Thrust bearings are generally designed to transfer high and axial loads from the rotating shaft. These bearings are widely used in rotating machines such as Turbines, Compressors, Pumps, etc. because of their low friction, good load bearing characteristics and high damping characteristics. The surface above the Pads has a significant impact over the bearings life.[10] Thus, previous literature indicates that profiles have significant factors which influence the load carrying capacity of bearing. Therefore, the objective of this paper is to study the wear rate before using after using of a Bronze material with Catenoidal surface over the over the pad. Thus, an experimental study has been performed which finds out the before and after wear results which provides a validation of theoretical models.

Keywords* : *bearings life, catenoidal surface, damping characteristics, load bearing capacity,wear.

I. INTRODUCTION

In the era of technological development, there is need of more analysis over the bearing pad surface, compact size of bearing which influences to high load carrying capacity and decreasing Power consumption. Abramovitz [1] theoretically studied the effect of pad curvature on operating condition. He assumed convex type of surface over the pad and concluded that with the use of this surface, it would result in 10% increase in load carrying capacity as compared to flat pad. Thus, at early industrial development the study on bearing were theoretically made and hence it must be now be experimentally verified. Many investigators have studied and analysed the process regarding the development of surface profile of pads. Anant Pal Singh [2] investigated performance parameters of sector shaped thrust bearing on the continuous surface profile. He used Computer Aided Finite difference numerical solution to determine pressure distributions of a sector pad. He found out that with the use of new surface profiles such as Cycloidal, Catenoidal and Quadratic, there is effective increase in load bearing capacity, decrease in power consumption and reduction in coefficient of friction. Bagci and Singh [3] studied the work of Anant Pal Singh and extended the work. He investigated the performance characteristics of bearing having Catenoidal, Polynomial, Exponential, Cycloidal and Truncated cycloidal film shapes. Dobrica and Filon [4] proposed a Thermohydrodynamic (THD) steady model and this model was applied to well-known geometry of a slider pocket bearing. He found out that peak pressure developed in the pad transfer toward the trailing edge. Hargreaves [5] presented both theoretical as well as experimental results of surface waviness on pad bearings of rectangular slider pads. He found out that surface waviness on the bearing pad increases the load bearing capacity. Sharma and Pandey [6] compared the experimental results of pressure distribution with various single continuous surface profiles of pads such as cycloidal, catenoidal, polynomial and plane pads. He showed that the Cycloidal profile of pad generates about 30 % more pressure than the flat pad. Naduvinamani [7] studied the combined effects of couple stresses and surface roughness on the performance characteristics with various film shapes such as cycloidal, plane, secant, hyperbolic and exponential. Glavatskih [8] described the method to improve temperature monitoring of fluid film bearings and showed that the proposed method improves sensitivity to thermal transients in convention bearing and temperature monitoring in the PTFE faced bearings. Abhijeet Patil [9] compared the experimental results of pressure distribution on various profiles of pad such as plane, cycloidal, catenoidal and quadratic. He found out that in cycloidal surface shaped sector pads, the pressure generated within fluid film increases which increases the load bearing capacity of hydrodynamic bearing.

II. BEARING MATERIAL

Bearing life mainly depends upon the choice of bearing material, so it is important to select the bearing material correctly to service conditions and operating mode. The coefficient of friction of Bronze alloy lies between 0.08-0.14.The Bronze bearing provides Low coefficient of friction, Good wear behavior, High compressive strength,Structural uniformity and Corrosion resistance. [10]

III. INSTRUMENTATION AND EXPERIMENTATION

3.1 Details Of Experimentations

Experimental test rig The experimental setup of tilting pad thrust bearing is available in Walchand College of Engineering, Sangli. [10]

3.2 Speed, Load and Cooling rate Variation[10] :

- Tilting pad thrust bearings are used in various engineering fields. They are widely used in 203 pumps. The speeds from this pump testing are selected.

- For Load variation, Hydraulic Jack is used. The load is varied by using a Direction Control Valve.

- The cooling rate affects the performance parameters of the system. A Flow control valve is used to vary the cooling rate from 0° to 90°. Depending upon the number of process parameters, L_8 Orthogonal Array is selected.

Table 3.1 Process parameters and their levels

Level	Speed (rpm)	Load (kg)	Cooling Flow Rate (m^3/sec)
1	981	1056	0.147
2	1152	3695	0.383

3.3 Surface Wear of Bronze Profile:

Accuracy of surface profile generated over pad is checked using Coordinate Measuring Machine (CMM) at eleven different points taken along the circumferential width of pad. Measured coordinates are then verified with the values calculated theoretically.After conducting experimentation on pads, they are again checked for its wear under CMM at same eleven coordinates. Below given Figures show respected value of thicknesses at various nodal coordinates taken on circumferentially width of pad, at 25 %, 50% and 75 % of radial length of pad after wear of pad surface.

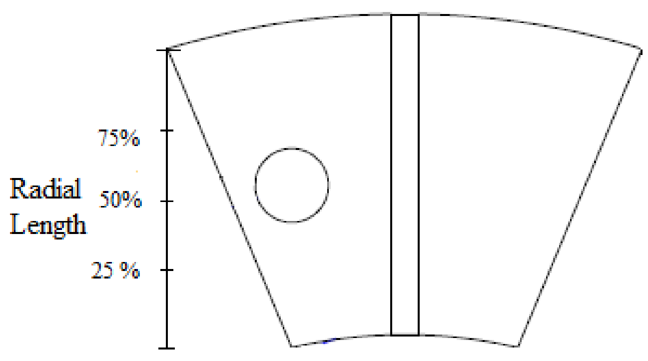

Figure 1: Pad percent details for wear measurement

IV. RESULTS

- At 25 % of pad radial length –

The Figure shows wear curve on the pad surface with respective pad length.

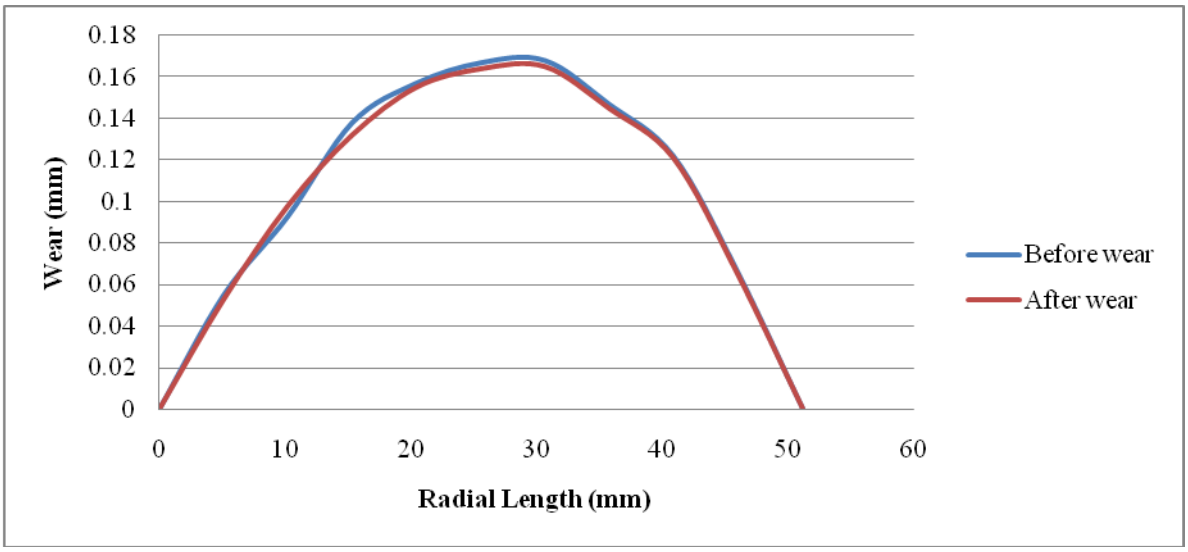

Figure 3: Surface wear of profile at 25% radial length

- At 50 % of pad radial length –

The Figure shows wear curve on the pad surface with respective pad length.

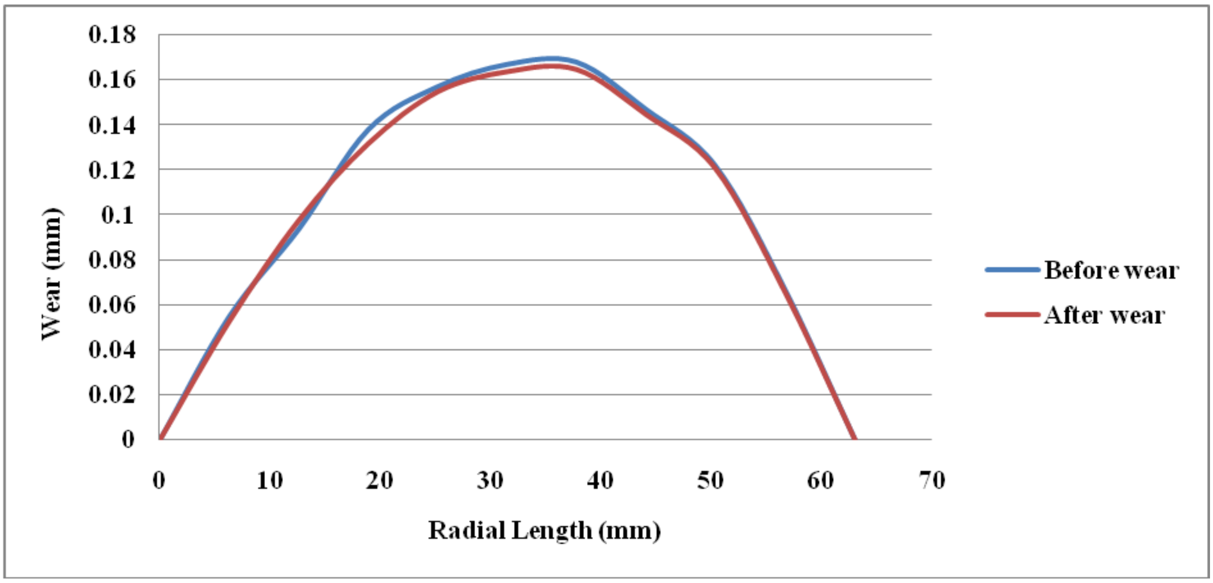

Figure 2: Surface wear of profile at 50% radial length

- At 75 % of pad radial length –

The Figure shows wear curve on the pad surface with respective pad length.

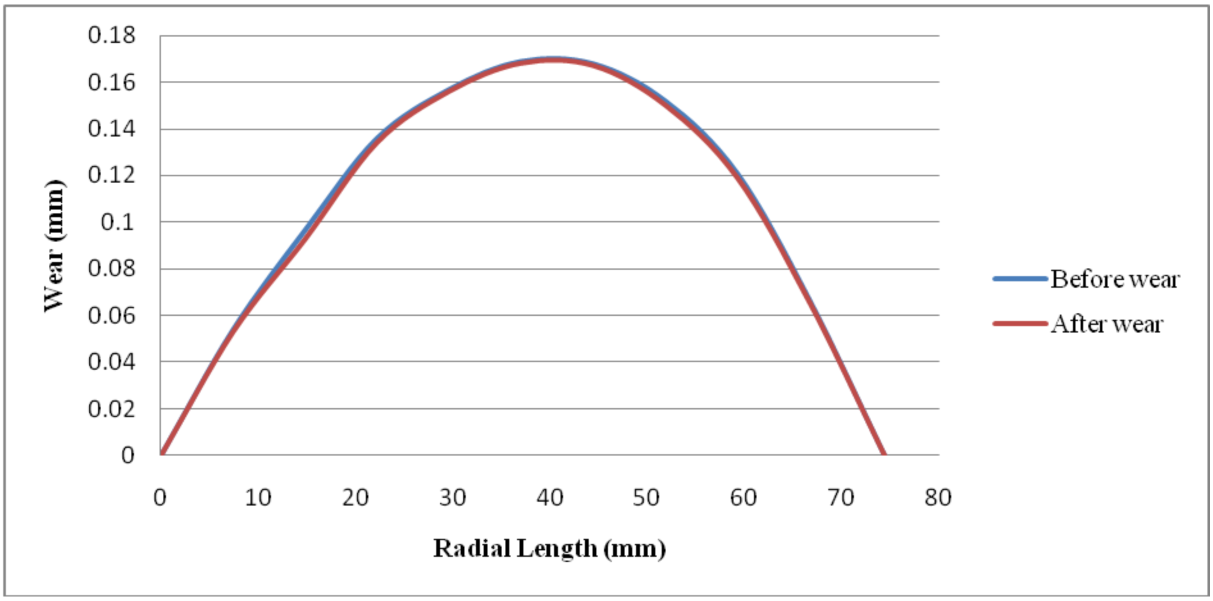

Figure 4: Surface wear of profile at 75% radial length

V. CONCLUSION

The Catenoidal surface influences a higher Load carrying capacity in comparison to Conventional/Plane pad as well as less wear which means considerable reduction in coefficient of friction.

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