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Analysis of Composite Journal Bearing-As a Review

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Abstract—Technology has always been used to achieve better performance in any mechanical system. The cylindrical hydrodynamic journal bearing is the most basic hydrodynamic bearing with cylindrical bore. This bearing has a high load capacity, and the simple design is compact, bi-rotational, and easy to manufacture. However, as the design speeds of machines increased, it is found that this bearing had limitations due to oil whirl. Oil whirl is very undesirable because of high vibration amplitudes, forces, and cyclic stresses that are imposed on the shaft, bearings and machine creating the instability of bearing.

In this work, we are going to do the pressure distribution analysis of the lobe type composite journal bearing which is composed of PTFE based material with some filler material since the PTFE material has capability of withstanding dry and wet running and the filler material to increase load carrying capacity, thermal conductivity, dimensional stability, and to lower friction coefficient.

Keywords-PTFE; Carbon Fiber; Oil whirl; 3 Lobe Bearing

I. INTRODUCTION

Bearings are used for transmitting forces between machine components in relative motion. One of the objectives of the machine designer is to incorporate efficient bearing that minimize power consumption due to friction, and achieve longer life of the bearing. A lubricant layer between the mating surfaces of a bearing helps in reducing frictional force and thus minimizes the wear. Hydrodynamic journal bearing are considered to be a vital component of all the rotating machinery. It is used to support radial loads under high speed operating conditions. In a hydrodynamic journal bearing pressure of hydrodynamic lift is generated in thin lubricating oil film that separates the shaft and the bearing thus preventing metal to metal contact.

To meet these requirements plain bearing with symmetrical lobe has been developed. Various tests has been conducted to improve performance of plain bearing under these condition in both materials and design and possibility has been formed in modifying the geometry of bearing. Although it is generally believed that surface unevenness impairs hydrodynamic performance. Theoretical analysis has been revealed a multilobe bearing has found to be more stable than circular bearings. A three lobe bearing possesses good stability

characteristics as turbo machinery works on higher speed and load, hence would act has better replacement for plain journal bearing.

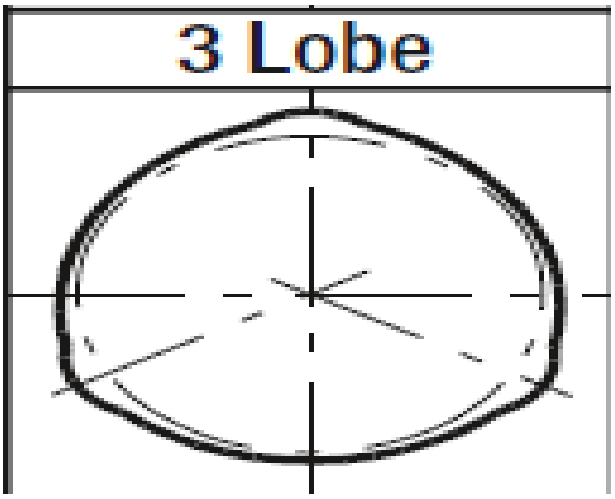


Fig. 1 Three Lobe Bearing

A composite consists of two or more distinct materials that when combined creates a material that is stronger, tougher and more durable than the individual material. Basically, a base material is blended withfiller and then molded together under specific heat and pressure. The molding of blended resign allows the thermoplastic to flow around filler creating a fairly homogenous material. There are several reasons for adding this filler material to make composite. These are to increase load carrying capacity, thermal conductivity, and dimensional stability, to lower the coefficient of friction and wear rates, also to take stresses acting on it.

Some of the filler materials which can be used to improve the properties of PTFE composite journal bearing. Glass Fiber: Glass in the form of short fibers it can be used as filling material. The most popular compounds are15% or 25% glass by weight. Glass has little effect on most of the electrical properties of Teflon. It resists acids and oxidation, but it can be attacked by alkali. Carbon: Typical carbon filler is high-purity coke powder. It is often used in combination with graphite in concentrations of 25% to 35% by weight. Compounds of Teflon and carbon have excellent wear resistance, both dry and in water. They are compatible with most chemicals and can carry heavy loads under rubbing contact. Graphite :This crystalline form of carbon is used alone or in combination with glass or amorphous carbon. A typical compound is 15% graphite by weight. Addition of graphite helps to reduce the wear of soft metal mating parts and improves frictional and wear properties when mixed with other fillers. Like other forms of carbon, it serves well in corrosive environments.

The cylindrical (plain) hydrodynamic journal bearing is commonly used hydrodynamic journal bearing with cylindrical bore. It is found that this bearing has limitations due to oil whirl. Oil whirl is very undesirable because of high vibration amplitudes, forces, and cyclic stresses that are imposed on the shaft, bearings and machine creating the instability of bearing. Also due to the oil whirling sometimes the friction between the journal shaft and bearing causes wear which is undesirable.

II.METHODOLOGY

2.1 Selection of composite material

A composite consists of two or more distinct materials that when combined creates a material that is stronger, tougher and more durable than the individual material. Basically, a base material is blended with filler and then molded together under specific heat and pressure. In our study we are going to use a composite material that is PTFE (polytetrafluoroethylene) as a base material with a carbon as filler material. Filler material is used to improve properties of base material. Since we have to improve load carrying capacity that's why carbon is used as filler material because compounds of carbonhave excellent wear resistance, compatible with most chemicals and can carry heavy loads.Typical carbon filler is high-purity coke powder.It is to be used 25% to 35% by weight [2].

2.2 Selection of parameters:

As far as suitable to the test rig on which we are going to test manufactured specimen the parameters for the bearing are selected. Following are the parameters which are selected for bearing which is to be manufacture.

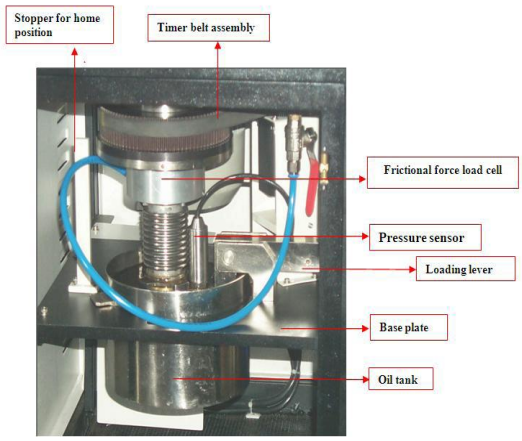
Material of Journal	Chromium Nickel Steel
Material of Bearing	PTFEwith 25 to 35 % by weight
Diameter of journal (dj)	39.96 mm
Length of Bearing (L)	40.00 mm
L/ D	1
Clearance (C)	0.185 mm
C/Rj	0.005
Speed range	1000-2000 rpm
Load (W)	300 N
Lubricant	SAE20W40
μ	0.0981pa_sec

2.3 Specimen preparation

Test specimen to be tested would be manufactured considering above selected PTFE with carbon as filler material and by taking selected parameters given above. While manufacturing journal bearing specimen two specimens are manufactured, one is of plain bearing type with no lobe and another specimen with lobe type.

2.4 Test rig

The trial set up is shown below in fig. Firstly the trial is to be taken on plain journal bearing and readings are to take by varying the load (N) on bearing.



Maximum pressure (kpa) reading at given load is to be noted. Three to four readings should

be taken at that speed of journal. Again trial is to take on lobe type journal bearing and same procedure is repeated. Again three to four readings should be taken.

2.5 Experimental Procedure

Following steps are performed to carry out the experiment:

1. Fill the oil tank with lubricating oil of known viscosity.
2. Connect the power inputs cable to 230V, 50Hz, 1 phase supply with neutral. Switch ON the MCB on the machine side panel.
3. Pour and maintain oil level in tank 2mm below the top of the bearing.
4. Remove the pressure sensor from the bearing.
5. Set speed 250rpm and load to 150N, press start button on the controller and observe angular indexing.
6. Observe for oil seeping out from the bearing and tight pressure sensor at that point.
7. Before tightening pressure sensor, pour the oil through sensor hole to remove air trapped inside.
8. Ensure whether the pressure sensor is at initial position or if not then bring it to its initial position manually.
9. Switch ON the PC and open the Winducom software, click the option run continuously, give the file name and fill up all necessary information such as load, speed, lubricant name, viscosity etc.
10. Switch ON the power supply of control panel of TR-60.
11. Reset the pressure and friction torque at zero reading.
12. Add the weight to the loading arm. The readings are taken for four different loads, viz.150N, 300N, 450N, 600N.
13. Switch On the power supply for motor and adjust the knob of speed regulator so as to adjust the desired speed.
14. After attaining the desired speed switch ON the test start button and stepper motor will start the indexing of bearing.
15. After 180o rotation of bearing, the stepper motor will ensure bearing back initial position.
16. Store the data file created by winducom software.
17. Switch OFF the motor and controller.
18. Take sufficient time to cool the lubricant.
19. After completion of testing of first bearing remove it and check the roughness of that bearing.
20. Repeat same procedure for lobe journal bearing.
21. Plot the graphs for various readings and compare the different graph.The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire journals, and not as an independent document. Please do not revise any of the current designations.

CONCLUSIONS

From the above study we conclude that the performance of composite journal bearing made from PTFE (polytetrafluoroethylene) as base material with copper as filler material having three lobes would be compared with plain journal bearing to find out pressure distribution whether pressure distribution is steady or not in lobe type journal bearing than plain journal bearing and load carrying capacity also the effect on the surface roughness of the bearing due to foreign particles, wear, cavitation's, erosion and dust.

FUTURE SCOPE

The future holds great challenges in the form of new designs and new ideas that brings together higher efficiency with lower cost.

1.Different types of composite materials combinations can be used by varying the composition of filler material.

2.Number of lobes of the bearing can be varied from two to four and to find out pressure distribution analysis between plain and lobe type bearing.

3. Composite bearings which are made of PTFE have a unique property of dry running. These bearings need to be tested for different temperature which will decide the working range for liquid operation.

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