ISSN 2395-1621

Investigation Of Performance Of Hydrodynamic Multilobe Bearing: A Review

#1Mahesh Nigade, #2Prof. Ganesh e. Kondhalkar

[1]mahesh.nigade@gmail.com
[2] ganesh.kondhalkar@gmail.com

[1]PG Student of Mechanical DesignEngineering,
Anantrao pawar. College of Engineering, parvati Pune
Savitribai Phule Pune University, Pune
Maharashtra- 411001 India
[2]Assistant Professor, Mechanical Engineering Department
Anantrao pawar College of Engineering, , parvati Pune
Savitribai Phule Pune University, Pune
Maharashtra- 411001 India

ABSTRACT

The new machine design applications require high operating speed, higher power density, small size, high load carrying capacity and to full fill this requirement it is necessary to consider transmission section. So one of the most important element to be considered for design is bearing. For hydrodynamic bearings it is important that minimum film thickness never drops below a safety limit. An oil film becomes thinner if load increases. This also results in elevated temperatures, which reduce oil viscosity and further decrease oil film thickness. When the fluid-film bearings operate under high speed, heat is generated within the oil film due to shearing of the lubricant and temperature rise of the lubricant fluid film. An oil film becomes thinner if load increases. This also results in elevated temperatures, which reduce oil viscosity and further decrease oil film thickness. To take into account the effect of deformations, new multilobe bearings are proposed in this work. These bearings will be analyzed for its thermo-hydrodynamic performance numerically as well as experimentally.

Keywords— **hydrodynamic bearings, lubricant fluid film, multilobe bearings**

ARTICLE INFO

Article History

Received :18th November 2015

Received in revised form :

19th November 2015

Accepted : 21st November , 2015

Published online :

22nd November 2015

I. INTRODUCTION

These new machine design applications require high operating speed, higher power density, small size, high load carrying capacity and to full fill this requirement it is necessary to consider transmission section. So one of the most important element to be considered for design is bearing. Bearing not only support rotor weight and operating speed but also influence on rotor dynamic behaviour

This constant trend towards higher power densities in rotating machinery calls for better mechanical components capable of carrying higher loads while being the same or smaller in size without sacrificing machine safety. For hydrodynamic bearings it is important that minimum film thickness never drops below a safety limit. An oil film becomes thinner if load increases. This also results in elevated temperatures, which reduce oil viscosity and further decrease oil film thickness. When the fluid-film bearings operate under high speed, heat is generated within the oil film due to shearing of the lubricant and temperature rise of the lubricant fluid film and the bearing surface takes place. This in turn causes significant reduction of the viscosity of the lubricant, and the bearing operates at a lower value of minimum fluid-film thickness. Thus, the flow field of the lubricant becomes distorted and the bearing performance is affected. Further, it has also been realized that the hole-entry hybrid journal bearing system undergoes elastic deformation when operating under heavy loads. The bearing deformations are generally of the order of the magnitude of fluid-film thickness and thus the fluid film profile is modified and the performance of a bearing system is changed.

Aluminum, brass and lead is the material of choice for the linings in conventional hydrodynamic bearings Aluminum, brass and lead. The provides good conformability and embed ability but loses its strength with rising temperature. Another limitation is comparatively high breakaway friction. One way to avoid these limitations is to use different materials for bearing linings. It has been shown that load carrying capacity of tilting pad thrust bearings is significantly increased by Aluminum, brass and lead withstand high temperatures and provide low breakaway friction, which makes it an interesting candidate to use in plain journal bearings.. Bearing compliance can be achieved by other means, for example, using thin elastic wall housings or bushings.

The theoretical approach is to solve Reynolds equation and developing a CFD code to examine pressure and temperature profiles and the results are validated with the work done by Ferron et. al. Then validated approach is used to study the behaviour of multi-lobe bearings.

II. LITERATURE REVIEW

Journal bearing fluid film thickness will be get affected by pressure generated in fluid, temperature generated in fluid The angular speed of journal and load acting on bearing is responsible for pressure generation and temperature effect. Similarly lobes, recess, number of recess and their position fluid properties also responsible for performance and stability of bearing To study this author reveal some literature survey is as follows

J. Ferron and J. frene [1] studied on both theoretical and experimental thermohydrodynamic problem of a finite length journal bearing. The analysis takes into account heat transfer between the film and both the shaft and the bush. Cavitation and lubricant recirculation are also taken into account. The experimental program is conducted on an original device to study the performance of a plain bearing. The pressure and the temperature distribution on bearing wall are measured along with the eccentricity ratio and the flows rate for different speeds and loads.

Mukesh Sahu, Ashish Kumar Giri, Ashish Das [2] work on “Thermohydrodynamic Analysis of a Journal Bearing Using CFD as a Tool” Three dimensional study has been done to predict pressure distribution along journal surface circumferentially as well as axially. Three dimensional energy equation is used to obtain the temperature distribution in the fluid film

Stanisław Strzelecki [3] Worked on “Effect of lobe profile on the load capacity of 2-lobe journal bearing”. In this, the results of calculations of load capacity of 2-lobe journal bearing characterized by different profiles of upper and bottom lobe. The load capacity of combined 2-lobe journal bearing type 2-LCOF is smaller than the load capacity of 2-lobe and Offset-Halves one. At assumed bearing type and bearing aspect ratio an increase in lobe relative clearance causes the decrease in load capacity of combined and another considered 2-lobe bearings. Except of 2-lobe bearing with offset upper half and cylindrical bottom one, the largest load capacity shows the 2-lobe journal bearing, particularly in the range of larger relative eccentricities. All considered 2-lobe bearings show small differences in the values of load capacity for the lower range of relative eccentricities of bearings.

Strzelecki and Ghonheam**[4]** worked on “Dynamically loaded cylindrical journal bearing with recess”. In this, the profile of the journal centre trajectory changes with the presence of recess in it. They considered two types of bearing load one characterized by internal combustion engine and other by needle punching machine. They also calculate the journal centre trajectory with and hence found out various parameters oil film pressure distribution and oil film resultant force. They eventually found out that the trajectory is affected by the presence of recess. The presence of recess on the peripheral position of the bearing affects the trajectory too; hence this method could be subsequently applied to the study of multi- lobe bearing.

Ghoneam and Strzelecki [5] worked on “Thermal problems of multilobe journal bearing tribosystem” They found an approximate method for finding the condition of the lubricating oil film temperature. Oil film temperature was obtained from the basis of the known quantities like Reynolds’s number and viscosity equation based on empirical calculations and theoretical data. It could help in solving the problems related to 4-lobebearing with known parameters. The oil film temperature distribution and maximum oil film temperature have been obtained from the numerical solution of bearing geometry, Reynolds, energy and viscosity equations.

Swapnil M. Pawar, S. G. Jadhav, V. M. Phalle**[6]**

The major problem with hydrodynamic bearing is failure of fluid film during the operation which may cause metal to metal contact between journal and bearing surface which leads to wear and friction which overheats the surfaces. Hence the power loss increases. One of the most important causes of fluid film failure is oil whip at high speed due to which constant wedge is not form between the surfaces which causes uneven displacement of the journal and leads to bearing vibration.

Transient CFD Analysis of Multi-Lobe Bearings at 60000 RPM for A Gas Turbine.

By NabarunBiswas and K.M.Pandey[7]

The objective of their work was to design 3 lobe bearing and to analyze the various flow parameters arising due to the motion of the shaft at rpm of 60000. The design of the 3 lobe model was done using GAMBIT and its subsequent analysis and simulation was carried out using FLUENT. They used the steady, conservative form of Navier-Stokes equations in two dimensional forms for the incompressible flow of a constant viscosity fluid.

They found the pressure distribution and temperature distribution across the various parts of the oil media as well as the shaft in an unsteady condition.

Tribology International 41 (2008) 1190– 1204

CFD analysis of journal bearing hydrodynamic lubrication by Bingham lubricant

ByK.P. Gertzos, P.G. Nikolakopoulos, C.A. Papadopoulos[8]

The performance characteristics of a hydrodynamic journal bearing lubricated with a Bingham fluid are derived by means of three-dimensional computational fluid dynamics analysis. The FLUENT software package is used to calculate the hydrodynamic balance of the journal using the dynamic mesh technique. The performance characteristics and the core formation in a hydrodynamic journal bearing lubricated with a Bingham fluid were examined. When the stress on the lubricant is less than the yield stress, the material is rigid and a region that is core is formed; exceeding the yield stress leads to a quasi-Newtonian flow.The Navier–Stokes equations were solved using the FLUENT package.They found that the volume that a core occupies is greater for a larger value of L/D and yield stress for a specific relative eccentricity. A core is formed at a specific relative eccentricity and adheres to the bearing surface at the inlet side. The core moves to the outlet side for greater values of relative eccentricity.

At a high value of relative eccentricity, a core is formed and adheres to a small region of the journal. As the value of eccentricity increases, the solid on the bearing separates into two or three parts and a floating core between these parts is observed. The load carrying capacity, the film pressure, and the frictional force of a Bingham solid are larger than those of a Newtonian fluid and they increase as the yield stress increases

III. OBJECTIVES

- To review literature of Multi-lobe bearing.
- Develop a CAD model for multi-lobe bearing
- CFD analysis of multi-lobe bearing by using Dynamic meshing.
- Performance testing of multi-lobe bearing by experimental setup.
- Validate the results by actual and CFD results.
- The main objective of this study project is to analyze the pressure, load and temperature distribution on hydrodynamic journal bearing under SAE40 Hydraulic oil for various loading conditions and operating parameters

IV. METHODOLOGY

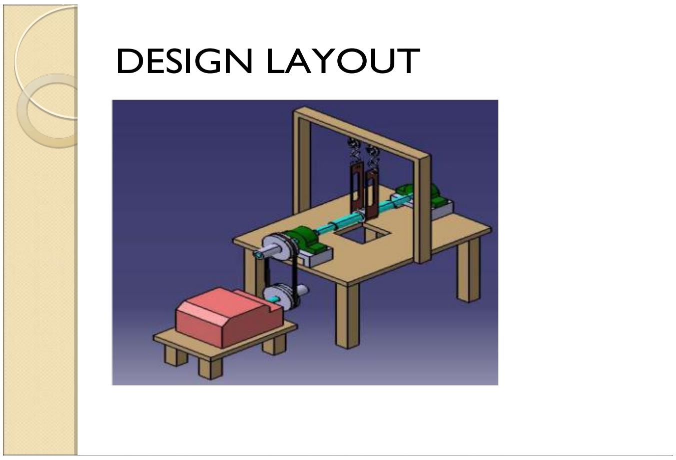
During Project Stage 1

- Literature survey for the use of certain projects previously conducted over the topic.
- Understanding of software tools needed for project.
- Developing CAD model For CFD analysis.
- Construction of progress report for phase I.

During Project Stage II:

- CFD analysis of Multi-lobe Bearing
- Conduct actual experimentation.
- Find out pressure and temperature of fluid film of bearing.
- Comparison of the results.

V. EXPERIMENTAL SETUP



VI. CONCLUSION

The conventional materials like white metal, babbit provide good conformability and embeddability but lose its strength with rising temperature. Another limitation is comparatively high breakaway friction. One way to avoid these limitations is to use different materials for bearing linings. It has been shown that load carrying capacity is significantly increased by aluminium, brass and lead as with withstand high temperatures and provide low breakaway friction, Application of these materials as bearing lining provides journal bearings with compliant properties. Bearing compliance can be achieved by other means, for example, using thin elastic wall housings or bushings.

The theoretical approach is to solve Reynolds equation and developing a CFD code to examine pressure and temperature profiles and the results are validated with the work done by Ferron et. al. Then validated approach is used to study the behaviour of multi-lobe bearings.

REFRENCES

[1]J. Ferron and J. frene studied on both theoretical and experimental thermohydrodynamic problem of a finite length journal bearing Vol. 105, JULY 1983 **by ASME**

[2]Mukesh Sahu, Ashish Kumar Giri, Ashish Das International Journal of Scientific and Research Publications, Volume 2, Issue 9, September 2012 2 ISSN 2250-3153

[3]Stanisław Strzelecki worked on “Effect of lobe profile on the load capacity of 2-lobe journal bearing”. In this, the results of calculations of load capacity of 2-lobe journal bearing characterized by different profiles of upper and bottom lobe July 5, 2001Vol. 44

[4] Strzelecki and Ghonheam worked on “Dynamically loaded cylindrical journal bearing with recess journals of KONES combustion engines 2004 vol11 no3-4

[5]IJEDR1403014 International Journal of Engineering Development and Research 2974 CFD Analysis of Two Lobe Hydrodynamic Journal Bearing By Swapnil M. Pawar, S. G. Jadhav, V. M. Phalle Volume 2, Issue 3 | ISSN: 2321-9939

[6] IACSIT International Journal of Engineering and Technology, Transient CFD Analysis of Multi-Lobe Bearings at 60000 RPM for A Gas Turbine. By NabarunBiswas and K.M.Pandey Vol. 3, No. 5, October 2011

[7] Tribology International CFD analysis of journal bearing hydrodynamic lubrication by Bingham lubricant 41 (2008) 1190– 1204.

