Nano World Journal

https://doi.org/10.17756/nwj.2024-s1-036

Research Article

Open Access

Effect of Nano-lubricants on Journal Bearing for Performance Enhancement

Kamalkishor Maniyar[1*], Pallavi Jadhav[2], Ramdas Biradar[3] and Jagannath Gawande[4]

[1,2]*Dr. D. Y. Patil Institute of Technology, Pimpri, Pune, Maharashtra, India*

[3]*Pimpri Chinchwad University, Pune*

[4]*P.E.S.'s Modern College of Engineering, Pune*

***Correspondence to:**
Kamalkishor Maniyar
Dr. D.Y. Patil Institute of Technology,
Pune, Maharashtra, India.
E-mail: kkmaniyar2020@gmail.com

Received: January 03, 2024
Accepted: March 14, 2024
Published: March 19, 2024

Citation: Maniyar K, Jadhav P, Biradar R, Gawande J. 2024. Effect of Nano-lubricants on Journal Bearing for Performance Enhancement. *NanoWorld J* 10(S1): S206-S208.

Copyright: © 2024 Maniyar et al. This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY) (http://creativecommons.org/licenses/by/4.0/) which permits commercial use, including reproduction, adaptation, and distribution of the article provided the original author and source are credited.

Published by United Scientific Group

Abstract

Journal or plain bearing includes a shaft which rotates freely in a supporting metal sleeve or shell called bearing. There are no rolling elements in journal bearing. Its design and manufacturing are simple, but the performance is difficult. Journal bearing consists of two main components one is shaft which rotates freely inside the casing which is cylindrical in form. The bearing is clamped to the housing. The lubricating film is produced by the gas or liquid which separates the journal and bearing surfaces. In this paper, for performance enhancement of journal bearing mainly bearing oil temperature and additive effects have been taken into consideration.

Keywords

Journal bearing, Nano-lubricants, Oil temperature, Friction

Introduction

Journal bearings are important elements for various components like pumps, compressors, internal combustion engines, and motors. Journal bearing consists of two main components one is shaft which rotates freely inside the casing which is cylindrical in form. The bearing is clamped to the housing. The lubricating film is produced by the gas or liquid which separates the journal and bearing surfaces. The gap between journal and bearing surface is called as clearance space. Because of the clearance space it becomes possible to assemble the bearing, the nano-lubricants space becomes available, the space can be used for volume expansion in case if it is unavoidable and if shaft is not aligned the clearance space gives the advantage to it. For the low load applications like blowers, pumps and motors anti-friction bearings can be the most suitable choice [1].

Experimentation

Scope for present work

This paper will focus on the effect of rotor speed over eccentricity ratio and maximum fluid pressure which in terms impact the friction level. In any machine apparatus bearings are the most critical components affecting combined performance and life. The bearing lining surface wears when journal and bearing comes in direct contact which each other. This may happen mostly at the time of sudden starting, running at very low speed and shut down of the machine. This occurrence of unwanted friction at specific conditions is called as boundary nano-lubricants or mixed nano-lubricants. Gear pump also has journal bearings in which the shaft works as the journal and the fluid is pressurized along itself and along the surface of the bearing. The fluid pressure is directly proportional

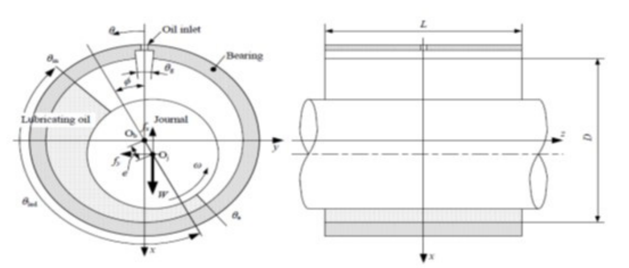

Figure 1: Schematics of journal bearing.

to the speed at which shaft rotates. Thus, for the proper operation minimum speed of rotation is always required. The shaft which is rotating element is a radial supported by the journal bearing. The eccentricity will be generated when the shaft rotates under some load of application. It simply means the journal and the bearing are in eccentric position. It causes the lubricant to form geometry of wedge which is convergent in shape, and it can carry the load by producing the viscous effect pressure. But under very high load or very low speed of rotation, the sufficient pressure cannot be formed by film and hence friction can occur (Figure 1) [2].

Conditions of friction

During the startup and shutting down the journal rotation speed is always below the minimum required speed, thus there is no uniform film formation of the lubricant due to lack of pressure. Thus, frequent ON-OFF will cause excessive wear of the bearing, in addition to above condition the oil temperature is low the oil film has considerable thickness to separate the two surfaces, but frequent start and shutting down cause to increase in heat of the oil resulting in very thin oil thickness which in terns causes wear of the bearing. Thus, the premature failure of the bearing can occur and ultimately the machine efficiency lows down.

Figure 2 explains the pressure profile, the vector of oil pressure at the centre of the bearing, it can also be observed in three dimensions as shown in figure 3 [3].

Results and Discussion

Design considerations for nano-lubricants

Eccentricity ratio

As mentioned in earlier discussion during sudden change in rotor speed the eccentricity becomes higher which can cause direct metal contacts and failure can occur in the bearing. The instability of machine can occur at very less eccentricity. The rotor speed as well as load can affect the eccentricity of the bearing [4], following figure explains at steady load the eccentricity decreases as rotor speed increases (Figure 4) [5].

Maximum fluid pressure

For proper lubricated condition sufficient fluid pressure is important. This fluid pressure depends upon various factors like oil supply pressure, load conditions, speed conditions, oil properties like viscosity and oil temperature, the figure below indicates general scenario of pressure profile for different values of eccentricity ratios which depends upon the load conditions and speed conditions, thus this graph will guide to select proper lubricants with suitable properties if load and speed conditions of bearing application are known (Figure 5) [6].

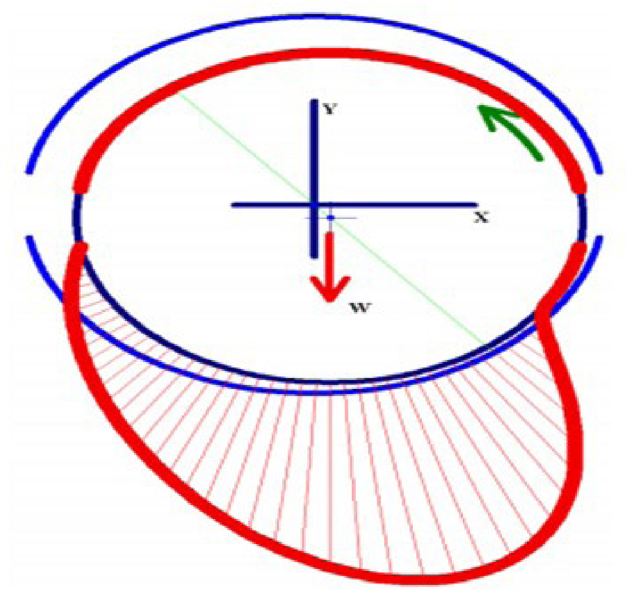

Figure 2: Schematic of hydrodynamic pressure profile.

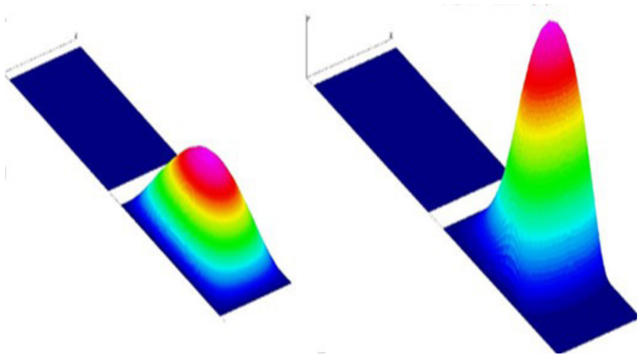

Figure 3: Comparison of low load and high load hydrodynamic pressure profile.

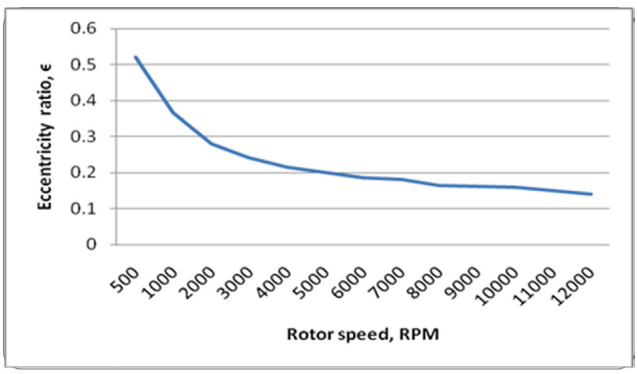

Figure 4: Eccentricity ratio.

Conclusion

In case of hydrodynamic lubricated journal bearings, proper wear resistant lubricant selection hugely improves

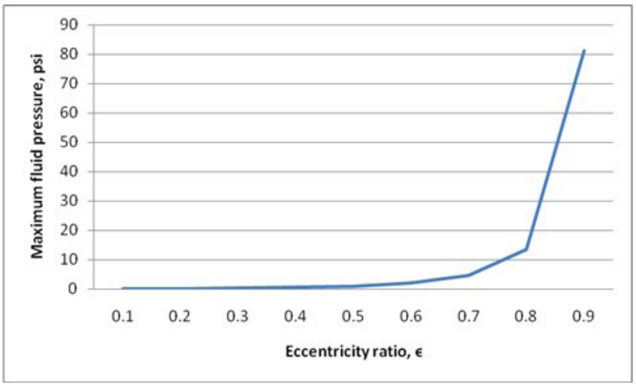

Figure 5: Maximum fluid pressure.

bearing performance without changing mechanical design parameters of journal bearing, this paper leads to study the further scope of lubricant properties.

Acknowledgments

None.

Conflict of Interest

None.

References

1. Mehra C, Kokadiya AS, Khandare N. 2014. Study of pressure profile in hydrodynamic lubrication journal bearing. *Int J Eng Res Technol* 3(7): 359-362.
2. Childs P. 2013. Mechanical Design Engineering Handbook. Butterworth-Heinemann.
3. Understanding journal bearings.
4. Fuller DD. 1984. Theory and Practice of Lubricants for Engineers. Wiley and Sons.
5. Dwivedi VK, Sanjeev KG, Deepti S, Pratibha S, Bhupendra S. 2012. Effect of eccentricity ratio on pressure profile of short journal bearing. In Proceeding of 1st International Conference on Innovative Technologies in Mechanical Engineering, Ghaziabad, Uttar Pradesh, India.
6. Ahmad MA, Kasolang S, Dwyer-Joyce R, Abdullah NR. 2013. The effect of oil supply pressure on the circumferential pressure profile in hydrodynamic journal bearing. *Appl Mech Mater* 315: 809-814. https://doi.org/10.4028/www.scientific.net/AMM.315.809