



Characteristics of conical hydrostatic journal bearing under micro polar lubrication

#¹Mr. Dumbare L.R., #²Prof Galhe D. S.

¹lrd143777@gmail.com

²latishkumar.dumbare@rediffmail.com

¹Mechanical Engineering Department, Savitribai Phule Pune University, Jaihind College Of Engineering Kuran, Junnar, Pune, India.

²Mechanical Engineering Department, Savitribai Phule Pune University, Jaihind College Of Engineering Kuran, Junnar, Pune, India.

ABSTRACT

Attributable to their potential focal points including zero beginning contact, low thick running erosion, high load conveying limit, high solidness and high positional exactness, remotely pressurized (or thereabouts called hydrostatic) greased up heading are generally utilized as a part of numerous applications. Cone like hydrostatic course have been effectively utilized as a part of different designing applications, for example, accuracy machine devices, for the upside of being equipped for conveying both pivotal and spiral burden. The joined impacts of couple anxieties, liquid latency and break volume liquid compressibility on the enduring state execution and the dynamic firmness and damping attributes of hydrostatic roundabout step push direction are displayed hypothetically. Utilizing an annoyance procedure, brings about terms of consistent state burden conveying limit, oil stream rate, firmness and damping coefficients are introduced. The impact of worn imperfection parameter semi-cone edge on the execution of funnel shaped mixture diary bearing framework remunerated with an opening restrictor has been examined. This exploration finishes up the execution of a multi break worn mixture cone like diary bearing framework remunerated with an opening restrictor changes obviously as the wear profundity parameter changes for the diverse estimations of semi-cone point.

Keywords— Conical hydrostatic bearing, oil stream rate, firmness, damping coefficient

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

Instantly, with the change of current industry, turning equipment tends to be more capable, quick, high-precision and high-power, and the need exactness, low power usage, high constancy of the bearing as a structure support. Suitably, taking after the examination of the hydrodynamic lubing up bearing, exhibits that the hydrostatic bearing oil execution has an unprecedented impact on the course advantage life and reliability. Its lubing up execution will clearly impact the entire machine steadfast quality, life compass and fiscal marker In the blink of an eye, analysts

have inspected in motion picture structure oil execution to a certain degree. The constrained part procedure theoretically focused on the execution of four holders hydrostatic diminished bearing structure. Set up the bearing space control stream oil Reynolds scientific explanation. Find out the numerical estimations of unmistakable external weight bearing static and component execution. The generation results show that the oil stream is in like manner a more significant impact on the breaking point of the diminished bearing [1].The Stokes advancement of thick fluid oil in the fluid hydrostatic bearing, which is

bended outside utmost, and concentric circle interior cutoff. Through examination as configuration, given a two-dimensional weight dispersal, and figure the total push induced assessments, decided the result unsurprising with the beforehand expressed theoretical results[1].

II. MICROPOLAR LUBRICATION

The grease speculations sought the bearing examination by different analysts have considered just the plainly visible change in the properties of the oil. The individual particles in the grease can change their shape or rotational movement and get to be viable in the area equal to bearing clearances. Consequently, the established Newtonian hypothesize is not legitimate for the liquids considering the impact of particles. Newtonian liquid mechanics should be summed up when the outer length scale get to be practically identical to the normal measurements of the material particles in complex liquids, for example, polymeric suspensions, creature blood, and fluid precious stones. Eringen³ rearranged his microfluids theory⁴ of 22 thickness coefficients to 6 consistency coefficients by overlooking the misshapening of microelements. The Navier–Stokes comparisons were summed up with the presentation of another precise speed vector of pivot of particles and the comparing consistency coefficients. Orientation are the gadgets used to backing the distinctive moving machine components. Fast and exactness needed in the machine hardware had prompted an upset in the outline and improvement of different bearing arrangements, for example, slider, step, push, hydrodynamic, and hydrostatic direction. The outline of course is in view of working conditions and the oil utilized. The customary bearing configuration is in light of Newtonian theory. Nonetheless, the unusually high estimations of viscosities got tentatively by Needs¹ and Henniker² in limit oil couldn't be clarified on the premise of traditional ideas. Strong molecule added substances are utilized as a part of base oil to enhance greasing up execution of the heading. Additionally, greasing up oil under standard working conditions get stacked with soil and minute metal particles. Henceforth, the liquid suspension properties in the course are affected by the tiny occasions. Eringen termed these liquids showing the microrotational impacts as micropolar, a unique instance of microfluids to record for the unexplained limit layer wonder in a round channel. Micropolar liquid focuses in little volume component pivot about the centroid of volume component notwithstanding their inflexible movement. The hypothetical results reported by the above scientists obviously show that the vicinity of microstructures in the liquid would adjust the established results. The smaller scale continuum hypotheses of liquids, for example, liquid suspensions, emulsions, fluid gems, and blood was checked on by and the micropolar speculations have been generally connected under distinctive conditions and standards for different arrangements of direction. Press film activity in diverse direction with micropolar oil was investigated by different specialists. The season of methodology or reaction time for a micropolar liquid was seen to be more prominent than the relating time anticipated by Newtonian hypothesis. Slider bearing designs (one to three dimensional) greased up with

micropolar liquid were considered by different specialists. The most extreme burden limit and contact power were seen to increment with the increment in centralization of added substances and contaminants in the oil. Comparative results were additionally reported for moving contact⁴ and push orientation under micropolar oil. Diary direction are the most considered sliding heading with distinctive geometrical designs and working conditions. The execution of diary course with micropolar oil was dissected by considering diverse parameters, for example, least liquid film thickness, load limit, coefficient of grinding, side spillage stream, temperature changes, firmness, and damping coefficients. The examination of diary direction for interminably long, short, permeable, and limited length and limited width setups indicated ideal execution qualities with micropolar ointment when contrasted with Newtonian oil. The execution of diary direction was likewise dissected by considering the impacts of harshness, porosity, misalignment, dynamic stacking and security characteristics. Thermal and cavitational impacts were incorporated into the investigation of micropolar greased up diary bearing. Journal bearing with arrangements, for example, circular, hydrostatic, and noncircular lobed heading with micropolar oil were investigated in point of interest with reference to their execution attributes. The presentation of micropolar parameters in the routine liquid stream mathematical statements had prompted hypothetical results in subjective concurrence with the genuine test estimations of consistency in limit oil. In this survey article, an endeavor has been made to clarify the execution attributes of distinctive bearing setups with micropolar oil under different working conditions. The bearing execution has been measured by considering the variety in burden limit, coefficient of contact, bearing stream, heat era, and bearing framework security with micropolar lubrication.[4]

2.1 Stability Characteristics :The wonder of self-energized vibrations in diary orientation brought on by oil film powers are demonstrated as oil whip or oil whirl. This causes a difficult issue in the productive working of the high velocity machines and may bring about bearing disappointment for the turn speed over the spin threshold. The dependability attributes can be clarified regarding solidness and damping coefficients of the bearing framework. Watched that oil spin happen effortlessly for limited width diary bearing working with micropolar ointment under substantial burden conditions. They additionally demonstrated that overwhelming solidness coefficient is bigger for micropolar ointment while the comparing commanding damping coefficient has a littler worth. The security of funnel shaped spin movement of inflexible rotor on hydrodynamic diary bearing working with micropolar ointment. They watched that funnel shaped security increments with the increment in coupling number of the micropolar grease. The dependability examination on hydrodynamic diary orientation working with micropolar ointment. Their outcomes demonstrated that the security of diary bearing increments with the increment in micropolar parameters of the grease. Better strength of circular diary bearing by watching that damped recurrence of spin declines and limit rate increments with the increment of fixation in the added substances of micropolar lubricant. Increase in element solidness film coefficient and

abatement in element damping film coefficient with the increment in coupling number of the micropolar oil working in a slider bearing. Nicodemus and Sharma⁷² watched an increment of 103–112% in liquid film solidness coefficients and 65–81% expansion of liquid film damping coefficients with the increment in micropolarity of the ointment in a hydrostatic bearing. Analysis of four pocket opening remunerated half breed diary orientation of distinctive break shapes working with micropolar grease. They watched a change of the request of 20–13% in the liquid film firmness coefficient and 73–75% adjustment in damping film coefficient for distinctive break shapes. Further, they watched that triangular break gives the best security to all the bearing designs. Consequently, from writing, it is found that the increment in security of distinctive setups of heading can be credited to the improved thickness of the micropolar lubrication.

2.3 Experimentation

Hydrostatic bearings test bench has been designed and set up as shown in fig to study the performance of grinding machines wheel head and to validate the theoretical results. The hydrostatic bearings have been built with gun metal and shaft material is En8.

To compare the results of the models, a test bench of hydrostatic bearings has been built. Pumping pressure and journal speed effect have been analyzed in the static behavior of the bearings: Temperature increase, pressure into recess, flow-rate through guide, stiffness and load capacity of hydrostatic bearing.

The bearing in a hydrostatic spindle consists of a thin film of pressurized oil. The oil is supplied to the spindle pockets, through flow controllers, by a high-pressure pump; there is one flow controller for each hydrostatic pocket. The shaft is suspended in the housing in an oil film. When load is applied to the shaft, via grinding forces, for example, the pressure in the pocket opposite the force increases to keep the gap constant and re-center the shaft, thus maintaining a high level of stiffness. Concentricity of the rotating spindle arbor only depends on its roundness. A highly concentric arbor, or shaft—say, one manufactured to a roundness of 0.000020"—will not deteriorate over time when hydrostatic bearings are used because there is no shaft wear. And because a film of oil is much thinner than a standard bearing, the shaft of a hydrostatic spindle can have a much larger diameter than the shaft in a standard-bearing spindle. A hydrostatic spindle can be six times stiffer than a standard spindle.

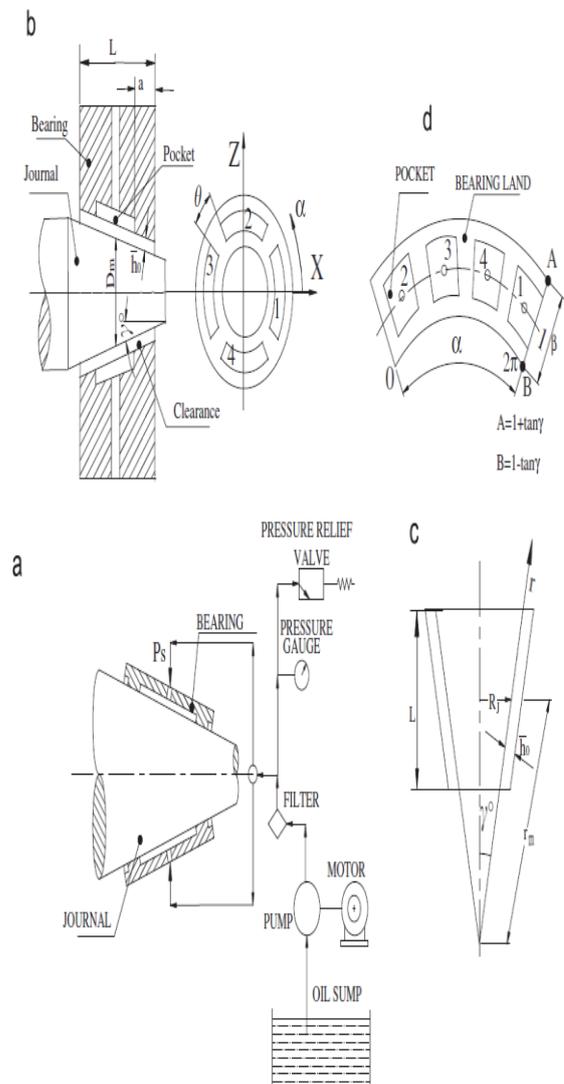
To carry out the experimental study it has been used pressure, temperature and flow-rate. Fluid pressure has been measured with five gauges: one for each recess (four pockets bearing) and the fifth for supply pressure. The recesses pressure is measured just after the restrictors, and the discharge between restrictors and pockets has been considered negligible, Pressure gauges have a range from 0 to 100 bars and its precision is better than 1% of full scale. Temperature has been measured in six positions of the test bearing: fluid inlet, fluid outlet, and the four recesses of the bearing. This way, the heat generated in each pocket and the overall temperature rise of the fluid can be analyzed.

(a) bearing configuration,

Temperature sensors haven been used in the test bench, where the range of the sensors goes from 0 to 100°C, and their precision is of 0.5°C. To measure the temperature of the fluid into the pockets, four drillings have been manufactured.

Hence, the setup consists of two hydrostatic journal bearings, motor, pump, flow control valve, filter, temperature sensors, pressure gauges, etc.

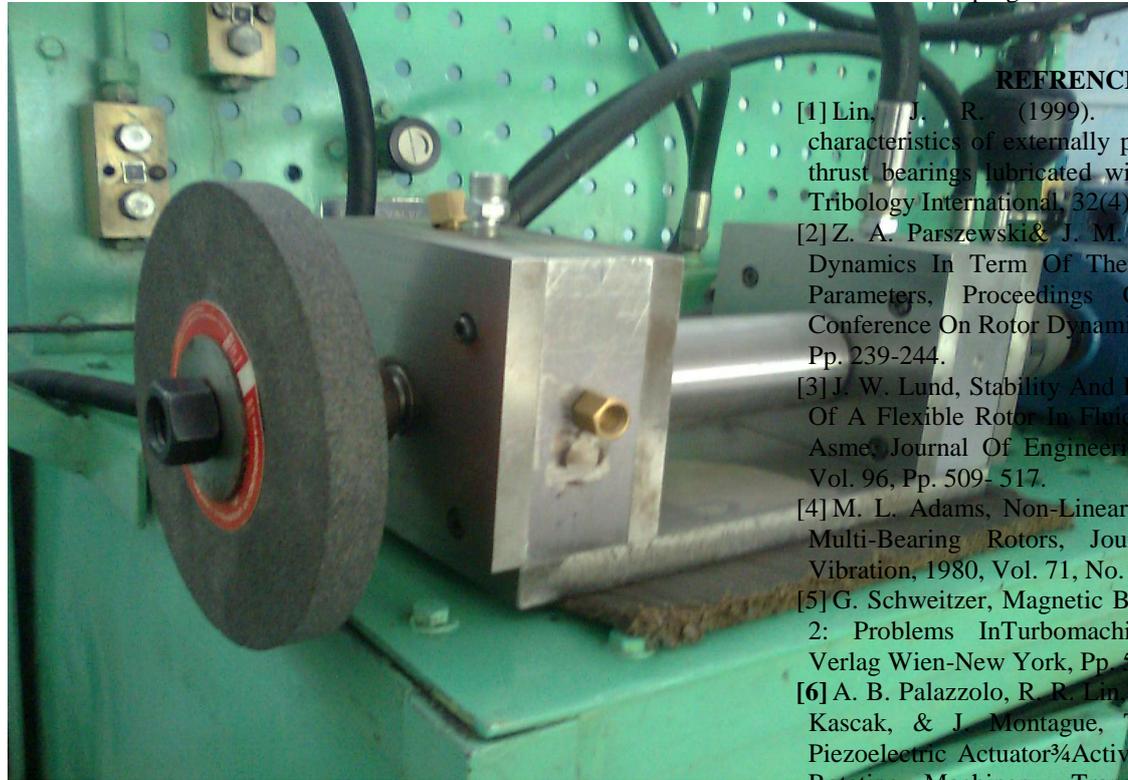
The bearing design data needs to be generated under more realistic operating conditions. In recent times, even though the hybrid conical journal bearing system has not received a major attention of researchers and as a consequence of this, very limited analytical/experimental studies have been reported in few. Their study suggests that an increase in oil temperature due to pad rotation has a detrimental effect on the load carrying capacity, where it increases the fluid flow rate in the bearing. The influence of convection and dissipation effects on the characteristics of a conical bearing with constant film thickness, rotating with a uniform angular velocity.



(b) multirecess conical journal bearing,

- (c) co-ordinate system and
 (d) developed bearing surface.

The geometry of a four-recess hybrid conical journal bearing system has been shown in Fig . All the nodes situated on a recess have equal pressure. Flow of lubricant through the restrictor is equal to the bearing input flow.



ACKNOWLEDGEMENT

I am profoundly grateful to Prof. D. S. GALHE for his expert guidance and continuous encouragement throughout to see that this paper rights its target since its commencement to its completion. Thanks for his valuable contribution in developing the IJRSD article template.

REFERENCES

- [1] Lin, J. R. (1999). Static and dynamic characteristics of externally pressurized circular step thrust bearings lubricated with couple stress fluids. *Tribology International*, 32(4), 207-216
- [2] Z. A. Parszewski & J. M. Krodkiewski, *Machine Dynamics In Term Of The System Configuration Parameters*, Proceedings Of The International Conference On Rotor Dynamics, 1986, Tokyo, Japan, Pp. 239-244.
- [3] J. W. Lund, *Stability And Damped Critical Speeds Of A Flexible Rotor In Fluid Film Bearings*, Trans. Asme, *Journal Of Engineering For Industry*, 1974, Vol. 96, Pp. 509- 517.
- [4] M. L. Adams, *Non-Linear Dynamics Of Flexible Multi-Bearing Rotors*, *Journal Of Sound And Vibration*, 1980, Vol. 71, No. 1, Pp. 129-144.
- [5] G. Schweitzer, *Magnetic Bearings, Rotordynamics 2: Problems In Turbomachinery*, 1988, Springer Verlag Wien-New York, Pp. 543-570.
- [6] A. B. Palazzolo, R. R. Lin, R. M. Alexander, A. F. Kascak, & J. Montague, *Test And Theory For Piezoelectric Actuator^{3/4}Active Vibration Control Of Rotating Machinery*, Trans. Asme, *Journal Of Vibration And Acoustics*, 1991, Vol. 113, Pp. 167-175.

III. CONCLUSION

The The congruity presumption of established liquid mechanics falls flat in characterizing the material properties of liquid, when the liquid stream is considered inside a space of scale tantamount to the span of atoms. In these cases, the natural movement of the particles must be considered. The significant impact of considering the atom size and their pivot is the increment of viable thickness in examination to the traditional consistency. The heap limits demonstrated the expanding pattern while the coefficient of grinding fluctuated backward way. The dependability parameters of fast bearing get together were seen to increment in correlation to Newtonian oil. In spite of the systematic expectation of execution change, test confirmation of these attributes is still needed. There may be some more components, as surface composition, versatility, and turbulence, which can be fused alongside micropolar idea of the oil. The temperature increment in diary direction with expanded micropolar impact is a matter of concern. In any case, the warmth era with micropolar impact is not concentrated on in point of interest for diverse bearing setups. Subsequently, earnest consideration is needed for further trial and scientific investigation of sliding heading considering the micropolar impact of the grease for sensible bearing design.[4]