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Experimental Analysis of Journal Bearing Under Hydrodynamic Lubrication

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Abstarct : *Journal bearings are one of the most commonly used types of bearings in rotating machines.. The objectives of this research are to provide an analysis of the pressure distribution on a journal bearing with different speeds of the journal and at different applied loads. The result indicates that with the increase in applied load the maximum pressure at the lubrication film increases.*

Keywords: *Journal bearing, pressure distribution, load, rotational speed*

INTRODUCTION

In journal bearings the contacted surfaces are separated with the help of a lubricants thick film that helps in restricting the metal to metal contact [1,2]. With the increase in rotational speed of the journal enough pressure is generated around the periphery of journal that sustains the applied load [3]. The pressure distribution in the journal bearing is obtained by solving the Reynolds equation (1) [4]

$$\frac{\partial}{\partial\theta}\left(h^3\frac{\partial P}{\partial\theta}\right)+\left(\frac{R}{L}\right)^2\frac{\partial}{\partial Z}\left(h^3\frac{\partial P}{\partial Z}\right)=6\mu R^2[(\omega_2-\omega_1)\frac{\partial h}{\partial\theta}] \text{ - (1)}$$

h - film thickness
P - pressure
θ - contact angle
R - radius
L - length
∂Z - wedge action along z-axis
μ - viscosity
$(\omega_1-\omega_2)$ - stretching action
∂x - wedge action along x-axis
u_1 - initial fluid velocity
u_2 - final fluid velocity

EXPERIMENTAL SETUP

In the present investigation a journal bearing test rig TR-660 was used to describe the distribution of pressure in the bearing. The journal was mounted horizontally on a shaft which is supported on aligned bearings. A loaded bronze flawless bearing freely slides over journal and as it rotates bearing is formed, radial load is applied on bearing by pulling it upwards against journal by a loading lever. Ten numbers of sensors are fixed on the circumference of bearing with their terminal ends ending in junction box. The journal is driven by belt & two step pulley arrangement and speed required is set on EDUCOM software. The complete specification of the journal bearing test rig are given in Table 1.

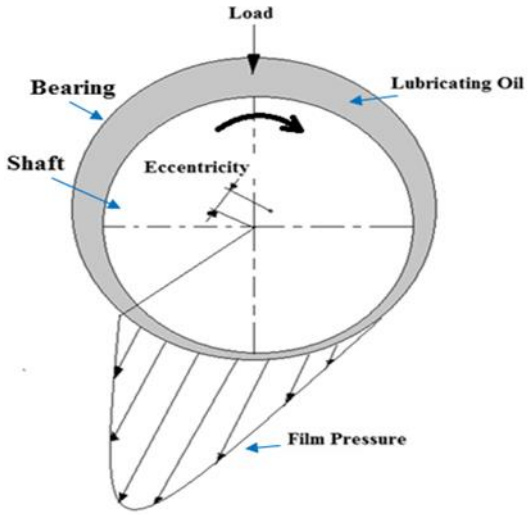

Figure 1: Distribution of pressure around the journal.

SELECTION OF PARAMETERS

In this research radial load & journal speed were considered as the factors which influence the pressure distribution around the journal. So radial load and journal speed were the input factors and pressure distribution [5, 6] as the output factor selected.

The experiments were performed using a SAE 10W30 grade oil which was supplied to the system at 1 bar of pressure. The applied load was varied 10N to 30N in steps of 10N, and rotational speeds were increased from 1000 rpm to 3000 rpm in step of 1000 rpm and the observed pressure at different pressure sensors was recorded.

RESULTS

The whole experimental work has been done in three steps. In the first set of experiments the rotational speed was kept constant at 1000 rpm and load was varied to 10N, 20N and 30N and the pressure distribution obtained from this set is plotted in figure 2

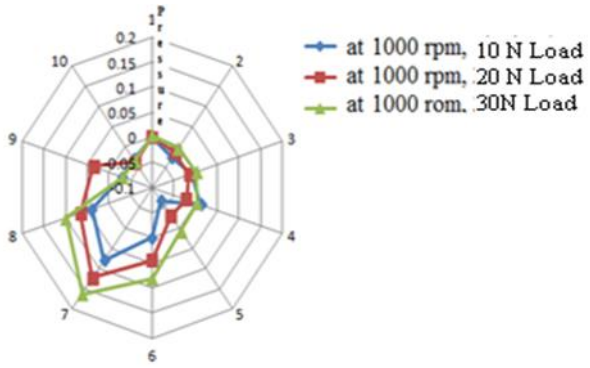

Figure 2: Pressure distribution curves at 1000 rpm

In the second set of experiments the rotational speed was kept constant at 2000 rpm and load was varied to 10N, 20N and 30N and the pressure distribution obtained from this set is plotted in figure 3

Table 1: Mechanical Specification

S.No.	Part detail		Range
1.	Shaft detail		22 ± 0.005mm
	Journal outer diameter fitted on shaft		40 - 0.005/0.006mm
	Journal inner diameter fitted on shaft		22.035mm
2.	Bearing	Inner dia	40 +0.050mm
		Width	40.04mm
3.	Radial clearance		0.027mm
4.	Length/ dia (l/d) ratio		1
5	c/r ratio		0.00135
6.	Base plate height from floor		800mm
7.	Journal height from base plate		150mm
8.	Maximum load		3000N
9.	Loading ratio		1:5
10.	Spindle speed	Min speed	40
		Max speed	8000rpm
11.	Lubricating oil	Oil pressure	5 to 10 bar

In the third set of experiments the rotational speed was kept constant at 2000 rpm and load was varied to 10N, 20N and 30N and the pressure distribution obtained from this set is plotted in figure 4

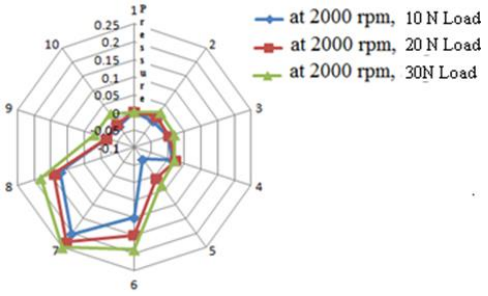

Figure 2: Pressure distribution curves 2000 rpm

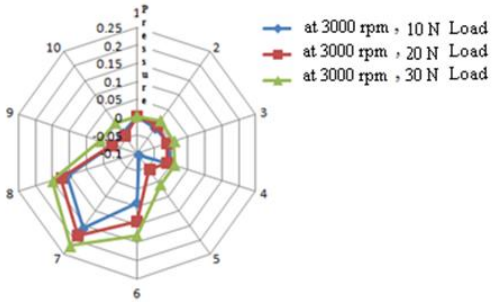

Figure 3: Pressure distribution curves at 3000 rpm

CONCLUSION

It is seen from figure 2 , 3 and 4 that with the increase in load on the bearing the maximum pressure generated in the journal also increase

Figure 2, 3, and 4 also represents that with the incrase in rotational speed from 1000 rpm to 2000 rpm the pressure generated also incearses but with further incease in rotational speed to 3000 rpm it tends to decrease a bit. the breakage of the lubricating film may be the reason of this decrement.

REFERENCES

[1] Durak E, Kurbanoğlu C, Bıyıklıoğlu A, Kaleli H. Measurement of friction force and effects of oil fortifier in engine journal bearings under dynamic loading conditions. Tribology International. 2003;36(8):599-607. doi:10.1016/s0301-679x(02)00263-3.

[2] T, Pürçek G, Murphy S. Sliding wear of cast zinc-based alloy bearings under static and dynamic loading conditions. Wear. 2002;252(9-10):693-703. doi:10.1016/s0043-1648(01)00876-6.

[3] Brito F, Miranda A, Bouyer J, Fillon M. Experimental Investigation of the Influence of Supply Temperature and Supply Pressure on the Performance of a Two-Axial Groove Hydrodynamic Journal Bearing. J Tribol. 2007;129(1):98. doi:10.1115/1.2401206.

[4] Andersson P, Lintula P. Load-carrying capability of water-lubricated ceramic journal bearings. Tribology International. 1994;27(5):315-321. doi:10.1016/0301-679x(94)90025-6.

[5] Ozsarac U, Findik F, Durman M. The wear behaviour investigation of sliding bearings with a designed testing machine. Materials & Design. 2007;28(1):345-350. doi:10.1016/j.matdes.2005.05.017.

[6] Jiang G, Hu H, Xu W, Jin Z, Xie Y. Identification of oil film coefficients of large journal bearings on a full scale journal bearing test rig. Tribology International. 1997;30(11):789-793. doi:10.1016/s0301-679x(97)00040-6.