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# Experimental Investigation of Effect of Holes on Journal Surface on Bearing Performance

[1]Hemant Patidar
Mechanical Engineering Department
Shri G. S. Institute of Technology & Science Indore (M.P.)
Indore, India

[2.] Assistant Prof. Dinesh Kumar Pasi
Mechanical Engineering Department
Shri G. S. Institute of Technology & Science Indore (M.P.)
Indore, India

***Abstract:-* The article presents the experimental investigation of a bearing performance with fine hole created on the surface of the journal of journal bearing. The presented research review the theoretical research conducted previously and conduct the experimental investigation related to this work. The results of the investigation on a bearing with fine holes on the journal (load capacity, oil temperature, and oil flow rate) were compared with those obtained for a standard bearing with a plain journal. The complete experiment is performed on the bearing apparatus. The results shows that the shaft with fine hole on its surface has a better performance than that of standard plane shaft. The shaft having fine hole on its surface controls the temperature rising at various speed of the shaft and reduce friction torque in comparison to plain shaft. In this experiment we are not study the effect of size of hole. But number of hole we are varying.**

***Keywords:- Journal Bearing, Temperature, Speed And Torque.***

## INTRODUCTION:-

Journal bearings consist of a shaft or journal which rotates freely in a supporting metal sleeve or shell. There are no rolling elements in these bearings. Their design and construction may be relatively simple, but the theory and operation of these bearings can be complex. Journal bearings operate in the boundary regime (metal-to-metal contact) only during the startup and shutdown of the equipment when the rotational speed of the shaft (journal) is insufficient to create an oil film. It is during startup and shutdown when almost all of the damage to the bearing occurs. Journal bearings with hole pattern in mating surfaces show better properties, under some condition than standard ones with plain surface mating components. Hole on shaft surface of journal bearing can stable on the lubricant in the bearing, reduces the friction between mating surface contact and control the temperature rising at higher speed of shaft. The hole is used to stable oil over the length of the journal and to improve the temperature field. The oil supply conditions (pressure, temperature, hole dimensions and location) influence the flow rate. Theoretically, the conditions will affect the oil temperature inside the bearing as well. When the temperature changes, the viscosity is altered, subsequently affecting the film thickness.

Experimental Description:-

I. Fabrication of journal:-

Dimensions of shaft:-
Length of the rod of mild steel(MS) = 104mm
Diameter of MS rod = 35mm
Inner diameter of sleeve = 35.01mm
Outer diameter of sleeve = 50mm
Length of sleeve = 50mm
Take a rod of MS and performing operation on it according to our requirement like facing, turning to get the rod in desire shape as of shaft.
Take a two sleeve of gun metal and doing some surface finish operation. One sleeve used for making hole and another used without hole. Now put the sleeve over the MS shaft by press fitting.

## II. FABRICATION OF HOLE ON SHAFT:-

Diameter of hole = 1mm

Depth of hole=1mm

No. of hole on shaft per side =4

Hole made on shaft (angle)=90*,180*
Drilling machine is used for making hole on the shaft of journal bearing.
Drill size =1mm

## III. EXPERIMENTAL SETUP:-

Assemble bearing housing.

Bearing housing consists many parts which are as follows:-

1. Bearing with pressure gauge
2. Support for hanging load
3. Load tray for placing load
4. An angular meter which shows deflection due to torque.



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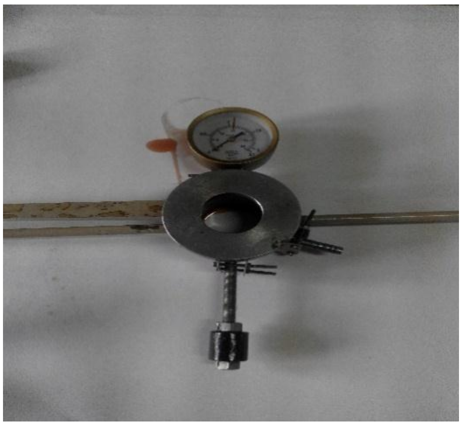
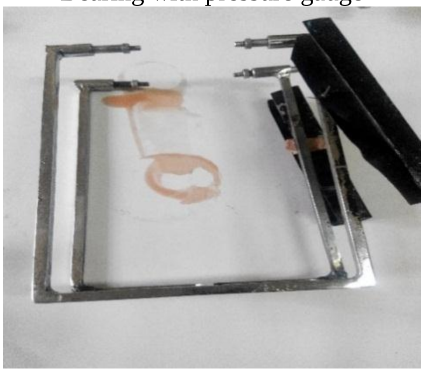
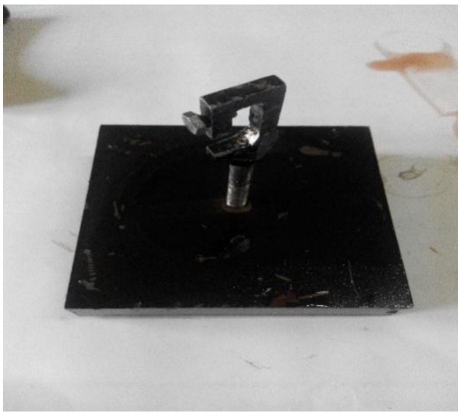


Bearing with pressure gauge

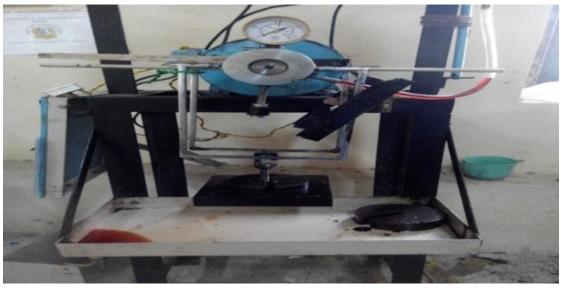


Support for load



Load tray

Angle measuring
Assembled bearing housing



External devices used for performing experiment are as follows:-

1. Infrared thermometer for measuring oil film temperature.
2. Tachometer for measuring speed of the shaft.
3. Spring balance for measuring torque.


Infrared thermometer

Tachometer

*Experimental Procedure:-*

Do centering of the shaft and make a proper space for the tachometer which measure the speed of the shaft. Firstly perform experiment with the shaft having fine hole. Prepare the bearing apparatus for experiment and check all the wiring of the apparatus for further precaution. Now take an oil of grade SAE30 and filled the oil in the container which is given in the rear side of the apparatus. There is a valve given in the container to control the flow of the oil to the bearing. Now rotate the shaft at different speeds(600,800,1000,1200 rpm) and at different loads(6, 8,10,12kg). As there is hydrodynamic lubrication in this arrangement therefore as the shaft rotates it sucks the oil and creates a thin film of oil between shaft and bearing. After sometime this thin oil film carry the complete load of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bearing housing(6kg). As the time passes the temperature of the oil film rises and we measure the temperature after a particular interval (30min) of time with the help of infrared thermometer at different loads and at various speed which can be measure by tachometer. The oil is leaked from the bearing during the experiment so there is a tray provided beneath the housing to collect the oil and recirculate it.

Similarly the torque generated by the rotation of shaft to the bearing housing through oil film can also be measure with the help of spring mass balance. This torque will be measure at different loads with various speeds. We attached a spring mass balance 21cm away from the center of shaft and as the shaft rotates it tilted the bearing housing at some extent and the value of tilting of bearing housing gives the value of the force.

$$\text{Torque} = \text{force} \times \text{distance}$$

Value of displacement is fixed which is 21cm and hence we get the value of the torque.

Same procedure is done with the plain shaft and we get the different values of temperature and torque at different loads and various speed and finally compare and discuss the results.

Shaft having without hole-

1) Calculation of the temperature of oil film between shaft and bearing at various speed and different load.

2) Calculation of the torque generated due to the rotation of shaft to the bearing apparatus at various speed and different load.

Shaft having hole-

1) Calculation of the temperature of oil film between shaft and bearing at various speed and different load.

2) Calculation of the torque generated due to the rotation of shaft to the bearing apparatus at various speed and different load.

Compare the effect of temperature variation occurs in the oil film of journal bearing between the shaft having hole and the shaft having without hole.

Compare the effect of torque variation generated due to the rotation of shaft of journal bearing between the shaft having hole and the shaft having without hole.

*Result and Discussion:-*

Measurement of temperature of oil film between shaft and bearing in journal bearing which having hydrodynamic lubrication. Reading are taken after an interval of 30min each, which means initially reading($t_1$) is taken 0min, then intermediate reading($t_2$) taken after 30min and final reading($t_3$) taken after 60min. and measurement of torque generated by the journal to the bearing apparatus through oil film.

Temperature in =degree Celsius.

Torque=newton meter.

Table 1. result analysis in experimental.

| | | Without hole | | | With hole | | |
|---|---|---|---|---|---|---|---|
| load | rpm | T(initial) | T (final) | torque | T(initial) | T (final) | torque |
| 6kg | 600 | 27.2 | 43.1 | 0.6 | 26 | 38.2 | 0.4 |
| | 800 | 36.8 | 47.1 | 0.65 | 34.2 | 42 | 0.5 |
| | 1000 | 39 | 53.5 | 0.7 | 36.5 | 49.1 | 0.55 |
| | 1200 | 40.1 | 56.8 | 0.9 | 37.5 | 51.1 | 0.7 |
| 8kg | 600 | 33.2 | 46.5 | 0.9 | 28.5 | 40.4 | 0.7 |
| | 800 | 34 | 47.9 | 1 | 31 | 43.1 | 0.8 |
| | 1000 | 34.6 | 53.5 | 1.2 | 32 | 48.1 | 0.9 |
| | 1200 | 35.6 | 54.1 | 1.3 | 33.3 | 50.5 | 1 |
| 10kg | 600 | 34.9 | 45.7 | 1.4 | 33.4 | 40.3 | 1.1 |
| | 800 | 35.1 | 49.2 | 1.5 | 34 | 44.6 | 1.3 |
| | 1000 | 36.2 | 53.3 | 1.7 | 34.8 | 47.5 | 1.4 |
| | 1200 | 37.3 | 55.4 | 1.8 | 35.1 | 49.7 | 1.5 |
| 12kg | 600 | 33.1 | 45.4 | 1.4 | 31.5 | 40.8 | 1.2 |
| | 800 | 34 | 49.7 | 1.6 | 32.1 | 45.2 | 1.3 |
| | 1000 | 40.1 | 55.8 | 1.7 | 34.7 | 49.4 | 1.4 |
| | 1200 | 41.2 | 57.1 | 2 | 35.2 | 52.6 | 1.6 |



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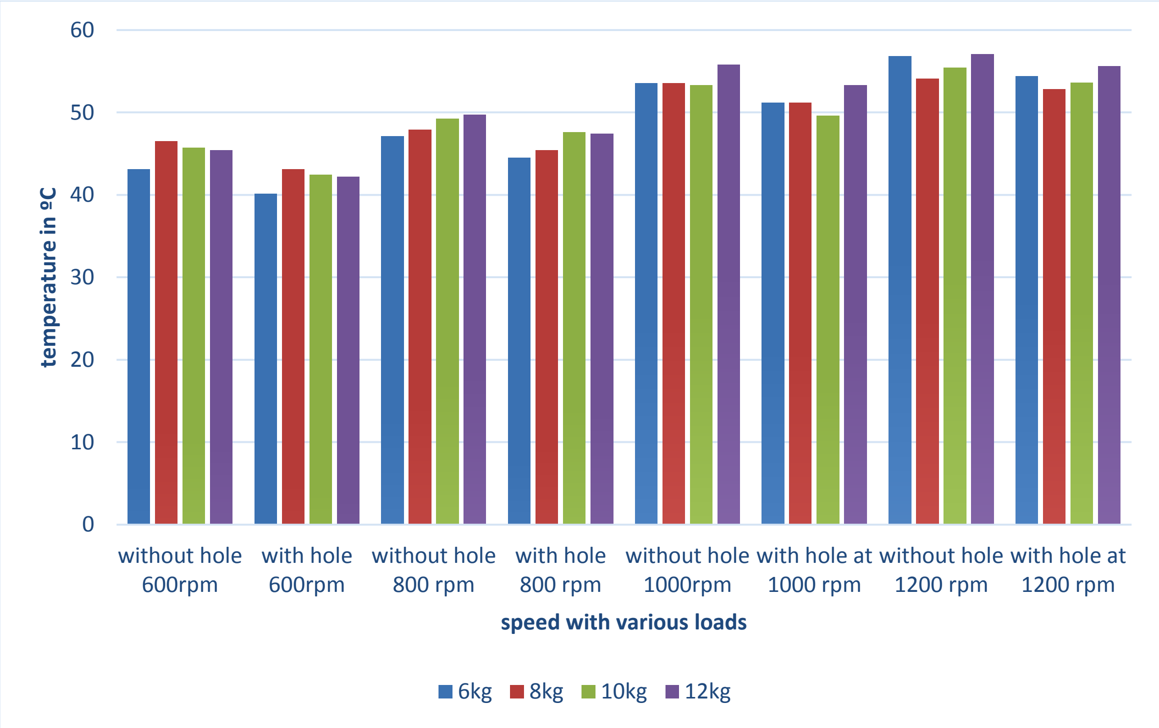
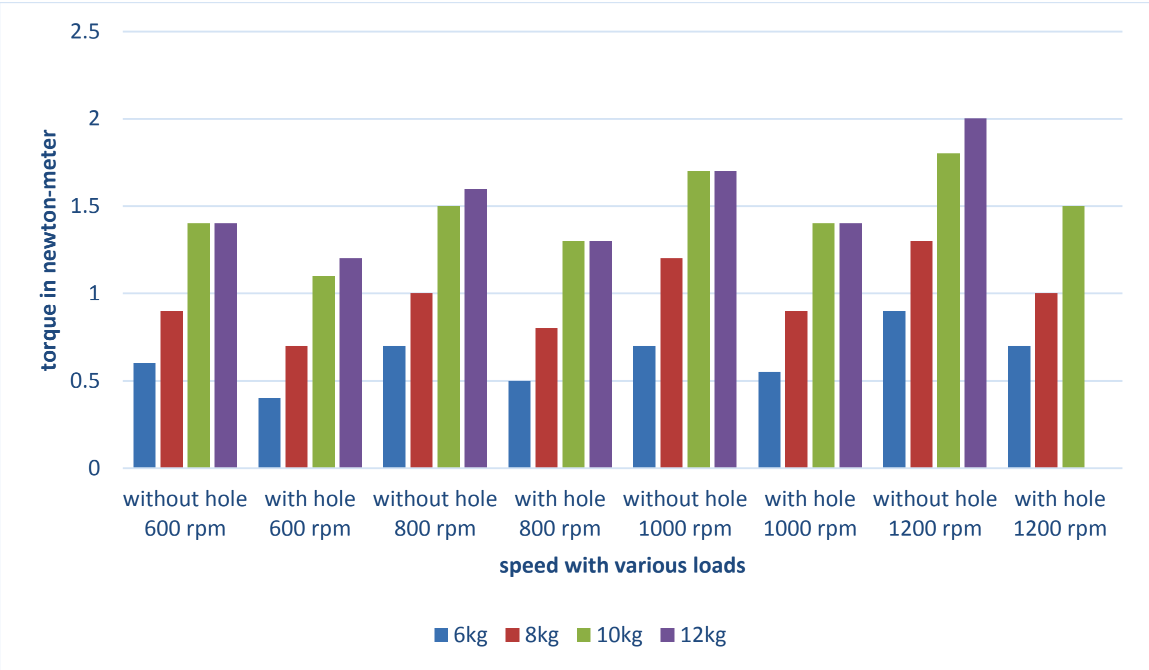
Compare of rise in temperature between with and without hole at various speed and different load.




Variation in torque between with and without hole at various speed and different loads.



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## CONCLUSION:-

From the above experiment it can be concluded that:-An intensive oil flow achieved with fine hole on journal which reduces the rate of rise in temperature at various speed and at different loads. This intensive oil flow also causes better heat abstraction.

1. Frictional torque is reduced with holed journal which is generated in oil film due to the rotation of the journal, lesser frictional power loss can be achieved.
2. Since hole on shaft surface they would be stable on lubricant on shaft suraface.and it can reduce the wear on journal and bearing. This action will enhance the life of bearing.
3. Temperature generation in journal and bearing will be less on holed shaft compare to shaft having without hole.
4. Overall temperature, frictional torque and wear will be less on holed shaft compare to shaft having without hole.

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