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EXPERIMENTAL EVALUATION OF TEMPERATURE DISTRIBUTION IN JOURNAL BEARING OPERATING AT BOUNDARY/MIXED LUBRICATION REGIMES

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ABSTRACT
The excessive rise of temperature in the journal bearing operating at boundary/mixed lubrication regimes. Journal bearing test set-up is used to measure the temperature along the circumference of the bearing specimen for different loading conditions. Here in this journal bearing of l/d ratio 1, diameter of journal is 60mm and the bearing length is 60mm, clearance is 0.06mm has been designed and tested to access the temperature rise of the bearing. The result shows that as the load on the bearing is increasing temperature also increasing. Temperature analysis of journal bearing is also done by the Ansys workbench software.

INTRODUCTION
In journal bearing, journal is rotating within the supporting sleeve. Chaitanya Desai et al have carried out Experimental Analysis of Pressure Distribution of Hydrodynamic Journal Bearing: a Parametric Study. To analyse the pressure distribution in hydrodynamic journal bears for various loading conditions and various operating parameters. Journal bearing test rig is used to test the 140 mm diameter and 70 mm long bearing. The bearing is loaded mechanically. The bearing is tested under various parameters like type of lubricant, loading conditions, speeds etc. S. Kasolang et al have carried out Experimental Study of Temperature Profile in a Journal Bearing. In hydrodynamic lubrication, the viscosity condition of the fluid is critical to ensure good performance of the lubricated machine elements such as journal bearings. In this paper, an experimental work was conducted to determine the temperature distribution around the circumference of a journal bearing. A journal diameter of 100mm with a ½ length-to-diameter ratio was used. Temperature results for different radial loads and speeds were obtained.

EXPERIMENTAL SET-UP
Journal bearing test specimen is to be tested using journal bearing test set-up. Which consists of VFD, DC motor, Support bearings, journal bearing, temperature sensors, lubricant SM 120 and mechanical loading system as shown in Figure 1? VFD is used to adjust the speed for different loading conditions, coupling is provided connect motor shaft with the journal and test specimen is to be supported by the two antifriction bearings. Temperature sensors are used to measure the temperature along the circumference of the bearing.

Figure 1: Journal Bearing Test Rig

The bearing is made up of Gun Metal material which is having length to diameter ratio 1 that is length of the bearing is 60mm and diameter of the journal is also 60mm as shown in Figure 2.

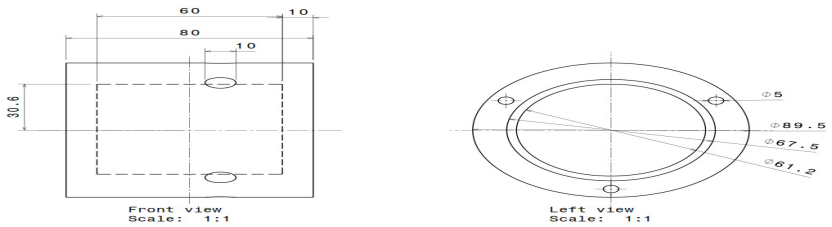

Figure 2: Journal Bearing Drawing

Table 1. Dimensions of Test Bearing.

Diameter of journal d	60.00 mm
Length of the bearing L	60.00 mm
Radial clearance c	0.06
Aspect ratio l/d	1.00
Clearance ratio c/r	0.002

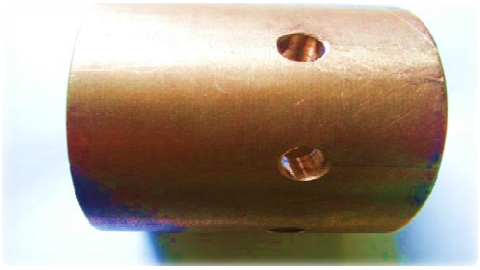

Figure 3: Journal Bearing Test Specimen

Temperature sensors are positioned on the circumference of the journal bearing which is positioned at 45^0 on upper and lower half of the bearing in order to measure the temperature. There are five temperature sensors provided to measure the temperature at different positions and oil inlet port is provided on upper side to supply the lubricating oil. The range of these temperature sensors is 40^0C to 150^0C. The positions of these temperature sensors are shown in the Figure 4.

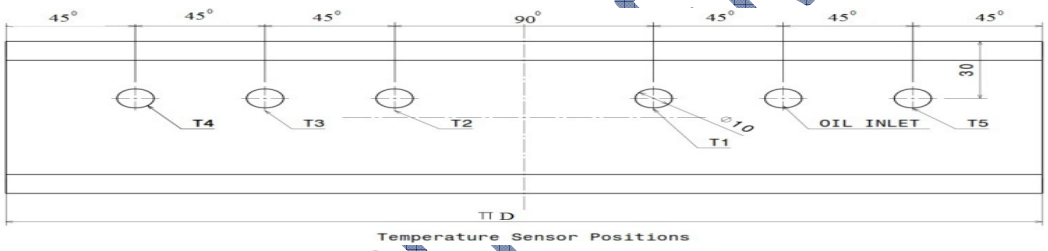

Figure 4: Temperature Sensors Position

RESULTS AND DISCUSSION

After testing the bearing for 08 hours temperature is to be measured at five different locations on the bearing and current is to be measured using VFD with an interval of 30 minutes. Graph 6.1 shows the temperature verses time which shows that the temperature is gradually increasing with respect to time and then it remains constant at the end. Temperature observed on the upper half of the bearing that is T1 and T5 is more as compared to the temperature observed on the lower half that is T2, T3, and T4 of the bearing. As the load increases the temperature also increases.

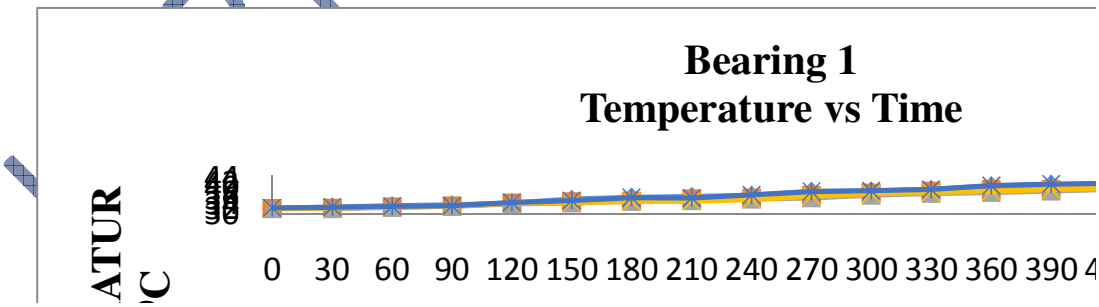

Figure 5: Temperature vs. Time [Load 20kg, Speed 50rpm]

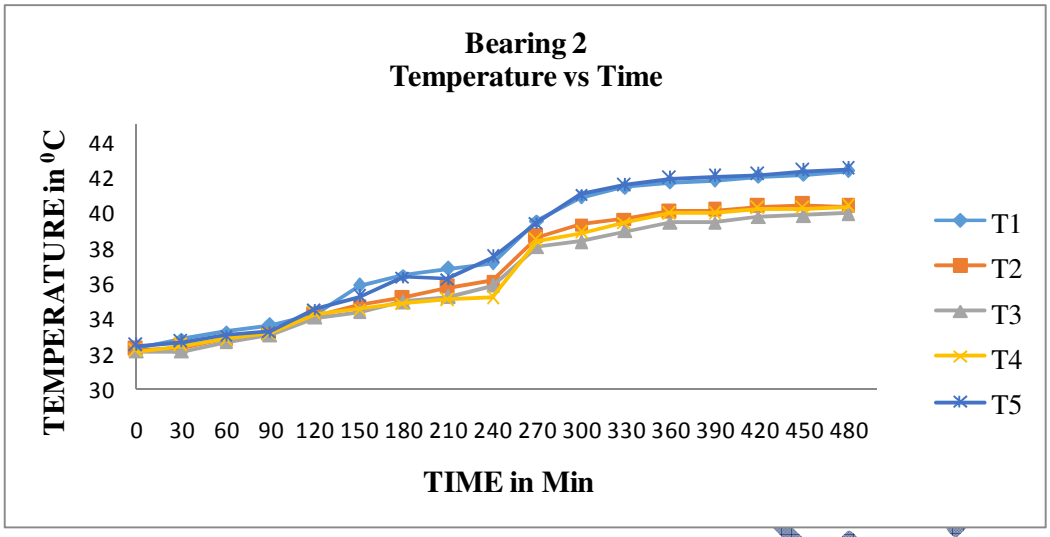

Figure 6: Temperature vs. Time [Load 25kg, Speed 62rpm]

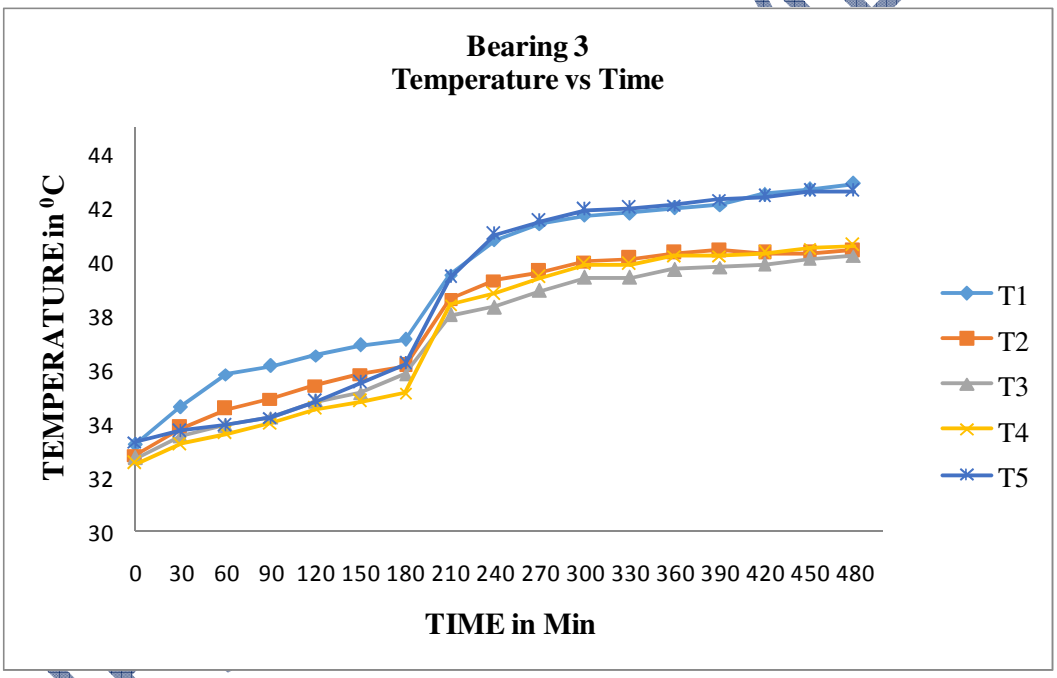

Figure 7: Temperature vs. Time [Load 30kg, Speed 75rpm]

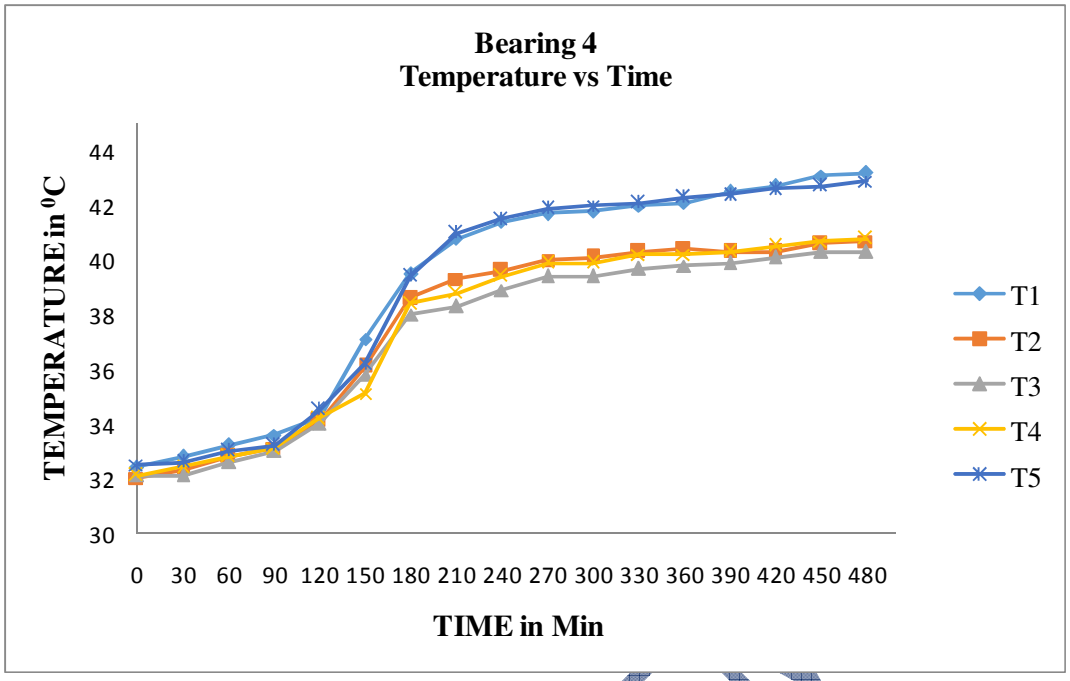

Figure 8: Temperature vs. Time [Load 35kg, Speed 88rpm]

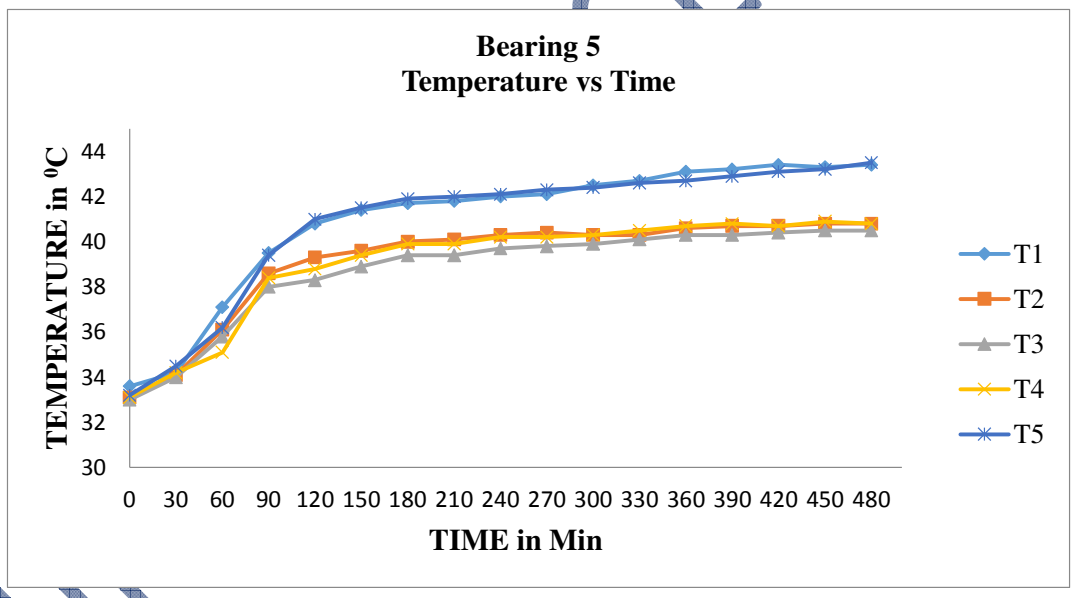

Figure 9: Temperature vs. Time [Load 40kg, Speed 100rpm]

By using Ansys software the temperature profile of the bearing obtained. Firstly bearing is to be designed in the CATIA software and this bearing is imported in the Ansys workbench 14.0. Then by using thermal analysis results obtained for the temperature analysis and directional heat flux. Figure 10 shows bearing zones where temperature varies from minimum to maximum. As the maximum temperature zones shows in the side of the bearing while in the same area wear of the bearing observed in the experimental analysis.

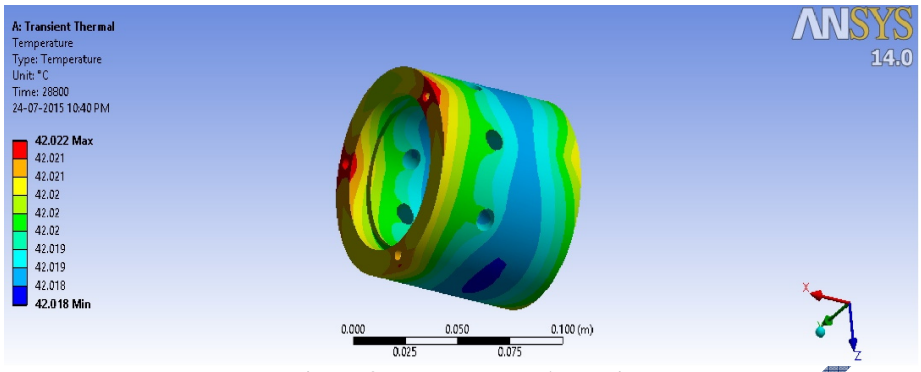

Figure 9: Temperature Analysis

CONCLUSION

Temperature profile of the journal bearing established by using the journal bearing test rig set-up for different loading conditions and speed. Here temperature is increasing with the increasing load for given speed which follows the similar trend which is non-linear for every operating conditions. It has been concluded that the thermal behaviour of journal bearing is affected significantly by rotational speed and load.

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