

TRIBOLOGICAL PERFORMANCE OF BRASS JOURNAL BEARING WORKING UNDER SIMULATED CONDITIONS

Sanket Laxman Patil¹, Kumarom Mahesh Kasve², Bhavesh Shashikant Pagar³, Dinesh Chaudhari⁴, Vinay Kumar⁵, Vishal N. Sulakhe⁶

¹Student, Mechanical Department, Sandip University, Maharashtra, India

²Student, Mechanical Department, Sandip University, Maharashtra, India

³Student, Mechanical Department, Sandip University, Maharashtra, India

⁴Student, Mechanical Department, Sandip University, Maharashtra, India

⁵Assistant Professor, Mechanical Department, Sandip University, Maharashtra, India

⁶Head of Department, Mechanical Department, Sandip University, Maharashtra, India

ABSTRACT

Bearings for sugar mills are known to withstand high load and low speed operations. A temperature rise was detected in the warehouse of a sugar factory, when working in the polluted or contaminated environment of the sugar industry. Therefore, an experiment was conducted on brass (CuZn) plain bearings when lubricated with oil with different flow rates.

In this study, the rise in temperature of a plain bearing in a sugar factory was analyzed. By simulating the operating conditions in a sugar mill the causes for rise in temperature in the bearing were identified and commissioning in a plain bearing test rig that takes into account the combination of operating conditions (self-load, speed, dirt, lubricants, etc). Insufficient supply of internal lubricant can lead to plain bearing failure. This affects the production costs of the industry and can also endanger human lives.

Keyword: Journal bearing, Lubrication, temperature rise, flow rate

INTRODUCTION

A bearing is a machine component that supports and limits the motion of a moving item. They are typically divided into two types: sliding contact and rolling contact bearings. In sliding contact bearings, a lubricant is introduced or supplied between mating surfaces minimises friction and wear and, in some situations, for the purpose of dissipation of heat created when the bearing is in contact with the mating surface. Rolling motion is used to reduce friction in rolling bearings. Journal bearings are typically used where different applications and operating conditions are required.

The causes for failure of a journal bearing are surface unevenness, misalignment, lack of lubrication, dirt, improper surface finish, contaminants, etc. Sugar mill bearing are known to works at low speed and high load. Lubricating oil contains impurities such as bagasse, water, sugar cane juice, and soil. These contaminants flow with the oils onto the journal and bearing surfaces.

This research includes problems such as the temperature rise of bearings and decline in the performance of the journal bearings used in sugar factories. Note that this temperature rise occurs in brass journal bearings.

In this research, a case study from the sugar mill sector was used to observe and comprehend the behaviour of brass journal bearings working under oil as a lubricant at different flow rates. The experiment was carried out on brass journal bearings at a sugar mill size. In this topic the behaviour of the plain journal bearing is being observed under various flow rates of oil is being used as lubrication for the bearings. Different flow rates are used so as to get a better idea about the condition and flow rate under which the brass journal bearing performs the best and gives a better result and less rise in temperature in the bearing.

EXPERIMENTAL DETAILS

In this work, a case study from the sugar mill sector was used to observe and comprehend the behaviour of a journal bearing. The testing setup for the journal bearing with downsizing has been created and tailored to fit the environment and operating conditions of the sugar mill bearing. The conditions in the sugar industry have been created and a test rig setup has been developed to study the behaviour of journal bearing under these operating conditions. EN8 and brass were employed as shaft and bearing materials in this study. Oil is used as a lubricant with various flow rates to perform the test on the journal bearings. Gulf engine oil with SAE 40 grade is used for the experiment. Viscosity of SAE 40 (Gulf) engine oil is approximately 16.34 cSt at 100 °C. The bearing used has an outer diameter of 40mm, an inner diameter of 30mm, and a length of the bearing is 40mm. Shaft diameter and rotation speed is 30mm and 400-600rpm. The total test run for 10-15 minutes is performed. Equipped with two pulleys and a V-belt arrangement, used a 1.5 HP AC electric motor to drive (rotate) the shaft, and at the shaft had a self-load is 73.54 N. A frequency converter ensures that the shaft rotates at different speeds. Variable Frequency drive(VFD) was used to control and maintain the frequency of the shaft. The frequency controller ensures that the shaft keeps rotating smoothly at various frequencies. A Resistance Temperature Detector (RTD) was used to measure and record the temperature of the journal bearing whose range was from -100 °C TO 300 °C. During the testing that was being performed due to voltage fluctuation the VFD and the RTD probe got damaged and malfunctioned, so instead of VFD the use a 3 Phase Starter to start and stop the motors the motor was also 3 Phase, the starter drove the motor and make the motor run at a constant speed. As the RTD probe was also damaged, so for temperature measurement we used Contactless thermometer. Double-row self-aligning deep groove ball bearings (DGBB) ensure shaft alignment. Two bearing housings are used to support the shaft and limit the axial and rotational motion of the bearing during experimental work. Lubricating oil flows into the bearing by gravity. To supply the lubricating oil to the bearings the housing is pierced with a hole on top where a beaker is attached on either sides of the shaft so that oil is being supplied to both the bearings. The temperature of both bearings is measured with a non-contact thermometer with an accuracy of at least $\pm 1^{\circ}\text{C}$.

The figure 1 shows the test rig.



Fig no. 1

RESULT AND DISCUSSION

Bearing failures in sugar mills are primarily caused by the continuous temperature rise of the bearings when operating in contaminated lubricating oil. In this study, the brass journal bearings are supplied with three different flow rates they are Q1, Q2 and Q3.

Flow rate(Q1) = 76.74 min per 200 ml. (OIL)

Flow rate (Q2) = 52.44 min per 200 ml. (OIL)

Flow rate (Q3) = 28.44 min per 200 ml. (OIL)

- I. Flow rate(Q3) = 28.44 min per 200ml. (OIL). Both lubricant reservoirs were filled with 200-300 ml of oil. The nob of the beaker was then adjusted to the Q3 flow rate position. Then the atmospheric temperature was recorded which was 32.8°C as the initial temperature. By using the starter the motor was started and was rotating at the default the speed. A shaft with self-load of 75 N is automatically subjected to the test bearing. Shaft rotates continuously without load until the bearing temperature becomes stable. The shaft was rotated for 10 min under the Q3 flow and the temperature of the brass bearing was measured and noted at four intervals after recording the atmospheric temperature at the initial stage. The temperature of driver as well as driven brass bearing was recorded after 3 min, 5 min, 7 min and 10 min. the temperature rise in the bearing is shown in the table along with the graph. The fig no 2 shows the temperature rise of driver and driven bearing with respect to time.

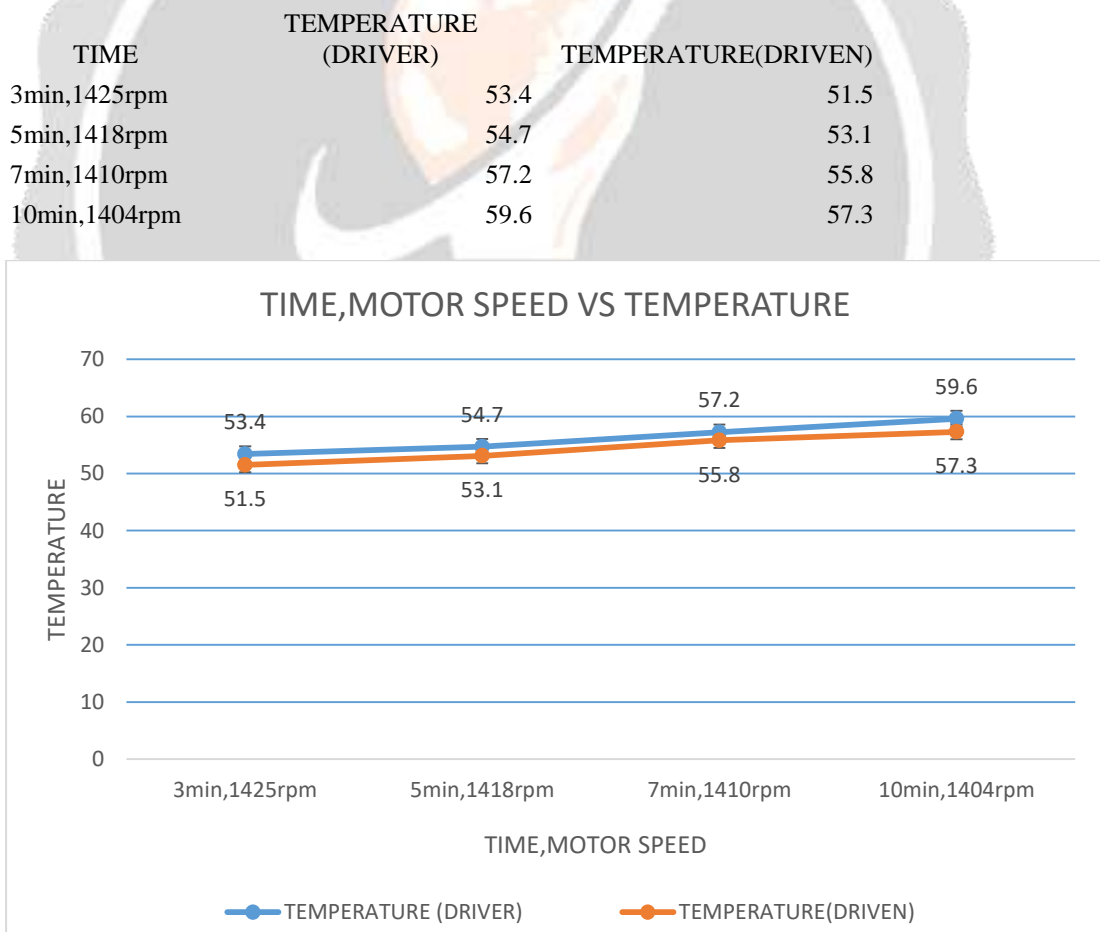


Fig no. 2

II. Flow rate(Q2) = 52.44 min per 200ml. (OIL). Both lubricant reservoirs were filled with 200-300 ml of oil. The nob of the beaker was then adjusted to the Q2 flow rate position. Then the atmospheric temperature was recorded which was 32.7°C as the initial temperature. By using the starter the motor was started and was rotating at the default the speed. A shaft with self-load of 75 N is automatically subjected to the test bearing. Shaft rotates continuously without load until the bearing temperature becomes stable.

The shaft was rotated for 10 min under the Q2 flow and the temperature of the brass bearing was measured and noted at four intervals after recording the atmospheric temperature at the initial stage. The temperature of driver as well as driven brass bearing was recorded after 3 min, 5 min, 7 min and 10 min. the temperature rise in the bearing is shown in the table along with the graph. The fig no 3 shows the temperature rise of driver and driven bearing with respect to time.

TIME	TEMPERATURE(DRIVER)	TEMPERATURE(DRIVEN)
3min,1115rpm	57.2	55.8
5min,1102rpm	59.5	57.6
7min.992rpm	62.6	60.4
10min,980rpm	65.8	62.5

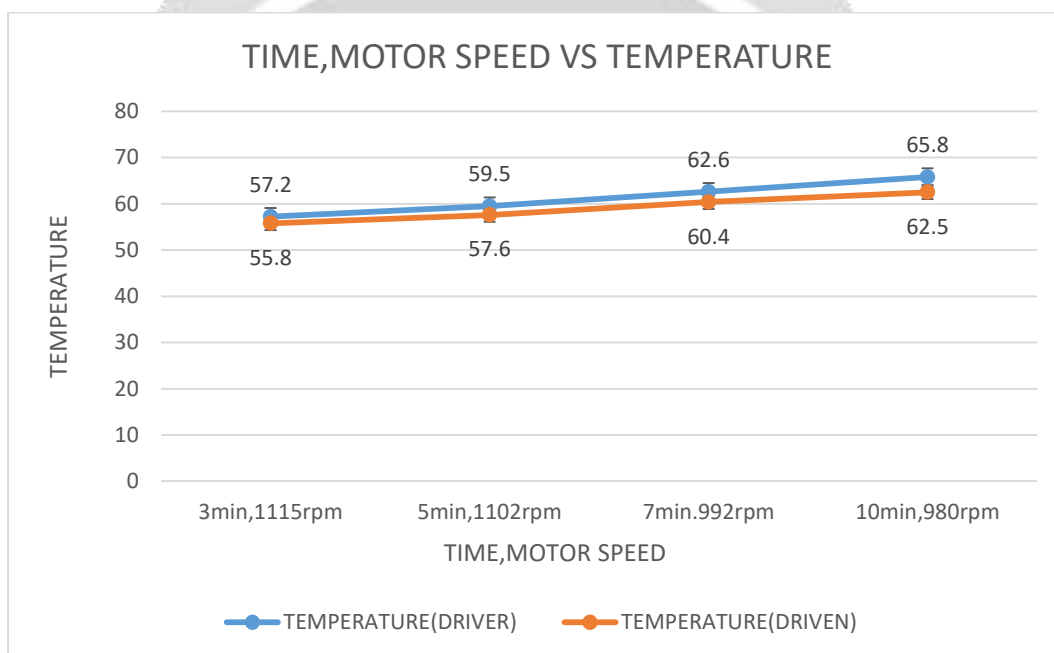


Fig no 3

III. Flow rate(Q1) = 76.54 min per 200ml. (OIL). Both lubricant reservoirs were filled with 200-300 ml of oil. The nob of the beaker was then adjusted to the Q1 flow rate position. Then the atmospheric temperature was recorded which was 32.7°C as the initial temperature. By using the starter the motor was started and was rotating at the default the speed. A shaft with self-load of 75 N is automatically subjected to the test bearing. Shaft rotates continuously without load until the bearing temperature becomes stable.

The shaft was rotated for 10 min under the Q1 flow and the temperature of the brass bearing was measured and noted at four intervals after recording the atmospheric temperature at the initial stage. The temperature of driver as well as driven brass bearing was recorded after 3 min, 5 min, 7 min and 10 min. the temperature rise in the bearing is shown in the table along with the graph. The Fig no 4 shows the temperature rise of driver and driven bearing with respect to time.

TIME	TEMPERATURE(DRIVER)	TEMPERATURE(DRIVEN)
3min,1115rpm	57.2	55.8
5min,1102rpm	59.5	57.6
7min.992rpm	62.6	60.4

10min,980rpm

65.8

62.5

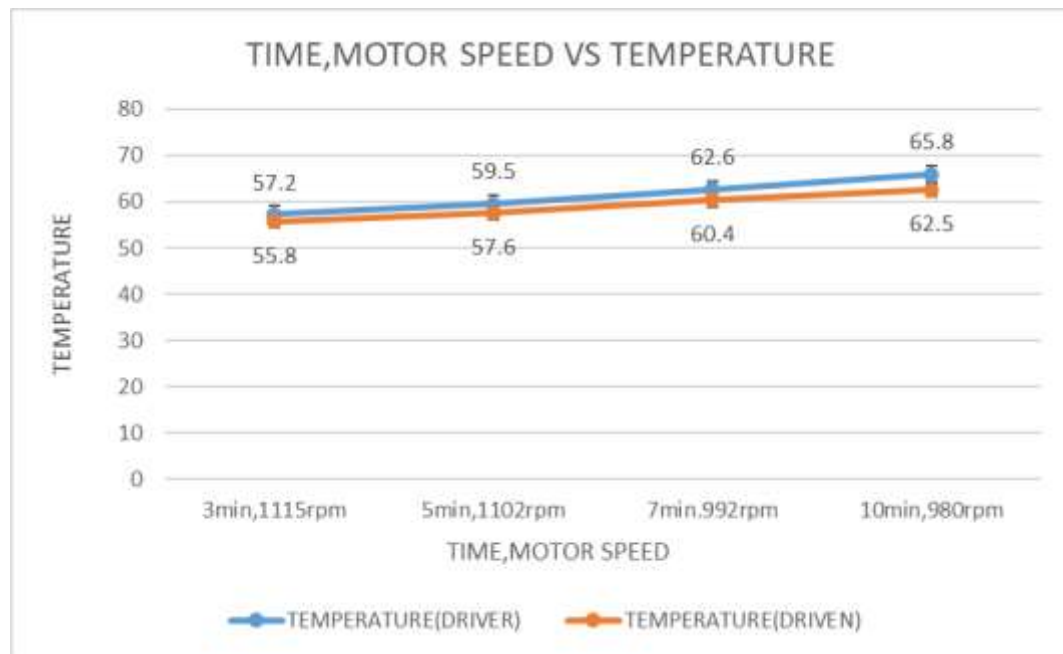


Fig no 4

CONCLUSION

1. It is observed that, the flow rate Q2 is better than Q1, as under Q2 flow rate of oil there is considerably less temperature rise in the brass journal bearing and also better performance was observed as compared to the Q1 flow rate of lubricating oil.
2. The study tells us that the Q3 flow rate for lubricating oil is better than Q2 flow rate. The brass journal bearings have better performance when the flow rate is Q3 also there is lesser rise in temperature as compared to Q2 oil flow rate.
3. The comparative study of Q1, Q2 and Q3 flow rates show that the brass journal bearing performs the best when the flow rate is Q3. Also the rise in temperature is significantly less when the flow rate is Q3.

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