PERFOMANCE CHARACTERISITICS OF PHOSPHOR BRONZE JOURNAL BEARING WORKING WITH VARIOUS CONDITIONS

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ABSTRACT

Bearings for sugar mills are known to withstand high loads and low speed operation. The temperature rise of plain bearings in a sugar factory was analyzed. The cause of the temperature rise in the bearing is identified by simulating the operating conditions and performing commissioning in a plain bearing test rig that takes into account a combination of operating conditions. 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. A temperature rise was detected in the warehouse of a sugar factory. When working in the polluted environment of the sugar industry. Therefore, an experimental study was conducted on phosphor bronze (PB) plain bearings lubricated with oil with different flow rates. In the experiment, it was found that the PB journal bearing performed better when the oil flow rate was Q3. However, it is advised that oil be used as a lubricant with a Q3 flow rate over the long term because the bearing performs best under it.

Keyword: - *Journal bearing, temperature rise, flow rate, oil etc.*

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1. 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. [1] In sliding contact bearings, a lubricant introduced or supplied between mating surfaces minimizes friction and wear and, in some situations, transports away heat created. Rolling motion is used to reduce friction in rolling bearings. [2] Journal bearings are typically used where different applications and operating conditions are required. Failure of Bearings are caused by surface unevenness, misalignment, lack of lubrication, dirt, etc. [3] Sugar mill bearing Works at low speed and high load. Lubricating oils contain impurities such as bagasse, water, sugar cane juice, and soil. These contaminated oil flow onto the journal and bearing surfaces.

This research includes problems such as the temperature rise of bearings in sugar factories. In this work, a case study from the sugar mill sector was used to observe and comprehend the behavior of phosphor bronze bearings with oil at different flow rates. In the topic, the outcomes of both bearings have been compared and analyzed.

2. EXPERIMENTAL PROCEDURE

In this work, a case study from the sugar mill sector was used to observe and comprehend the behavior of bearing. The trial setup for the journal bearing with downsizing has been created and tailored to fit the environment and operating conditions of the sugar mill bearing. In this work, a case study from the sugar mill sector was used to observe and comprehend the behavior of bearing. EN8 and phosphorous bronze were employed as shaft and bearing materials in this study. Oil are used to perform the tests. Viscosity of SAE 40 (Gulf) engine oil is approximately 16.34 cSt at 100 °C. The bearing has an outer diameter of 40 mm, an inner diameter of 30 mm, and a length of 40mm. Shaft diameter and rotation speed is 30mm and 400-600 rpm. The total test run for 10-15 minutes. 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. The frequency converter ensures that the shaft rotates at different speeds. A variable frequency drive (VFD) was used. But due to voltage fluctuations the VFD and RTD probe are damaged, so instead of VFD the starter has been used to start and stop the motor, drive the motor and make the motor run at a constant speed. For temperature measurement the Contactless thermometer was used. Double- row self-aligning deep groove ball bearings (DGBB) ensure shaft alignment. Two bearing housings are used to support the shaft and restrict the axial and rotational motion of the bearing during experimental work. Lubricating oil flows into the bearing by gravity. The temperature of both bearings is measured with a non-contact thermometer with an accuracy of at least ±1°C.

The Bearing test rig is shown in the figure below.

Fig No. 1 Journal Bearing test Rig

3. RESULT AND DISCUSSIO

Bearing failures in sugar mills are primarily caused by the continuous temperature rise of the bearings when operating in lubricating oil conditions.

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)

Fill the both lubricant reservoirs with 200-300 ml of oil. Open the beaker and circulate the solvent for 5 minutes. Then measured the atmospheric temperature is 32.8°C. Start the motor at the default the speed. Self-load of 75 N is automatically subjected to the test bearing. Shaft rotates continuously without load until the bearing temperature becomes stable, recording the temperature at this point.

i. The figure 2 shows Temperature rise VS Time at Q1 flow rate

The figure2 shows ‘Time, Motor speed vs Temperature rise’ in the PB journal bearing when the flow rate is Q1.

The blue line shows the temperature rise in driver bearing while the orange line shows the temperature rise in driven bearing.

Time	Temperature (Driven)	Temperature (Driver)
3min , 1124rpm	26.6	23.5
5min , 1116rpm	29.7	24.4
7min , 1102rpm	33.5	30.4
10min, 1088rpm	37.2	34.7

Table No.1

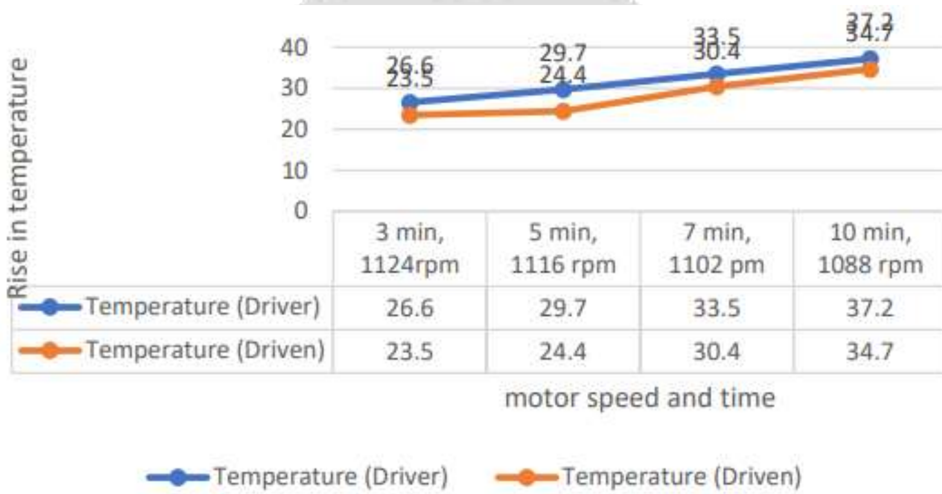

Fig.No.2 Time, Speed Vs Temperature

The temperature rise of PB at Q1 with respect to time under oil conditions are shown in figure 2. The temperature of the lubricating oil between bearing is measured continuously at intervals of up to 10 minutes using a non-contact thermometer. The shaft is rotated at a speed of 1200-1300 RPM up to 10 minutes, of the test run, respectively. The atmospheric temperature is 32°C. The maximum temperature at Driver side is 37.2 °C and the maximum temperature at driven side is 34.7 °C was recorded. The result of the lubricating oil affects the static properties of the Journal bearing.

ii. The figure 3 shows Temperature rise VS Time at Q2 Flow rate.

The figure 3 shows 'Time, Motor speed vs Temperature rise' in the PB journal bearing when the flow rate is Q2. The blue line shows the temperature rise in driver bearing while the orange line shows the temperature rise in driven bearing.

Time	Temperature (Driver	Temperature (Driven)
3min, 1325rpm	24.5	23.6
5min, 1318rpm	25.7	26.2
7min, 1311rpm	26.2	27.2

10min, 1302rpm	29.4	28.6

Table No.2

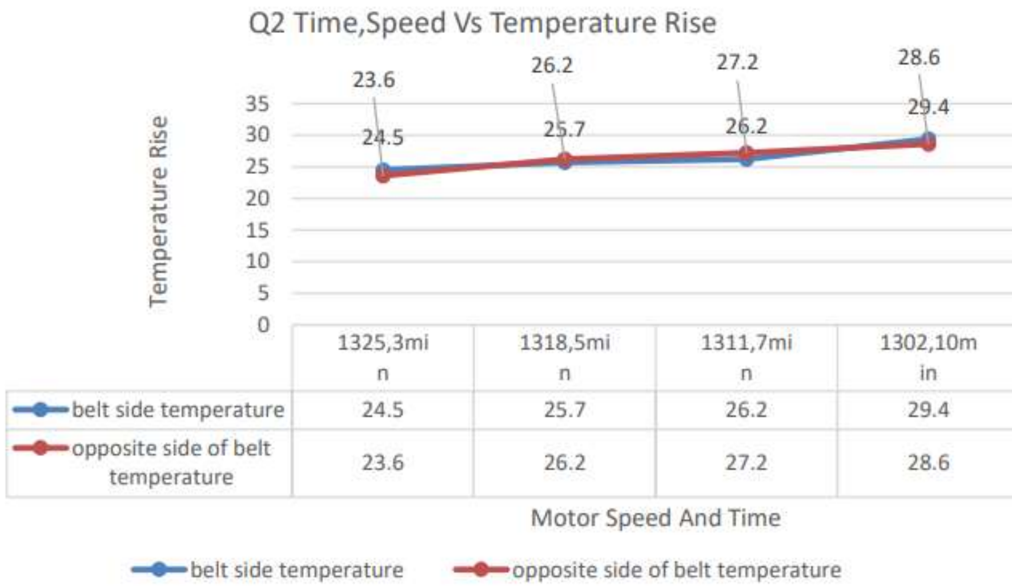

Fig No.3 Time, Speed VS Temperature

The temperature rise of PB at Q2 with respect to time under oil conditions are shown in figure 3. The temperature of the lubricating oil between bearing is measured continuously at intervals of up to 10 minutes using a non-contact thermometer. The shaft is rotated at a speed of 1200- 1300 RPM up to 10 minutes, of the test run, respectively. The atmospheric temperature is 32°C. The maximum temperature at Driver side is 29.4 °C and the maximum temperature at driven side is 28.6 °C was recorded. The result of the lubricating oil affects the static properties of the Journal bearing.

iii. The figure 4 shows Temperature rise VS Time at Q3 Flow rate.

The figure 4 shows 'Time, Motor speed vs Temperature rise' in the PB journal bearing when the flow rate is Q3. The blue line shows the temperature rise in driver bearing while the orange line shows the temperature rise in driven bearing.

Time	Temperature (Driver	Temperature (Driven)
3min, 1440pm	22.7	27.6
5min, 1432rpm	22.9	22.1
7min, 1421rpm	26	23.6
10min, 1412rpm	28.4	34.7

Table No.3

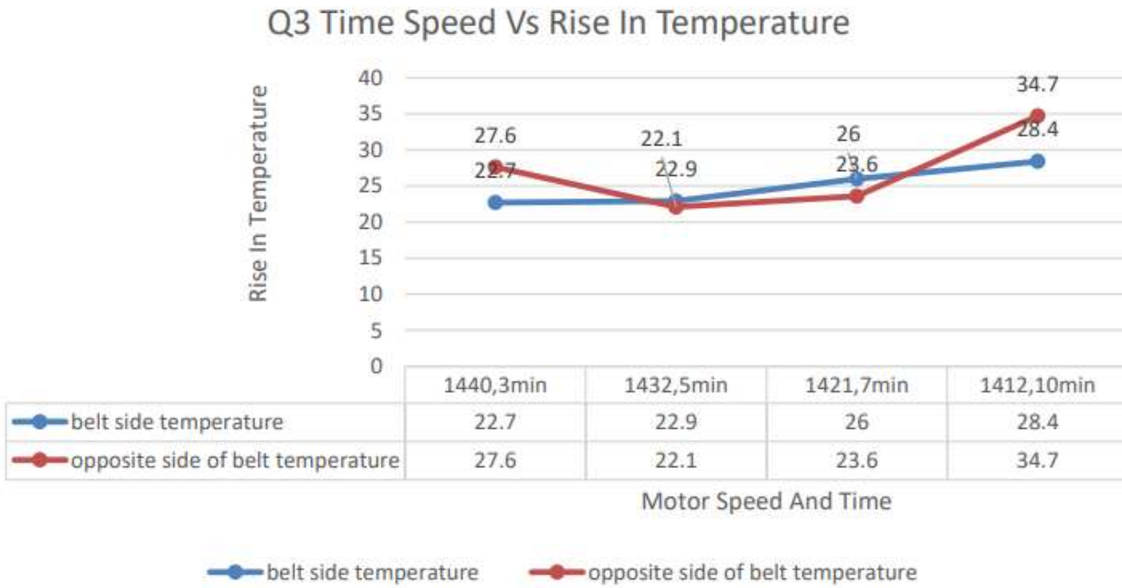

Fig No.4 Time,Speed Vs Temperature

The temperature rise of PB at Q3 with respect to time under oil conditions are shown in figure 4. The temperature of the lubricating oil between bearing is measured continuously at intervals of up to 10 minutes using a non-contact thermometer. The shaft is rotated at a speed of 1200- 1300 RPM up to 10 minutes, of the test run, respectively. The atmospheric temperature is 32°C. The maximum temperature at Driver side is 28.4 °C and the maximum temperature at driven side is 34.7 °C was recorded. The result of the lubricating oil affects the static properties of the Journal bearing.

4. CONCLUSIONS

Through comprehensive research and analysis, several important findings have been obtained. First, the performance of journal bearing depends on various factors, including geometry, lubrication, operating conditions and material properties. Understanding these factors and their interactions is essential for optimizing the design and performance of journal bearing. It is observed that Q2 flow is better than Q1, because under Q2 oil flow, the temperature in PB bushing bearing is significantly less increase and the performance is also better than Q1 lubricating oil flow. While research shows that Q3 flow for lubricating oil is better than Q2 flow. Outer bearing PB has better performance when the flow rate is Q3 and the temperature rise is also less than the oil flow rate Q2. Comparing the flow rates of Q1, Q2 and Q3, it can be seen that PB plain bearings perform best when the flow rate is Q3. Also, the temperature rise is greatly reduced.

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