EXPERIENTIAL WORK ON DIFFERENT JOURNAL BEARINGS WITH CONTAMINATED LUBRICATION

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ABSTRACT

The efficient functioning of journal bearings is crucial to the smooth operation of numerous pieces of rotating machinery. Journal bearing functionality and operational life can be negatively impacted by contaminated oil, which can be the consequence of particle matter or fluid impurities. The goal of this study is to better understand of journal bearing performance while using contaminated oil. In this study, a number of tests were carried out utilising a test rig that was especially created to mimic journal bearing working conditions. Different amounts of oil contamination have been applied to the bearing surfaces of the journal bearings. Temperature increase was monitored and examined. Comparing the outcomes of both side journal bearing. The results of both journal bearings have been compared in the matter of temperature rise with various contamination oil conditions. Improvement has been observed on the performance of Pb journal bearing as compared to stainless steel journal bearing under contaminated lubricating oil conditions.

Keywords*: Journal bearing, contamination (sugarcane juice & water), temperature rise, flow rate.*

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1. INTRODUCTION:

The shaft is loaded by gears, pulleys, rope, belt arrangements, etc., thus a bearing is needed to support these loads and allow the shaft to rotate freely. Whenever a variety of applications and functioning circumstances are required, journal bearings tend to be employed. Because of surface imperfection, misalignment, lack of lubrication, pollution, etc., journal bearing failure occurs. Low speed and heavy load are used in the sugar mill bearing's operation. Lubricating oil gets polluted when contaminants like bagasse, water, sugar cane juice, and dirt are added to it. This contaminated oil then flows into the journal and bearing.

In many industrial applications, spinning shafts are supported by journal bearings, which also offer low-friction operation. For machinery and equipment to run smoothly and last a long time, journal bearing performance must be efficient. Contaminants in the lubricating oil, however, can have a negative impact on the functioning of the bearing, causing increased friction, wear, and perhaps catastrophic failures. Particulates, deteriorated lubricants, water intrusion, or external pollutants are some of the possible causes of contaminated oil in journal bearings. These impurities may weaken the oil film's integrity between the journal and bearing surfaces, resulting in greater frictional losses and direct metal-to-metal contact. They may also result in abrasive wear, pitting, and surface damage, which further jeopardizes the performance and dependability of the bearing.

Researchers and engineers have investigated a number of strategies to reduce the negative impact of oil contamination on journal bearing performance in recent years. As a result, the purpose of this study is to examine and evaluate the performance of journal bearings using tainted oil. by performing carefully controlled tests and assessing crucial performance indicators including wear, friction, and temperature rise.

The results of this study will improve our understanding of the tribological behaviour of journal bearings and offer engineers and researchers useful recommendations for choosing the right materials to enhance bearing performance in polluted settings. In the end, our research aims to improve journal bearing system efficiency and reliability, lowering maintenance expenses and interruption in industrial applications.

2. EXPERIMENTAL DETAILS:

The working conditions and environment of the sugar mill bearing have been taken into consideration when designing and fabricating the trial setup for journal bearing with downsizing. EN8, phosphorous bronze and stainless steel have been employed as the shaft and bearing materials in this investigation, respectively. Bearings have a 40 mm outer diameter, a 30 mm inner diameter, and a 40 mm length. The shaft has a 30 mm diameter and rotates between 800 and 1400 revolutions per minute. The ratio of the journal (shaft) diameter to the bearing length is 1.333:1. The shaft has been rotated using a 1.5 HP AC electric motor with two pulleys and a V-belt setup. A variable frequency drive (VFD) is used to change the shaft's speed. The shaft alignment has been maintained by double-row self-align deep grooved ball bearings (DGBB). Two vibrations (rubber) pad of 6 mm thickness is required to keep at the bottom of the test rig, stabilize the vibration level of journal bearing. Two bearing housing is used to sustain the shaft and also restrict the movement of axial and rotation of bearings during the experimental work. The lubricating oil is flown inside the bearing through gravity. The temperature of all bearings have been measured by using resistance thermometers (RTD) probe with a least count of ± 1 ^{o}C , respectively.

(a)

(b)

Fig. 1 Journal bearings (a) phosphorus bronze and (b) Stainless steel

Fig. 2 Test rig of Journal Bearing

3. RESULTS AND DISCUSSION:

Operating the sugar mill with contaminated lubricating oil conditions (such as water, bagasse, sugarcane juice, dirt, and occasionally a mix of the two, three, and all of them) causes the bearing's temperature to continuously rise. At two separate locations with variable lubricating oil flow rates, the temperature was measured at each location.

Figure 3 depicts the temperature increase in Pb bearing with regard to time under oil contamination (sugarcane juice and water). Throughout the whole test run, the ambient temperature for each contaminated oil condition was changed. Continuous temperature readings of the lubricating fluid between the journal and the bearing have been made using an RTD (resistance thermometer) PT 100 probe. 1400 RPM is the speed at which the shaft rotates. A temperature of 32.7 ^{0}C was recorded for the atmosphere. The maximum temperature rise of 69.3 ^{0}C and minimum temperature rise of 60.4 ^{0}C was recorded respectively.

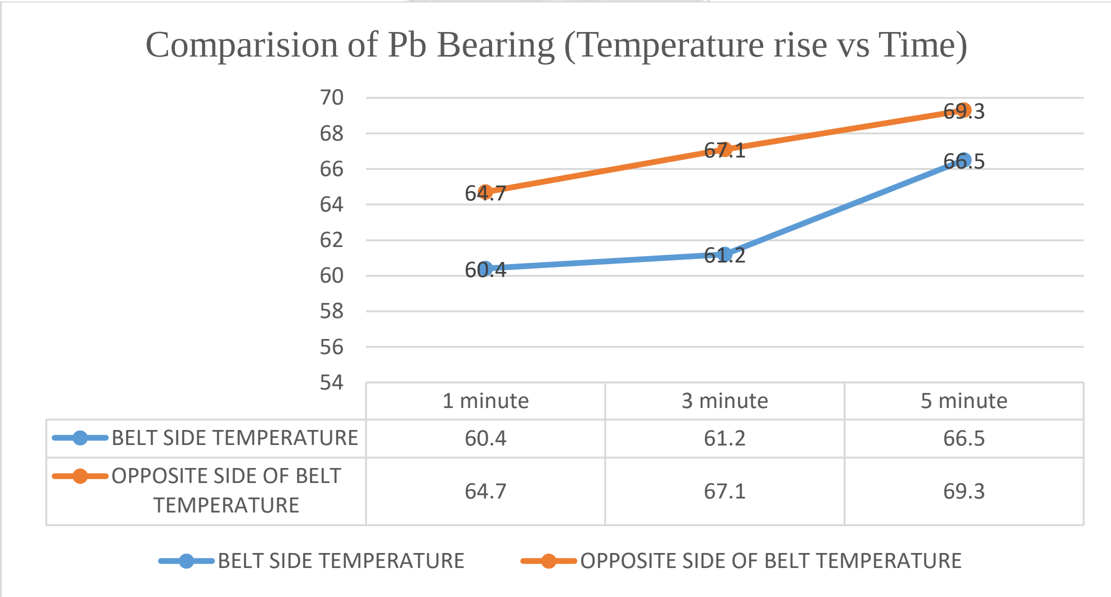


Fig. 3 Temperature of phosphorus bronze bearing under contaminated oil condition at Q3 (flow rate) position.

The temperature rise in stainless steel bearing with respect to time under contaminated (sugarcane juice and water) oil conditions are shown in figure 4. The atmospheric temperature for each contamination oil condition was varied for the entire test run. The atmospheric temperature of 32.7 ^{0}C was measured respectively. The maximum temperature rise of 71.2 ^{0}C and minimum temperature rise of 62 ^{0}C was recorded respectively.

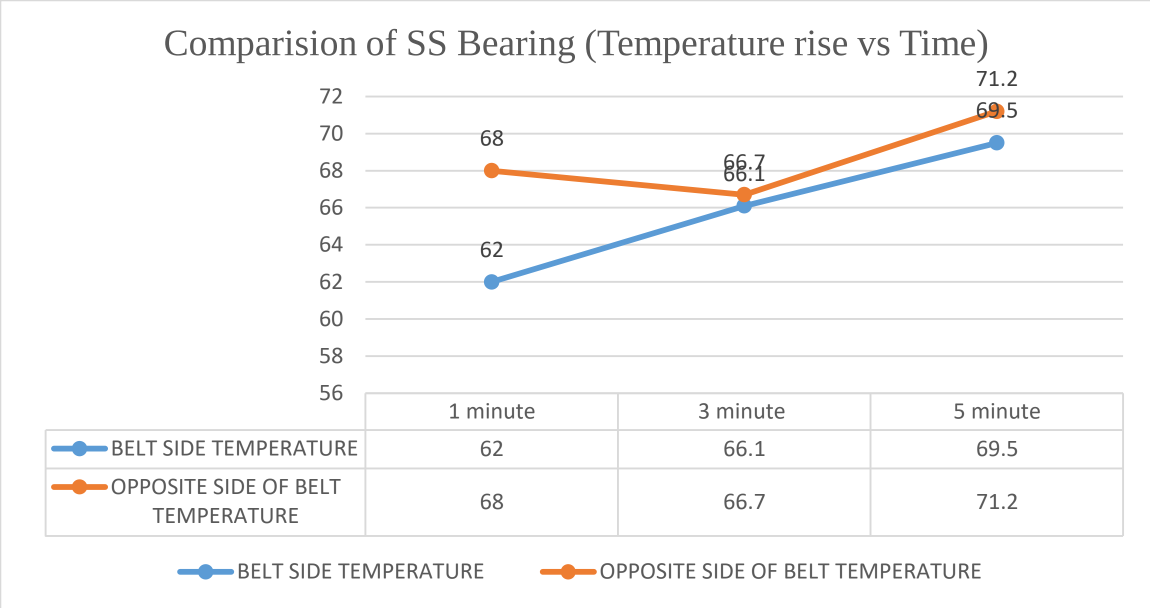


Fig. 4 Temperature of SS bearing under contaminated oil condition at Q3 (flow rate) position.

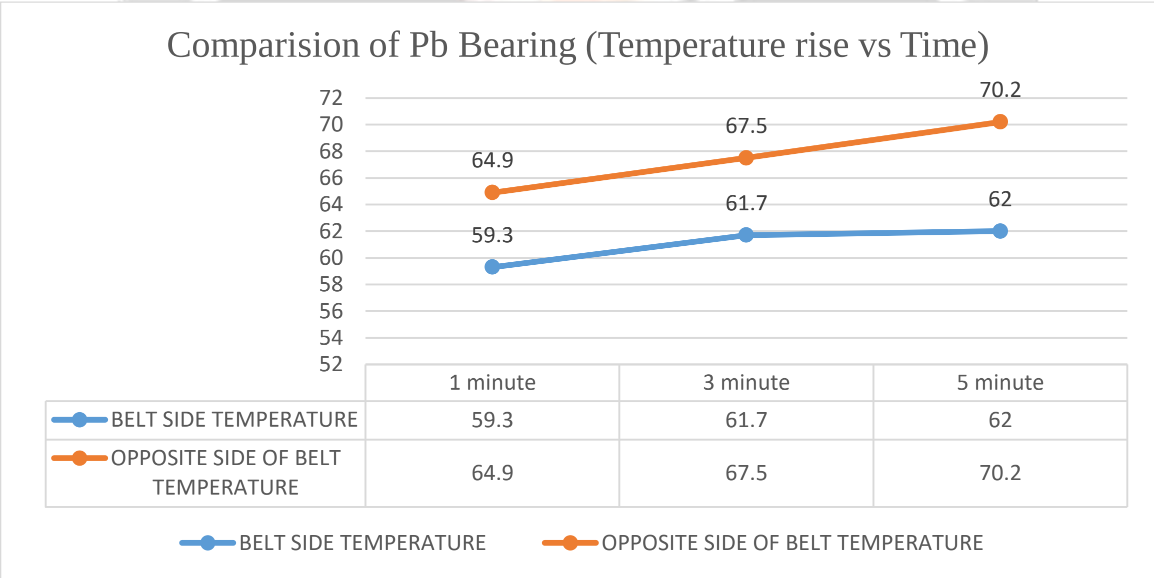


Fig. 5 Temperature of Pb bearing under contaminated oil condition at Q2 (flow rate) position.

The temperature rise in Pb bearing with respect to time under contaminated (sugarcane juice and water) oil conditions are shown in figure 5. The atmospheric temperature for each contamination oil condition was varied for the entire test run. The atmospheric temperature of 32.7 ^{0}C was measured respectively. The maximum temperature rise of 70.2 ^{0}C and minimum temperature rise of 59.3 ^{0}C was recorded respectively. The temperature rise in SS bearing with respect to time under contaminated (sugarcane juice and water) oil conditions are shown in figure 6. The atmospheric temperature for each contamination oil condition was varied for the entire test run. The atmospheric temperature of 32.7 ^{0}C was measured respectively. The maximum temperature rise of 71.5 ^{0}C and minimum temperature rise of 61.4 ^{0}C was recorded respectively.

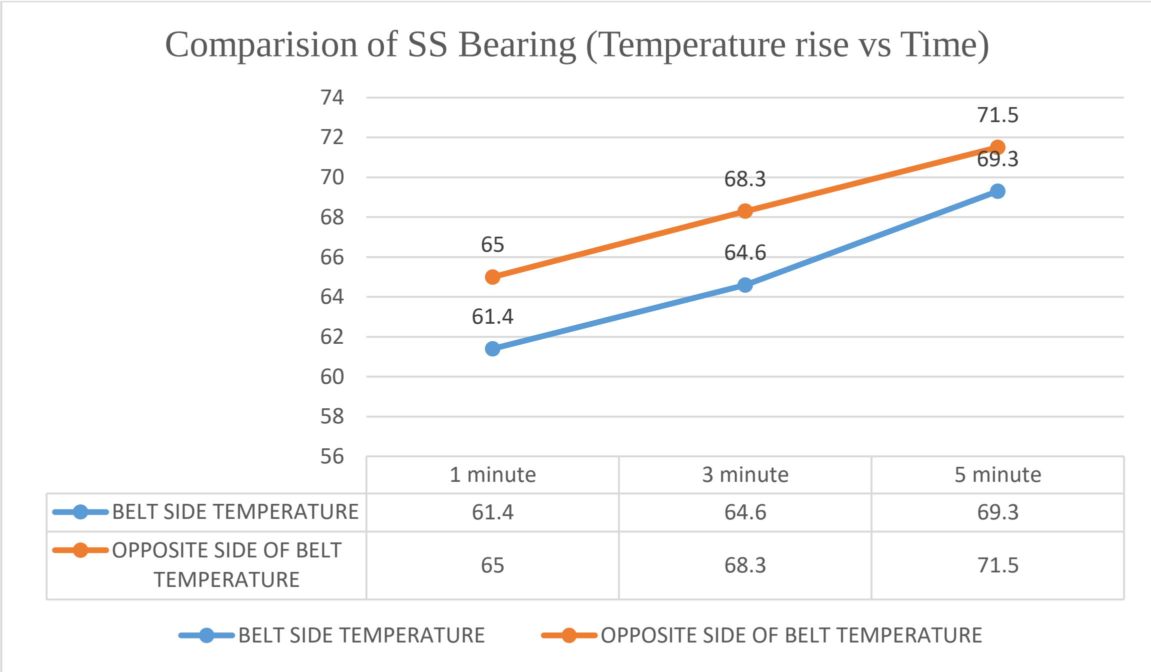


Fig. 6 Temperature of Brass bearing under contaminated oil condition at Q2 (flow rate) position.

The temperature rise in Pb bearing with respect to time under contaminated (sugarcane juice and water) oil conditions are shown in figure 7. The atmospheric temperature of 32.7 ^{0}C was measured respectively. The maximum temperature rise of 71 ^{0}C and minimum temperature rise of 61 ^{0}C was recorded respectively.

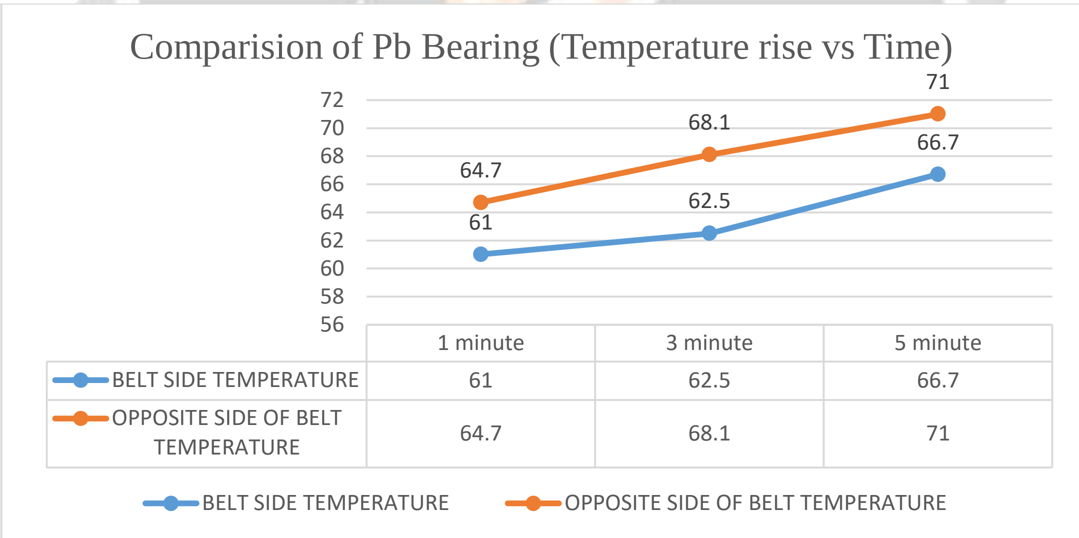
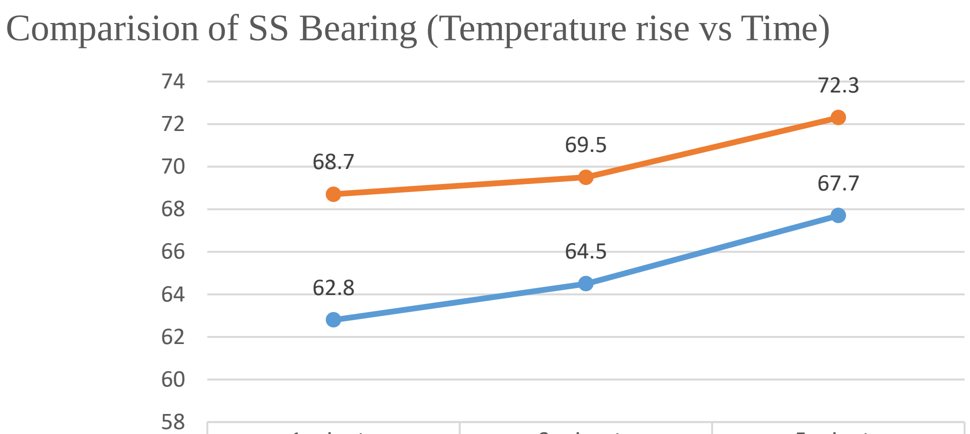


Fig. 7 Temperature of Pb bearing under contaminated oil condition at Q1 (flow rate) position.

The temperature rise in SS bearing with respect to time under contaminated (sugarcane juice and water) oil conditions are shown in figure 8. The atmospheric temperature for each contamination oil condition was varied for the entire test run. The atmospheric temperature of 32.7 ^{0}C was measured respectively. The maximum temperature rise of 72.3 ^{0}C and minimum temperature rise of 62.8 ^{0}C was recorded respectively.



	1 minute	3 minurte	5 minute
BELT SIDE TEMPERATURE	62.8	64.5	67.7
OPPOSITE SIDE OF BE;T TEMPERATURE	68.7	69.5	72.3

Fig. 8 Temperature of Brass bearing under contaminated oil condition at Q1 position

4. CONCLUSION:

The performance of journal bearings using contaminated oil was the subject of the current investigation. The results give helpful understandings into the tribological behaviour of journal bearings under such circumstances and provide helpful advice for enhancing bearing performance in actual applications. Through the use of experiments, phosphorus bronze (Pb) bearings, stainless steel bearings, and polluted lubricating oil have been studied and analysed. As a result of this investigation, we can conclude that in polluted lubricating oil, the maximum and lowest temperature increase of stainless steel bearings appeared to be greater while those of Phosphorus Bronze bearings have been found to be lower. Thus the Phosphorus Bronze Journal Bearing is thermally ideal for a variety of industrial applications as compared to stainless steel Journal bearings.

5. REFERENCES

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