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Assess the working status of the roller bearing

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Abstract:

Roller bearings are a type of support shaft in important mechanical drive structures. During the working process of the drive system, the bearing will gradually become less reliable over time. Sudden failures of roller bearings can result in heavy losses in production lines. The assessment of their working status should be conducted periodically and regularly. In this article, I have analyzed, identified the conditions and pointed out some the reasons for the failure states of the bearing. Corresponding to each cause, the degree of failure of the roller bearing appropriate remedy. The two main solutions that can be used are Non-Destructive Testing (NDT) lubricant quality testing.

Keywords

Ball bearing, Roller bearing, Non-Destructive Testing.

1. Introduction

Roller bearing is a form of shaft bearing, this is a mechanical mechanism that minimizes friction by shifting the sliding friction of two contact parts when moving into rolling friction between rollers or balls. Set fixed in an annular frame.

Roller bearing structure includes, Inner ring, outer ring and roller. Inner and outer rings often have grooves to guide the roller and to reduce stress. The inner ring is fitted with the axis of the shaft, the outer ring fitted with the shaft bearing (the case, the body). Usually the inner ring rotates with the axis, while the outer ring stays still, but also when the outer ring rotates with the axial pillow while the inner ring stays still with the shaft.

Roller bearings are very popular in many machines:

Figure 1. Roller bearing structure.

metal cutters, electric machines, cars, airplanes, tractors, agricultural machines, cranes, construction machines, mining machines, in gearboxes, in structure, etc. Some typical bearings are shown in Figures 2 and 3.

1.1. Types of roller bearings commonly used

- Ball bearing one row (Figure 2a): Mainly to bear radial force, but can also bear axial force by 70% unused centripetal force (unused centripetal force is the difference between radial force for magic with actual radial force). Ball bearings that support a row can work normally when the axis is tilted at a small angle, no more than 15'- 20'.

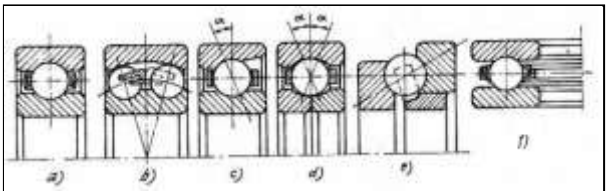

Figure 2. Types of ball bearings.

- Two-row ball bearings bearing (Figure 2b): Mainly with radial load, but also can withstand axial load equal to 20% of unused centripetal bearing capacity. The drive can work normally when the axis is tilted to an angle of 2' - 30'.
- Bearings block a row (Figure 2c): Withstand both radial and axial forces. Radial bearing capacity of this drive is greater than the bearing capacity of about 30% ÷ 40%. Bearing capacity depends on the contact angle between the ball and the outer ring. The larger the contact angle, the greater the bearing capacity.
- Short cylinder bearings support a row (Figure 3a): Mainly

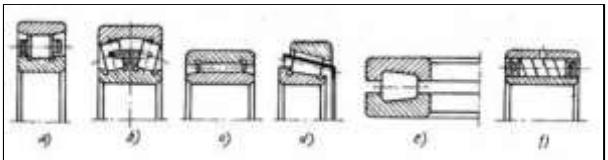

Figure 3. Types of roller bearings.

for bearing radial force. Compared to a single-row bearing of the same size, this type of drive is capable of bearing radial force greater than about 70%, and is more resistant to impact. However, some short-cylindrical cylindrical bearings do not withstand axial forces and do not allow axial tilt (Figure. 3a).

- Two-row spherical roller bearing (Figure 3b): Mainly for radial force, the radial bearing capacity of this type is twice that of the spherical ball bearing of two ranges of the same size and can withstand axial force is equal to 20% of unintentional centripetal force.
- Needle drive (Figure 3c): It is the drive where the roller is a small long cylindrical rod - called a needle. The number of needles is several times higher than the number of chopsticks in the conventional chopsticks. Needle drives

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are often used in areas where it is necessary to limit the orientation to the center.

- Roller bearing limited (Figure 3d): Can bear both radial force and large axial force. The tapered roller bearing can withstand radial force by 170% compared to a ball bearing a row of the same size. This type is widely used in machine construction because of its simple disassembly, adjustment of clearance and convenient wear compensation.
- The bearing cylinder curling (Figure 3e): It is the drive where the roller is hollow cylindrical, wrapped in thin steel tape (called twisted cylinder), this drive does not withstand axial forces. Thanks to the high elastic spring chopsticks, the drive is subjected to good impact loads, which can work normally when the shaft is tilted to 30 '.

1.2. Operating parameters of bearings

According to [1], the main operating parameters of the bearings are Noise, temperature, vibration and lubricant condition.

- Noise of bearings: During operation, use sound monitoring device to measure the volume and characteristics of noise when the bearing is rotating. It is possible to distinguish the damage of bearings as flaking as based on the unusual characteristics of noise.
- Bearing temperature: The bearing temperature can be estimated from the temperature measured from the outside of the cover of the bearing and can be measured directly from the outer ring of the bearing with a probe passing through an oil hole on the pillowcase. Normally, the temperature of bearings increases slowly after starting the engine until it is stable after about 2 - 3 hours. The bearing temperature is stable depending on the load, rotation speed and heat transfer characteristics of the machine. Inadequate lubrication or improper assembly can cause the bearing temperature to increase rapidly. Such cases should temporarily stop the machine and take corrective measures.
- Bearing vibration: Abnormalities of bearings can be analyzed by measuring the vibration of a running machine. A spectrum frequency analyzer is used to measure the magnitude of vibration and the distribution of frequencies. Test results can identify the cause of the abnormalities of bearings. The measured data is changed according to the operating conditions of the bearing and vibration measurement position. Therefore, it is necessary to determine the evaluation criteria for each measured machine. Monitoring vibration vibrations from bearings during operation is very useful in maintenance.
- Influence of lubrication: The main purpose of lubrication is to reduce friction and reduce internal wear to avoid premature failure. Lubricants help prevent direct contact of metal parts such as balls, inner rings, outer rings; Reduces heat generation by friction and cooling effects, sealing and rust prevention, extending the life of bearings.
- Choice of lubricants: There are two main methods for lubricating bearings: grease lubrication and oil lubrication. Depending on the condition and purpose of use, choose a suitable lubrication method to achieve the best operation of the bearing.

2. Bad conditions and causes of roller bearings

When roller bearings are used in ideal conditions, generated drive failures are fatigue-free forms. Usually the roller bearing life is expressed by working time or total number of revolutions before fatigue occurs in inner, outer, roller, fatigue due to stress changes by the cycles.

Roller bearings may appear cracks earlier than usual, this cause type includes

- Using the drive incorrectly.
- Installation of wrong drive or wrong implementation process.
- The lubricant is broken, the lubrication method is incorrect or not covered.
- Speed and temperature are not working properly.
- Lubricants are dirty during install.
- Use heavy load (overload).

When the drive failure phenomenon starts to appear, this stage is very important to focus on determining the cause of the drive failure. At this time, not only roller bearings, but also the shaft, drive cover and lubricant have been used should also be considered in parallel with the determination of the bearing status.

3. Common failures of roller bearings

During the work process, normally on the work surfaces of roller bearings there are some main types of damage [3]:

3.1. Cracking and breaking the components

The process of forming cracks on the surface of the details of the drive are caused by peeling and pitting the surface due to fatigue stresses that exceed the permissible limit. The initial cracks are usually very small (a few μm in size) and after a relatively short time of operation, this crack will develop very quickly and cause a breakage in detail, Figure 4. This type of failure is localized Ministry and also play a very important role, as an object of detection of diagnosis.

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Figure 4. Some status broke the ball bearings.

The frequency of damage to roller parts is given in Table 1.

Table 1. Table example.

Broken	Frequency [%]
Abrasion	25
Exhausted	26
Cracking and breaking	49

3.2. Residual deformation of the work surface

Due to the impact load or static load is too large when the drive is not rotating or rotating very slowly (less than 1 rpm). See Figure 5.

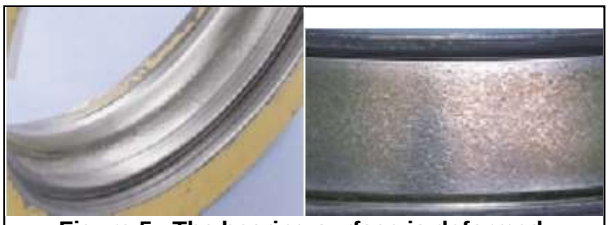

Figure 5. The bearing surface is deformed.

3.3. Rust and corrosion

Rust is the oxide, hydroxide or carbonate film produced on the surface of the material by chemical action. When the device stops and its temperature drops to condensation temperature, moisture condenses into droplets and falls. Falling water is often accompanied by lubricating oil, resulting in rust on the bearing surface. When the roller is placed in a damp place for a long time, rust occurs on the rolling groove in the empty area between the rollers.

Corrosion is a phenomenon of oxidation on the surface by chemical action with acid or alkali. Corrosion occurs when the compound of sulfur or chlorine exists in additives and lubricating oil decomposes under high temperature.

Figure 6. The bearing surface is deformed.

Corrosion also occurs when water enters the bearing. See Figure 6.

4. Some solutions to assess the situation of drive failure

To make the most of the capacity and usage time of the drive; proactive in extending bearing life; ensure maximum operating efficiency of equipment and machinery; minimizing unexpected incidents causing significant damage to maintenance and operation costs as well as reducing production capacity of equipment systems, it is necessary to monitor the working status of bearings during operate to Early detection of damage and handling before it grows. This will not only reduce the possibility of damaging but also allow the planning of supplies, human resources, plans to repair related items during the downtime.

4.1. Monitoring and analyze lubricating oil

Oil analysis is a long-term process, which can produce better predictive results than any other technique. It may take a year for these processes to achieve the required level of accuracy.

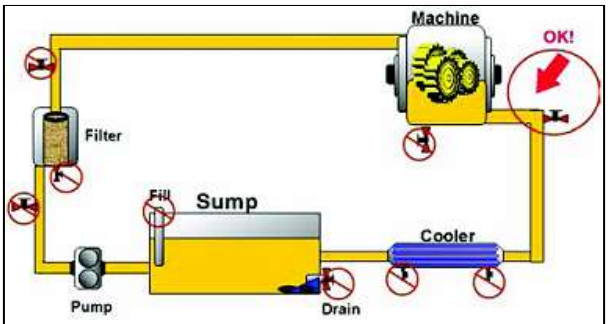

Figure 7. Sampling model to monitor the condition of lubricating oil.

Analytical techniques performed on oil samples can be divided into two categories: analysis of used oil and analysis of contaminated abrasive elements in lubricating oil. Analysis of the oil used will determine the condition of the oil, which will determine the quality of the oil and whether it will continue to be used. Analysis of contaminated abrasive elements in lubricating oil will determine the mechanical condition of lubricated machine

components, you can identify the components of solid materials present and evaluate abrasive particles, size, density distribution, shape, and structure. See Figure 7.

4.2. Non-Destructive Testing technical

Non-Destructive Testing (NDT), also known as non-destructive evaluation (NDE), non-destructive inspection (NDI), or defect detection is the use of physical methods to check the detection of defects within or at the surface of objects without damaging their usability.

Currently, non-destructive testing technology is an indispensable and indispensable technology for industries. Non-destructive testing includes methods for detecting damages, defects, checking the integrity of materials, structures, details or to determine the characteristics of objects without doing affect the usability of the test subject.

Non-destructive testing is also used to optimize processes and technological processes in fabrication and machining.

Thanks to the early detection and elimination of unsatisfactory materials, products, selling products, optimizing the production process, it reduces production costs, improves product quality, production efficiency and business of businesses.

At the same time, thanks to the early detection of defects in structures, systems and subsystems, it is possible to soon provide solutions to overcome and repair, avoiding possible disasters.

5. Conclusion

Abnormal activities and common failures of roller bearings have a great influence on the maximum operating efficiency of the equipment, sudden shutdowns and repair costs. To ensure reliable working conditions of the roller, monitoring, diagnostics and checking the working status of the roller bearings are essential. A number of monitoring methods (monitoring) of working conditions to diagnose roller bearing failures have been listed and analyzed. There are currently two working condition monitoring methods to effectively diagnose roller bearings such as NDT lubrication and technical analysis. Once the damage is determined, it will be fully active in developing the necessary maintenance schedule.

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