

The wear mechanism of the reducer box and preventive measures

GuangChun Yang^{1, a}

¹School of Mechanical Engineering, Panzhihua University, Panzhihua, Sichuan Province, China

^a1297208354@qq.com

Keywords: Fretting wear, Wear mechanism, Harm and prevention, Reducer casing, Repair methods

Abstract: By analyzing the micro-vibration and wear principle of the harm of contact surface of the reducer box bearing bore and bearing due to periodic relatively low amplitude vibrations, we reveal the fact that gearbox the micro-vibration wear mechanism is a special form of wear Involving both abrasive and fatigue wear mechanisms, put forward methods to prevent and reduce wear micro vibrations by optimizing design, process and material properties of measures, improve the reliability and service life of reducer and propose common repair methods of worn holes.

Introduction

Any mechanical equipment is given a certain amount of work performance when it is designed and by making to give assurance and implementation, in order to meet its value. Practice shows that Mechanical equipment in the course of using will appear regular aging, damage and even failure, resulting in reduced production efficiency and product quality, machine failure or a security incident.

The reducer box is the carrier that assemble shafts, bushings, gears, end caps, fasteners and other relevant parts into one, make them maintain the proper positional relationship and coordinated drive motion and force in accordance with a certain relationship. So, the quality of the reducer box has a direct impact on the accuracy, performance and life of the equipment.

The reducer box bearing bore wear characteristics

The tolerance of the reducer box bearing bore of mining machinery is generally "H7",cooperated with ball bearing fit for clearance positioning, whose parts are free installation, and stay relatively stationary when it is working. The work environment in coal mine is very harsh; it is damp, dark and full of dust, water vapor and harmful gases. Most mechanical devices are working at high speed, heavy duty, vibration, shock, friction and corrosion media working conditions, shorter downtime, making the mechanical parts are not good lubrication and maintenance, causing wear and failure of the mine machine is very serious. Machinery Manufacturing Company of Panzhihua Coal Group in the long-term practice of equipment overhaul found that the main failure parts of the reducer box is bearing bore, due to the complex nature of different working conditions and the environment, and its main form of damage is seen in the bearing parts wear, severe obvious groove depths of up to 1 ~ 2mm, causing reducer does not work. So, wear is the main form of failure of the reducer box .

The reducer box bearing bore wear mechanism

There is always a degree of macro-and micro-wave surface roughness in the processed actual

surface of the reducer box bearing bore. Therefore, during assembly, even if the surface roughness of the whole portion of the convex peaks is squeezed flat, but the actual surface in contact with the bearing holes is only in some of the bumps, and these contacts are not continuous.

The micro vibration wear. Reducer in work will be affected by vibrations generated from the vibration source and internal reducer external vibration source, the main external vibration source is vibration and shock caused by other equipment, such as motors, conveyor drive roller, etc; the main external vibration source is vibration caused by centrifugal and axial concentricity error between holes. At this point the two surfaces will be relatively low amplitude oscillatory motion under the effect of contact pressure, due to the great difference of the hardness and surface roughness of the bearing and bore, so that the engagement surface of the asperity of the hole is plastically deformed, causing the contact hump formed as a local dry friction. Under the repeated outside small amplitude vibration action, there is a strong extrusion, extrusion cracked, broken and so on between the part of contact metal, forming a "debris". Since the two friction surfaces are closely cooperating, these "debris" are difficult to discharge but remaining in the joints become abrasive, accelerating wear process rate. As a result, lead to destruction of joints, increased wear, so that the cooperation nature changed.

Abrasive wear. Micro-vibration wear make cooperation nature changed. If speed reducer continues to work without an instant repair, bearing outer ring will rotate slowly driven by rolling element bearings, what is commonly known as "playing circle" phenomenon. At this time junction will occur the two forms of wear and tear. First is micro-cutting. As the shape of "debris" is irregular, and its uniform distribution in the surface of the bearing hole, thus the bearing outer ring is plastic extrusion formed scratches in the course of rotation, and led a small part in an advantageous position debris trace move, forming a thin and shallow surface holes plow marks. Second is free abrasive wear. There is lubricants out in reduction gear box bearing hole when it is working, debris caught in the lubricating fluid scour the hole surface in a state of fluid, increasing the wear of the bore surface.

Fatigue wear. When the bearing hole continues to expand due to abrasive wear, the relative position of the bearing outer ring and the bearing hole is not constant, Scroll combines sliding contact occurs between them, there is a repeated contact stress in the contact points. If the stress exceeds corresponding contact fatigue strength of the material, so the bearing bore surface crack initiation and gradually extended to the interior materials, causing fatigue and wear. At this time the amount of wear of the bearing hole will be very large, if not repaired in time, it will seriously affect the operation of the equipment, and even a security incident.

Wear Control and Prevention

The main cause of the damage of the reducer box bearing bore is micro-vibration wear, Many factors affected it can be summarized as the following two aspects: First, the external conditions such as load, frequency, amplitude, temperature, contact pressure, number of cycles; Second, the material properties such as surface hardness. The most important factor is the friction coefficient of the contact surface, the contact pressure and sliding amplitude. It is unrealistic to completely eliminate fretting wear, but it is entirely possible to control to some extent appropriate measures.

Optimized design. One effective way to reduce and control micro-vibration injury is to optimize the design. The main measures are as follows: first, to reduce the surface roughness of reducer bearing hole and the concentricity error of two axial holes; The second is to reduce the tolerances between the bearing and hole; the third is to improve the precision of rotating parts such as gears,

shafts and other to reduce the eccentric mass as much as possible.

Optimization of process measures. First is bonding method. Since the bearing bore at work is generally relatively stationary and rarely demolished, in assembly adhesives can be considered to be bonded together so as to reduce the contact surface of each micro-vibration. Second is surface strengthening method. Surface hardening has a wide range of processes, it is simple, economical and easy, and does not need to change the design and materials. Currently the main methods of the reducer box bearing bore surface hardening are as follows: the first is rolling reinforcement that in the last step roll bearing holes to improve the surface hardness to reduce the micro-vibration wear; the second is to strengthen the EDM process. Using EDM micro-hardened the surface of the bearing hole to form a high hardness, high wear resistance of reinforced layers the work piece surface layer in order to improve its resistance to wear micro-vibration.

Optimization of material properties. Currently, the reducer box materials are mainly gray cast iron and steel, cast has a strong anti-adhesion capacity than iron, improving the surface hardness can increase the anti-blocking ability and the shear capacity. Data shows that the surface hardness of the general carbon steel increased from Hv180 to Hv700, micro-vibration and wear can be reduced by 50%. Therefore, improving the surface hardness of the bearing bore when choose cast iron or cast steel can significantly reduce micro-vibration wear and improve fretting wear performance.

Common repair methods

In practice, the reducer box should follow reasonable repair process, good economy, higher efficiency, production feasible. The common repair methods of Machinery Manufacturing Company of Panzhihua Coal Group are mechanical processing and thermal spraying.

Machining repair method. First is direct processing repair. For a split box bearing bore, if wear is very slight but affect the use, you can process combined surface bore to restore the use of the function. Second is casement repair. If the wear of casing bearing bore over the limit or badly worn, as long as the structure and strength permitted, we can extend the wear boring hole, then take casement repair method. To avoid possible bursting or modified of the pieces to be repaired, right amount of interference should be chosen. To prevent loosening casement or move during use, especially when split cabinet casement, often fixed with an adhesive or set screw stopper.

Thermal spray repair method. Thermal spraying, spraying material melted by oxyacetylene flame heating, high speed mist sprayed from the nozzle surface form a coating. It's feature are small piece heat, stress and deformation is not obvious, the process is simple and flexible, high production efficiency, and it is especially suitable for the repair of split bearing housing bore. When the dimensional accuracy and surface roughness of the coating is less than the requirement, the method can be boring its finishing.

Summary

With the degree of mechanization of mine increasingly high, in practice, we should strengthen the electromechanical staff's professional and technical training to improve their professional skills. Only let them know the working principle of mechanical and electrical equipment, characteristics, follow the laws governing the operation of electromechanical equipment, raise awareness, and effectively prepare routine maintenance and repair work sick to avoid equipment operation, production safety is guaranteed.

References

- [1] L.C. Ge, Mining Machinery and Equipment Parts Repair Technology, Coal Technology, (2013) No.4, p.7.
- [2] L.J. Chen, Failure Analysis of Abrasion of Coal Mine Machinery and Measures for Anti-abrasion, Coal Technology, (2011) No.6, p. 20.
- [3] W.Z. Wang, Q.C. Liu and W.D. Wang, Mechanical Damage and Preventive Measures of Fretting Wear, Heilongjiang Yejin, (2011) No.3, p.52.
- [4] CH. Li, Fretting Corrosion on Agricultural Equipment Damage and Prevent Measures, Journal of Agricultural Mechanization Research, (2005) No.4, p.49.
- [5] J.P. Guo, X. Liu: Manufacture Information Engineering of China, (2013) No.5, p.83.
- [6] J.B. Shi, Usage, Maintenance and Administration of Mechanical Facilities in Collieries, Coal Technology, (2011) No.7, p.280.