Analysis and Control of Solid Particle Pollution in Hydraulic System of Construction Machinery

The working reliability and service life of construction machinery are closely related to the pollution of hydraulic system. According to statistics at home and abroad, about 70% of the faults of the hydraulic system of construction machinery are caused by the pollution of the hydraulic system, and the hydraulic system faults caused by solid particle pollutants account for 60%~~70% of the total pollution faults.

The pollution of the hydraulic system directly affects the work of the entire hydraulic system. The problem that the hydraulic system is currently facing is how to effectively reduce and control the pollution of the system to ensure the reliability and service life of various hydraulic components and the entire system. Therefore, reasonable analysis and effective control of the pollution of the hydraulic system is the key to ensure the normal operation of the hydraulic system of construction machinery and prolong its service life.

1. The source of pollutants in the hydraulic system

The pollution sources of the hydraulic system mainly include potential pollutants,

regeneration pollutants and immersion pollutants. To sum up, the types of pollutants in the hydraulic system can be roughly divided into solid particles, air, water, chemicals and microorganisms, among which solid particle pollution causes the greatest harm.

2. The hazards and causes of solid particles

Among all kinds of pollutants, solid particles are the most common and most harmful pollutants in hydraulic systems. Among the failures caused by hydraulic system pollution, 20% are due to corrosion, and 50% of mechanical wear is due to the damage of the component surface caused by the presence of solid particles. 2.1. Composition and distribution of solid particles

Solid particles are mainly composed of exfoliation, colloid, metal powder, dust brought in the air, sand, grinding powder, sediment and fiber. Its distribution in the hydraulic system is shown in the table.

2.2 Main sources of solid particles

Solid pollutants mainly come from the following aspects:

(1) The flaky rust attached to the inner wall of the hard pipe of the system, and the chemicals remaining in the pipe after pickling;

(2) Iron filings left in the processing of hard pipes such as cutting and threading;

(3) Seals, sealing ring residues. Due to the constraints of the sharp edge and pre-tightening of the joint part, the seal may be partially damaged, and the damaged part will directly enter the system;

(4) Dust inside the high-pressure hose assembly and gluey fragments left on some joints;

(5) Stones, dust, etc. enter the pipeline due to environmental factors at the hydraulic system assembly site, which is rare;

(6) Molding sand residues, processed iron filings, sealing residues, etc. left inside the hydraulic components. Since the hydraulic components have undergone necessary cleaning and inspection before leaving the factory, this situation is rare. (Tianyang Steel Pipe)

2.3 Harm of solid particle pollution

2.3.1 Adhesion and blockage of filter holes and various gaps and passages will make it difficult for the hydraulic pump to operate, resulting in cavitation and noise.

2.3.2 Destroy the lubricating oil film and increase the friction and wear of the machine. Solid particles will destroy the lubricating oil film whose thickness is less than 0.6 times the size of the solid particles and fail, so that the friction and wear of the machine will increase significantly. There are five types of wear:

abrasive wear, erosive wear, adhesive wear, fatigue wear, and corrosive wear. Chief among these is abrasive wear. Each of the above types of wear creates new wear, which further aggravates the wear of the components. Wear and tear can lead to leakage of hydraulic components, reduced efficiency, shortened service life and even damage.

2.3.3 Accelerate the wear of sealing materials and increase the amount of external leakage. Solid particles will accelerate the damage of the sealing device of the hydraulic cylinder, strain and wear the moving surface of the hydraulic cylinder, resulting in increased internal and external leakage of the hydraulic cylinder, insufficient thrust or unstable movement, crawling, speed drop, and abnormal noise and vibration.

2.3.4 Some or all of the pores of the hydraulic components are blocked, causing the control components to fail

2.3.5 The metal and metal compound particles in the solid particles will catalyze the oxidation and deterioration of the oil, and the oxidation of the oil will deteriorate the quality of the oil and reduce the lubricating performance.

When the gaps of the components are blocked by solid particles, a wear chain reaction will occur. The wear chain reaction occurs because the wear pollutants in the system cannot be effectively controlled, which makes the system components wear further and generate more solid particles. . Thus further affecting the performance of the entire hydraulic system. Therefore, taking effective measures to remove oil pollutants, especially solid pollutants, is a prerequisite for ensuring the normal operation of the construction machinery hydraulic system.

3. Air defense measures

The pollution control of the hydraulic system runs through the entire process of hydraulic system design, manufacture, assembly, use and maintenance. It is impossible to completely remove the pollutants to solve the pollution of the hydraulic system, but to keep the pollution degree of the system at the system level through pollution control measures. The pollution of key hydraulic components is within the tolerance range, so as to achieve a reasonable balance. There are two main measures to control the pollution of the hydraulic system: one is to prevent pollutants from invading the system; the other is to filter and purify the system oil.

3.1 Pollution control in the design stage

In the design stage, devices and structures that are prone to particle impurities and pollute the system oil should be carefully selected. For example, from the perspective of controlling solid particle pollution, it is better to choose the flange connection structure instead of using pipe joints, because the pipe joints produce a lot of wear debris during assembly and maintenance; the breathing port of the fuel tank is designed to be located higher and covered as much as possible to prevent the intrusion of rain and dust. ; The hose can be lined oil pipe and so on.

The most important thing in the design stage is the design and selection of the oil filter. When designing, it may be considered to add an oil suction filter at the oil inlet of hydraulic components that are sensitive to hydraulic oil pollution, and to install an oil filter at the oil return of hydraulic components that are prone to wear debris, and to install an oil filter at the oil inlet of key hydraulic components. Auxiliary oil filter, in a system with a large amount of pollutant intrusion, install a bypass filter as a supplement to the in-line oil filter, improve cleanliness, extend the service life of the oil filter, etc.

3.2 Pollution Control in the Manufacturing Stage

Outsourced parts such as various valves, high-pressure hoses, cylinders, etc. and hydraulic oil must be strictly inspected in the factory. Critical parts need to be loaded, run-in and cleaned. Except for the purchased hydraulic components and some hoses, the hydraulic pipelines prepared on site must be pickled and derusted. The pipeline is carried out according to the following process: degreasing, pickling, neutralization, passivation, drying, oiling and sealing. Before pickling, the degreased pipes should be washed with purified pressure water to remove the alkaline solution and oil stains on the inner and outer walls of the pipe. All sealing surfaces, threads, etc. must be oiled and covered before cleaning.

After pickling, the pipeline must be pressurized and flushed, which is a very important link in the hydraulic system assembly process. After the pipeline is pressurized and flushed, the impurities in the pipeline can be washed away. When flushing, focus on beating the welding joints, flanges, variable diameters, tees and elbows evenly at regular intervals, so that the impurities in these parts can be shaken off and washed away with the oil.

It should be noted that the pickling and pressure flushing of the pipeline should be carried out on the eve of assembly, because these treatments are carried out too early and left unused for a long time, there is still the possibility of rusting

when the pipeline is assembled.

Before assembly, all hydraulic components and auxiliary parts that need to be cleaned must be cleaned and the oil ports should be sealed with seals. During assembly, environmental pollution must be prevented first. If possible, the indoor pressure can be higher than the outdoor to prevent atmospheric dust pollution. Secondly, dry assembly is adopted, that is, each component is cleaned and dried with dry compressed air before assembly. Finally, the assembler should keep the assembly tools, filter screen and refueling container clean, and assemble them in strict accordance with the relevant operating procedures to minimize the pollution caused by human factors.

Discussion on the Causes of Oil Leakage in Hydraulic System Pipeline and Countermeasures

There are many types of pipelines used in the hydraulic system. According to the working pressure and installation position of the hydraulic system, steel pipes, copper pipes, rubber pipes, nylon pipes and plastic pipes are selected. Once these pipelines are damaged and leak oil, it will pollute the environment, affect the normal function of the system, and endanger safety in severe cases. This paper analyzes and summarizes the causes of oil leakage in hydraulic pipelines

and the corresponding countermeasures.

1 Analysis of the causes of oil leakage

1.1 Poor pipeline quality

When repairing or replacing hydraulic pipelines, if poor-quality pipelines are installed in the hydraulic system, due to their low pressure bearing capacity and short service life, oil leakage will occur after a short period of use. The poor quality of the hard tubing is mainly manifested in the uneven thickness of the pipe wall, which reduces the bearing capacity; the inferior hose is mainly due to poor rubber quality, insufficient tension of the steel wire layer, and uneven weaving, resulting in insufficient bearing capacity. Under the impact of pressure oil, It is easy to cause pipeline damage and oil leakage.

1.2 Pipeline installation does not meet the requirements

1.2.1 Poor pipe bending

In the process of assembling the hard pipe, the pipe should be bent according to the specified bending radius, otherwise the pipe will have different bending internal stress, and leakage will gradually occur under the action of oil pressure. If the bending radius of the hard pipe is too small, the outer wall of the pipe will become thinner, and the inner pipe wall will have wrinkles, so that there will be a

large internal stress in the bend of the pipe, and the strength will be greatly weakened. If there is a large ellipticity in the bending part of the hard pipe, it is easy to produce longitudinal cracks and oil leakage when the oil pressure in the pipe fluctuates.

When the hose is installed, if the bending radius does not meet the requirements or the hose is twisted, etc., it will cause damage to the hose and oil leakage.

1.2.2 The installation and fixation of the pipeline does not meet the requirements

Common improper installation and fixation are:

(1) When installing the oil pipe, it is forced to assemble regardless of the length, angle, and thread of the pipe, which will deform the pipe and generate installation stress. At the same time, it is easy to damage the pipe, resulting in a decrease in its strength;

(2) When installing the oil pipe, do not pay attention to fixing it. When the bolt is tightened, the pipe will rotate together, causing the pipe to twist or collide with other parts and cause friction, shortening the service life of the pipe;

(3) Sometimes the clamps of the pipeline are fixed too loosely, which increases the friction and vibration between the pipeline and the clamps; sometimes it is too tight, causing the surface of the pipeline (especially the aluminum tube) to

be pinched and deformed; oil spill;

(4) The tightening torque of the pipeline joints seriously exceeds the regulations, causing the bell mouth of the joints to break, the threads to be strained, and tripped, resulting in serious oil leakage accidents.

1.3 Fatigue damage or aging of hydraulic pipelines

The observation and analysis of a large number of fractures of hard hydraulic pipelines shows that the rupture of hard hydraulic pipelines is a kind of fatigue damage, so there must be alternating loads on the pipelines. When the hydraulic system is working, the hydraulic pipeline has to bear high pressure, coupled with the combined effect of alternating stress caused by pressure instability, vibration stress caused by equipment vibration, assembly stress, etc. , Corrosion points or damages produce stress concentration phenomena, and the pipelines are fatigued, damaged and fractured, resulting in oil leakage. For rubber pipelines, aging, hardening and cracking will occur in places with high temperature, high pressure, bending and twisting, and finally the oil pipeline will burst and leak oil.

1.4 Hydraulic oil pollution and pipeline surface pollution

When the hydraulic oil is contaminated, the oil pipe will be worn and corroded, which will accelerate the rupture of the pipeline and cause oil leakage, and this

damage is not easy to be found, and the harm is more serious.

Since the hydraulic system is easily polluted, the hydraulic oil containing solid pollutants is similar to the abrasive used to grind the metal processing surface, which increases the friction between the oil and the inner wall of the pipeline. Moreover, the hardness of solid pollutant particles is much higher than that of the inner wall material of the conduit, which accelerates the wear of the inner wall of the conduit, and even scratches the inner wall. Especially when the flow rate of the liquid is high and unstable (fast flow rate and large pressure pulsation), the material on the inner wall of the catheter will be impacted and peeled off.

When the hydraulic oil contains water, it will cause the hydraulic oil to form an emulsion, which reduces the lubrication and anti-corrosion effect of the hydraulic oil, and accelerates the wear and corrosion of the inner wall of the pipeline. When the hydraulic oil contains a large number of air bubbles, the air bubbles are compressed in the high-pressure pipeline, and the surrounding oil flows to the space originally occupied by the air bubbles at high speed, causing a strong hydraulic impact. Under the impact of the high-pressure liquid mixture, the inner wall of the pipeline is damaged. Corroded and peeled off. All of the above situations will eventually cause the pipeline to rupture and leak oil.

(Tianyang Steel Pipe)

In addition, the outer surface of the pipeline is often stained with water, sludge and dust. If the protective layer is damaged, it is easy to cause corrosion, resulting in a decrease in strength, until blasting oil occurs from high temperature, high pressure, bending, and severe distortion.

2 Countermeasures

Although the hydraulic pipeline is under high pressure and the working environment is harsh, oil leakage failures can be prevented and avoided. The following preventive measures should be taken during use and maintenance.

2.1 Carefully check the quality of pipelines, and strictly prohibit the use of unqualified pipelines

During maintenance, for newly replaced pipelines, the manufacturer, date, batch number, specified service life and whether there are defects should be carefully checked, and pipelines that do not meet the regulations must not be used. When using, always check whether the pipeline is worn or corroded; if the rubber hose is found to be seriously cracked, hardened or bubbling during use, it should be replaced immediately.

2.2 Correctly install the pipeline, strictly prohibit illegal assembly

2.2.1 Correct assembly of hose lines

When installing the hose and tightening the thread, be careful not to twist the hose, you can draw a colored line on the hose to observe; when installing the hose in a straight line, there should be about 30% of the length margin to meet the needs of oil temperature, tension and vibration ; At the bend of the hose, the bending radius should be greater than 9 times the outer diameter of the hose, and the distance from the bend to the pipe joint should be at least equal to 6 times the outer diameter of the hose; it is best not to use the rubber hose in an environment with high temperature and corrosive gas; There are many hoses in the system, which should be fixed by installing pipe clamps or separated by rubber plates.

2.2.2 Correct installation of hard tube pipelines (www.steeltube-cn)

The hard pipe pipeline should be installed horizontally and vertically to minimize turns and avoid crossing; the radius of the turn should be 3 to 5 times greater than the outer diameter of the oil pipe; long pipes should be fixed firmly with standard pipe clamps to prevent vibration and collision; The distance between the clamps should meet the regulations. For pipelines with large vibrations, damping pads should be installed at the clamps; Twist, must not be forced to install.

2.3 Proper use and maintenance, no pollution of the hydraulic system

In daily maintenance work, it is not allowed to step on, pull and compress the pipeline at will, and it is not allowed to hit the pipeline with metal tools to prevent mechanical damage; hydraulic machinery or hydraulic equipment parked in the open air should be covered with cloth to prevent damage. Dust, rain and snow prevention work, water removal, drying and rust removal should be carried out in time after the rain and snow; the oil and dust on the surface of the pipeline should be wiped off frequently to prevent corrosion of the pipeline; when adding oil and disassembling components, strict control Pollution gates prevent debris and moisture from being brought into the system. Also, be sure to avoid spilling hazardous solvents and liquids on the catheter.

2.4 Others

For pipelines with large changes in oil temperature and ambient temperature on the equipment, thermal expansion compensation should be considered during installation to reduce the impact of thermal stress; in order to ensure safe operation of pipelines and prolong service life, for pipelines in high temperature areas The rubber tube should be well insulated and cooled, such as wrapping the heat insulation layer and introducing cooling air, etc. are all effective measures; on the premise of meeting the system performance requirements, it

should be considered to install a suitable accumulator in the place where hydraulic shock is easy to occur. Or shock absorber, and try to use hydraulic components with buffer devices to weaken hydraulic pulsation and prevent hydraulic shock.

Process introduction: The finished tube of DIN high-precision fine-drawn bright precision seamless steel pipe is used as the steel pipe for internal and external galvanizing, and the inner and outer walls of the steel pipe are subjected to cold galvanizing treatment, or military green passivation treatment after galvanizing, Both ends are sealed for dust-proof treatment.

Main features: The inner and outer walls of the steel pipe are galvanized or passivated, with outstanding anti-rust and anti-corrosion performance. It can be plated with white zinc, colored zinc (yellow zinc), and army green passivation.

Note: The length of the steel pipe shall not exceed 3m. Main features of military green passivation tube: outstanding anti-corrosion performance, neutral salt spray test according to GB/T10125, the test time is up to 240 hours, no red corrosion.

Main application: military industry, automobile industry, railway locomotive industry. Users who have high requirements for anti-rust and anti-corrosion on the inner and outer walls of steel pipes.