

REPAIRING AMPLITUDE CYLINDER OF THE PILE FRAME IN AN ENGINEERING SHIP

—A COMPOSITIVE REPAIRING TECHUIQUE BEING USED

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Abstract: the author brings forward a new repairing technique about using electrical resistance cold-cut and special electric brush plating. It is useful when a big ship mechanical is repaired.

Key Word: amplitude cylinder, repairing, technique

1. Foreword

"Hang gong zhuang 5" is a pile driving barge being introduced from Japan in 1974. Its pile frame amplitude is fulfilled through a big amplitude cylinder drive ($\Phi 920 \times \Phi 370 \times \Phi 8250$ mm). Because the amplitude cylinder was used continually, load was big, corrosion was serious and working condition is dicky. Some problems were found including grease seal in an end cover conditioning, chromium plating layer of piston rod exfoliation and partial pitting corrosion and pull had been found in an internal surface of cylinder sleeve.

Because "Hang gong zhuang 5" was useful, it was rebuilt. Its pile ability was advanced from depth of water 40m+ to 56m+. Its lifting capacity was advanced from 40t to 60t. A primary pile frame was increased 17m and a 10m subsidiary pile frame was supplied. The weight of pile frame was added 50t. The pile frame center of gravity was changed from 23m to 26m. So higher request was brought forward.

The problems of amplitude cylinder must be settled. Repairing amplitude cylinder is a key.

2. Taking down amplitude cylinder and preparing for succedent production process

2.1 separating cylinder and ship body

The maximum diameter of amplitude cylinder is 1.27m. Its total length is 11.66m. The net weight is 28t. The weight of piston, piston rod and head of piston rod is 12t. The weight of cylinder upper end plate is 1t. The weight of cylinder bottom end plate is 3t. The weight of cylinder sleeve is 12t. Over 35t crane ship or 50t hoisting machine will be used. Before the cylinder was taken down, the piston rod must be returned to limit place. Joint hoses were taken down and joints were closed down. Using a crane, amplitude

cylinder was raised and nether axes was taken down. Amplitude cylinder was carried to a support in a repairing yard and aligned.

2.2 cylinder disintegration

The axis of piston rod must be homocentric. Outgassing bolts were taken down and steel balls were brought out. Couplers were connected with air bleed holes. Pipes were connected and compressed-air was pushed into a cylinder block. The whole piston rod was pushed (travel is 8.25m). The piston rod runned to limit position and hydraulic oils were given out.

Because this repair process adopts the multiple technique including cold remelting and directional metal ions deposition, piston and joint don't need to be disassembled with the rod while the workload and the difficulty of disassembly are reduced.

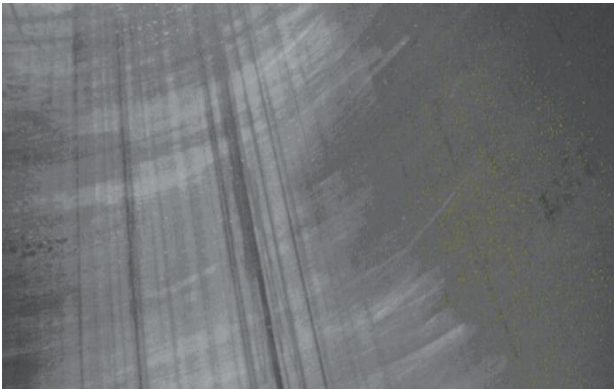
3. Test of the fuel tank

The test method of the fuel tank: firstly, clean the piston rod and the cylinder casing by silk as tool with cleaning agent (light diesel oil). Then examine and measure the abrasion of the combined parts and the straightness, conicity and ellipticity of the cylinder casing and the piston and so on. Lastly, check whether the upper end cover is grinded partially.

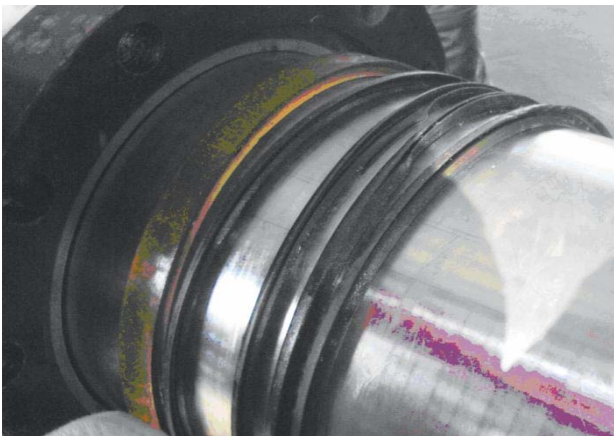
The result of test indicates that: the wear loss of the piston rod has increased, and the length of the original chrome surface layer extended from 3m to 4.6 m and depth of 1mm by the corrosion (Figure 1); the wear loss of the inside of the cylinder casing turns to worn surface with width of 300-500 mm, length of 5.1 m and depth of 1mm from the original three broached groove (Figure 2); the upper end cover worn badly, and v-type seal ring was in disguised form also (Figure 3).



(Figure 1)The wear loss of the piston rod



(Figure 2)The wear loss of the inside of the cylinder casing



(Figure 3)The wear loss of the upper end cover

4.The repair process of amplitude fuel tank

4.1. Adopt the multiple technique including cold remelting and directional metal ions deposition to repair the piston rod.

The entire process of repair is: repairing the surface----- cleaning-polishing the surface----- cold remelting of the eroded and worn surface (the technique of sloppy heat with resistance at normal temperature) ----- directional metal ions deposition of the eroded and worn surface(the technique of special brush plating)-----reinstatement the worn surface to the dimension-----the treatment of mechanical polishing . After the process ,the repair requirements should achieve the demand for the corrosion resistance, wear

resistance, hardness more than HRC55, finish around IT10 grade (GB)..

The repair of piston rod in the workshop, using sleeper by laying down according to the space of 3meter, and putting 2 root of channel steel with the length of 8 meter on the sleeper(channel steels are convenient for car to slide). Put 2 walking cars on the channel steel (Figure 4), then suspend the piston rod which is about to be repaired to the walking cars (the space of the car is not less than 5 meter). Since the piston is non-disintegration, pay attention to protecting oil seal on the piston. Determined the position to be repaired, by the actual measurement, the length of abscission layer is 4.6 meter which is from the projected head of piston rod. It's has been more than three years since the last completely knocked down repairing, and the corrosive situation is serious enough.If the hydrocylinder can not to be repaired soon, it would not work properly. Using the outside micrometer to measure the size of the datum plane after you have clear the hydraulic oil and the oil stain outside by the cleaning agent(Measuring the surface that doesn't weared which is leaned on the bottom of the piston).To repair it by using the size of this surface as the datum plane.



(Figure 4)Put 2 walking cars on the channel steel

Steps of the Repair Technology:

(1). Surface Polishment

Using the polisher to polish the Chromeplated surface that had corroded.As for the wear surface, using the rasping machine to polish the critical place roughly, and then using the rasping machine to polish it. Adjusting the sand strip to the sutiation of the abrading,from rough grinding to fine grinding.For the

place where has a deep etching,we should cold cut the repairing machine at ordinary temperature after clean it with grinding machine,and then weld the corroded chasm to make it in order. At last,we should use the specialized grinding tools to rub the place has been welded up to neatly.

(2).Surface Brush Plating .

Using the Contravariant pulse electrobrush plating for brush plating, the sequence follows: electrocleaning—use the first activator for activation—use the second activator for activation—use the third activator for activation—use the forth activator for activation—use the fifth activator for activation—use the super-standard activator for activation—Chromium-activation—special nickel—nickel-chromium alloy.It’s better to choose the activation of copper for the surface that has more corrosion and to repair the pocking mark. Activation Solution(Figure 5).



(Figure 5)Activation Solution

(3). Quality Control

In the process of brush plating,the quality is determined by the control of temperature ,current and the touch of the operator.(Figure 6). Especially for the transition of the repair which is the nodus of the repairing. That is whether the two materials can be hook up properly or the control of transition’s size effectively. In order to solve this problem the repair spent more than 10 days time,for the first thing is to ensure that the size is to meet the requirements and the second is to

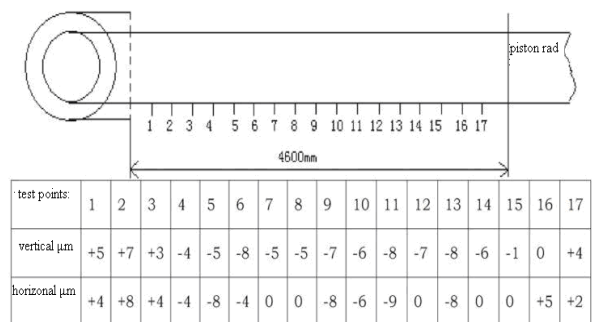


(Figure 6)In the process of brush plating,the quality is determined by the control of temperature ,current and the touch of the operator.

ensure that there is no traces of repair. For another difficulty is that whether the repair materials can combine with the body suitably,which means crack-free and non-points.In the process of repair, adopted a waffle slab technics to change internal stress to ensure the crack-free and no point after the repair.

(4). Detection

Detection it after repairing, no traces of repair, crack-free,be have no point,and no anesthesia,as well as no the phenomenon of delamination. The test results with the outside micrometer is as follows(Figure 7):



(Figure 7)The test result using the micrometer

Test results show that: The glossiness of surface meet the requirement after being restored (see picture 18). It meets the requirement that the deviation is controlled within $\pm 10 \mu m$, testing the hardness with the hardness tester, the hardness achieve above HRC55.

4.2 Restore the hydraulic cylinder liner with composite technics of cold remelting and macromolecule nano-materials.

Process: Repairing the surface of radical body → burnishing surface → clearing and laundering → cold remelting the pulled and worn surface → restoring the macromolecule nano-materials of the pulled and worn surface → polishing disposal with mechanical rubbing → the pulled surface resume to

the size.

Restoring requirements: achieving corrosion resistance, wear resistance, hardness above HRC55, glabrous degree IT11 grade - IT12 grade about (as international).

There are three worn groove in the hydraulic cylinder liner (near the bottom position in the oil tank knot), the specific dimensions are as follows: The first one is length 3.2 m × width 0.5 m × depth 1 mm; The second one is length 5.1 m × width 0.3 m × depth 1 mm; The third one is length 5.1 m × width 0.38 m × depth 1 mm. Repair of the technics operational flow is the same as repairing the piston rod. Because the worn deepest recesses achieve 0.2 mm, in the repair, we adopt the macromolecule nano-materials to deal with it. If there is dozens of injury, we adopt the composite technology of cold remelting and metal ions' directional deposition (brush).

By being tested, the piston-liner achieved the restored request after being repaired (Figure 8)



(Figure 8)The effect picture of restored hydraulic cylinder piston rod



(Figure 9)The effect picture of restored r piston-liner

4.3 The restoring effect

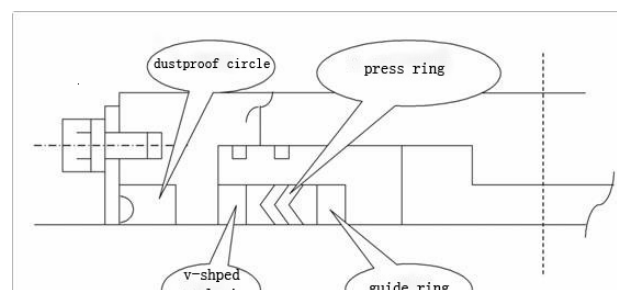
The restored site 's combination is solid, dense, without the possibility of falling. The reason is that: at the welding point, the equipment melt the repair materials and radical materials at the same time, after the two melted liquid metals fuse, re-solidified. It says that the repairing process of defects is the second

metallurgical remelting of the repair materials and radical materials, welding at room temperature, the matrix is not heat, the microstructure doesn't change near the welding, and dosen't have phenomena such as stress concentration. That is, the heat energy that each unit of welding process need is an intelligent output of the equipment, and more than 95 percent is used to melting work, the remaining drops away instantly. So in the whole process of welding, the matrix and the position near the welding is always at room temperature; there are no phenomena of heat distortion, crack, induration, and hard point. Don't affect mechanical processing performance, and don't have traces after being restored. Therefore, this technology is a new technology and technics that win time, save money and create profit value for the enterprises.

5. Guiding ring and oil seal replacement

After removing the dustproof circle of the upper end cover, we found the guiding ring in the oil seal of end-cover combination had been seriously contorted, and the material is copper ring, the seal ring of V type combination had changed. For the replacement of this guiding ring, we substituted SL-012 enhanced modified nylon 610 material for processing guiding ring of copper, SL-012 takes nylon 610 as its basic material and is modified by the modifier, the nylon modified materials with glass fiber enhanced, have the advantages such as high intensity, the bottom temperature (-40°) isn't sensitive to notched impact, good stability of size, oil resistance, solvent resistance, good wear resistance, self-lubricating, and so on. The materials are cheap and easy processing.

The repair need to resolve the problem of leaking oil tank, because the hinge head of oil tank doesn't taken down, the oil seal at the position of replacing oil tank' upper end cover need deal with incision. The airproof structure of upper end cover is shown in Figure 10;



(Figure 10)The airproof structure of upper end cover

Installing seals at the end-cap is as follows: First, process a guide ring with SL-012 enhanced modified nylon 610 material, and cut two bevel installation. Second, install seals of V-shaped, and cut a incision on each of the four V-shaped rings, the direction of incision displaces 180° and it's installed successfully. Third, install the press ring, the incision of which staggers with V-shaped ring. Fourth, install the gland. Fifth, install the dust ring (bond with viscose after cutting). Sixth, install the platen of dust ring.

While installing seals at the end-cap, pay attention that the height of combining seal is 53mm, which can be adjusted and controlled by the height of processing guide ring.

6. Oil tanks' repair and system debugging

After repairing the oil tanks, oil tanks amplitude system technical parameters have been optimized, and debug shows that: the greatest pressure on the fuel tank is 14 MPa. Amplitude time: front 30 ° ~ behind 30 ° ,18-20minutes. Because the oil seal on the piston head doesn't wear, so this time does not change. The installing order of the oil tank is opposite to the disassembly.

6.1.no-load test

Check the oil liquid surface in the fuel tank, the oil liquid must be filtered before being inserted into the fuel tank. Start the pump to insert oil into the fuel tank in rod side, and open the vent plug to exhaust emission. To supply oil in bore side, and open the vent plug in rod side to exhaust gas at the same time. Keep doing this until the piston rod walks all the stroke, and close the vent plug. In reciprocating operation of piston rod, inspect the oil tank, system pipe fitting and valve part, and they don't have external leakage phenomena.

6.2 load test

Connect the head hinge of piston rod with the pile frame, so that oil tank do amplitude test by pile frame. Exhaust the air from the oil tank. Don't find leakage phenomenon after inspection. The work pressure and amplitude time, range that load test records is: 0 ° - front 30 ° , front 30 ° -0 ° , 0 ° - behind 30 ° , behind 30 ° -0 ° . Flexion 15 ° , standing two hours, don't observe the phenomenon of self-Mobile.

7.summing up

The Hang Gong Zhuang Five continues to play a role of high-quality construction, has been praised by the owners and the relevant units. After six months construction on the sea, the surface of piston rod has no corrosion phenomenon, and the performance of oil tank meets the work requirements, this shows that: the repair of oil tank is a way to reuse the machine parts, using large oil tank repair technology at the scene creates a new repair construction technique in the country, in the new period that advocates promoting utilization efficiency of resource, in order to make comprehensive utilization of resources, the apply of this technology is helpful to promoting the development of conservation-oriented economic society.