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Discussion on the Refrigerator compressor connecting rod surface of powder metallurgy process

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Abstract: Powder metallurgy connecting rod is the main moving part of refrigerator compressor. During the surface treatment, it is easy to form crystal like viscous yellow foreign matters on its surface, which causes the connecting rod and the matched parts to be stuck, and the compressor does not start. In this paper, firstly, the influence of steam treatment on the processing of connecting rod and the production of yellow foreign matters is compared and analyzed, then the processing and surface treatment process before the use of connecting rod are discussed and compared, and the process of eliminating the production of yellow foreign matters from the source is studied. Finally, the feasibility of adopting the new process is confirmed through the comparative test and test method analysis.

Keywords: yellow foreign matter; powder metallurgy connecting rod; processing technology; oily processing

INTRODUCTION

Because the P / M parts adopt the die casting process, the internal of the parts is loose and porous, especially the P / M connecting rod of the refrigerator compressor. During the processing and grinding of the internal hole, the processing fluid, grinding fluid and other foreign matters will penetrate into the internal of the parts. When the pump body is in the high temperature state during the normal operation of the compressor, the processing fluid that infiltrates into the internal will seep out from the internal of the parts, which will directly cause the moving parts to be stuck, resulting in the integrity The machine doesn't start up. At present, the main processes used in the industry are connecting rod rough soaking, water-based processing fluid and quilting fluid, baking before leaving the factory, water-based antirust agent rust prevention (connecting rod processing process), baking, cleaning surface phosphating, brushing (end-user processing) to meet the requirements of parts processing and installation. However, the above situations have not yet taken root in the refrigerator compressor industry This solution.

In order to ensure the antirust ability of parts from the source and reduce the infiltration of foreign matters such as processing fluid and grinding fluid. In this paper, the influence of steam treatment on the surface quality of connecting rod is studied; the process of connecting rod blank not immersed in oil, oil processing and quilting grinding are adopted in the process of processing, which eliminates the influence of non oil processing fluid, blocks off the source of yellow foreign matters, and effectively improves the bad phenomenon that the connecting rod and crankshaft are stuck due to the Yellow foreign matters exuding from the P / M connecting rod, resulting in the whole machine not starting.

STEAM TREATMENT

Due to the inevitable existence of pores in iron-based powder metallurgy materials, new technologies and methods are emerging in the industry, such as powder injection molding, flow warm compaction, warm compaction, spray forming, etc., to ensure the high densification of the formed powder. Due to the properties of the material itself, the voids in different degree of P / M can not be completely eliminated. In water steam treatment, superheated water vapor is used to oxidize the surface of parts to form an oxide film with a thickness of about 5 μ m (on the surface of P / M connecting rod, it oxidizes to form a film with iron 3O4 as the main body, which has a hard luster and high compactness and is firmly bonded to the surface of connecting rod). The oxide film covers the surface and pores of connecting rod, and the surface structure and performance change. The oxide film of Fe3O4 is corrosion-resistant The oxidation resistance is improved to meet the rust prevention requirements of refrigerator compressor connecting rod.

Effect of steam treatment on material of connecting rod of refrigerator compressor

The PM connecting rod of refrigerator compressor is a thin-walled structure (the inner hole is matched with the moving parts, and the corresponding accuracy is required to be high). In the refrigerator compressor industry, in order to ensure the rust prevention of connecting rod parts (blanks) before processing, the rust prevention scheme of rough soaking or steam treatment is mainly adopted. Steam treatment can effectively achieve rough rust prevention without introducing other infiltrates. Take 8 connecting rods with and without steam treatment respectively, and the hardness of the test surface is shown in Table 1

Table 1 Comparison of hardness before and after steam treatment

	1#	2#	3#	4#	5#	6#	7#	8#
Hardness before steam treatment (HB)	115	108	101	106	110	107	103	105
Hardness after steam treatment (HB)	159	171	163	170	164	168	154	166

The influence of steam treatment on the processing of refrigerator compressor connecting rod

The inner hole of connecting rod is processed by boring first and then quilting. After steam treatment, the hardness is high, the tool is seriously worn, the machining quality of the inner hole is reduced, and the process cost is significantly increased. At the same time, the thickness of the oxide film formed by steam treatment is about 5 μ m, and the oxide film is cut off during machining, and the machining fluid still infiltrates into the connecting rod. Because the fit clearance between the connecting rod and the crankshaft of the compressor is about 10 μ m, foreign matters directly lead to the compressor connecting rod and the crankshaft As shown in Figure 1:

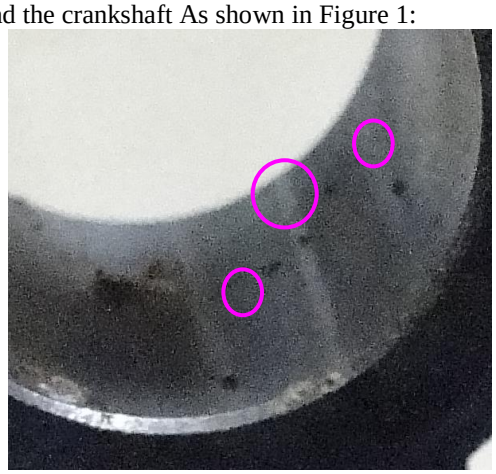

Figure.1 yellow foreign matters oozing from connecting rod surface

PROCESSING TECHNOLOGY ANALYSIS OF CONNECTING ROD OF REFRIGERATOR COMPRESSOR

The matching surface of the connecting rod of refrigerator compressor must have the requirements of high strength and wear resistance. Therefore, the manganese phosphating treatment before the connecting rod is used can form a black dense and wear-resistant phosphating layer composed of crystals of different sizes on the surface, which can significantly improve the corrosion resistance and wear resistance of the connecting rod surface.

Process plan I

Connecting rod processing technology (processing plant): connecting rod rough soaking (antirust effect), boring two holes (water-based processing fluid), quilting two holes (water-based processing fluid), cleaning and antirust (water-based antirust fluid), *baking.*

Finished connecting rod processing technology (compressor factory): phosphating baking two hole brushing (to ensure the inner hole finish) cleaning and sorting (aperture size), this scheme is widely used in the industry, and the cleaning workers in the processing process.The sequence can effectively oil the surface of the connecting rod, which is conducive to the subsequent phosphating stability. However, in the process of processing, the use of processing fluid and quilting grinding fluid will penetrate into the pores of the connecting rod, and the penetrated foreign matters cannot be completely removed by baking and cleaning means, so there is the possibility of re precipitation, and the control requirements of the production process are strict.

Process plan II

Connecting rod processing technology (processing plant): connecting rod rough (without treatment), boring two holes (oily processing fluid), quilting two holes (oily processing fluid), cleaning and antirust (antirust oil and antirust) Baking, the processing and antirust treatment of this scheme are all oil-based liquid, and there will be more oil in the pores. The cleaning effect on the oil removal is poor, which directly affects the phosphating effect, and at the same time, the oil seeps out at high temperature. The problems that need to be solved in this scheme are as follows: first, how to effectively remove the penetrating oil to meet the phosphating effect. Second, due to the particularity of powder metallurgy material, the oil continues to leak out at high temperature. How to ensure the reliability of the oil after mixing with compressor refrigeration oil.

Analysis and verification of improving phosphating effect

According to the characteristics of oil exudation in the pores of powder metallurgy connecting rod under

high temperature and returning to the original state under normal temperature, the test is carried out before cleaning and phosphating, the baking temperature is controlled at (120 ~ 150 ℃) to ensure that the oil exuded will not carbonize, and a relatively suitable baking strip is found. After baking, cleaning in time can effectively remove the oil exuded and ensure the parts list before phosphating Surface cleanliness. Through the analysis of the quality of phosphating film and the comparison of process plan I, the feasibility of the plan is determined.

Verify the process plan: baking, cleaning, phosphating, two hole brushing, cleaning and sorting Art Description: set the temperature of 120-150 ℃ in the oven, heat the connecting rod in the oven for 1 hour, and clean, phosphatize and brush the connecting rod directly after baking.

From the data in the figure, it can be seen that the thickness of the film before brushing is almost the same as that of process scheme I (commonly used in the industry), but the thickness after brushing is thicker and more stable than that of the verification scheme, which shows that the adhesion of the phosphating film with the verification scheme is better than that with process scheme I. Take the above polished connecting rod test hole roughness as shown in Table 2.

Table 2 roughness of connecting rod big hole

	1#	2#	3#	4#	5#	mean value
Validation plan	0.292	0.328	0.471	0.209	0.394	0.338
Process plan I	0.376	0.392	0.382	0.503	0.289	0.388

From the data in the table above, it can be seen that the thickness of phosphating film in the two processes is basically the same.

Reliability analysis of oil mixed with compressor oil in the second process

Refrigeration oil is an important part of refrigerator refrigeration device, part of the oil enters the system for circulation. Because the high temperature of 150 ℃ in the compressor cylinder can be contacted in the circulation process, and the temperature of - 40 ℃ or lower may be contacted in the evaporator system, so it is required that the oil for connecting rod processing must have good mutual solubility with the refrigeration oil.

Mutual solubility test, test preparation: oil, R600a refrigerant used in the processing, relevant test equipment. Test process: prepare a glass tube, carefully clean it (with distilled water), drain and dry it; introduce 1g oil into the tube; fill dry ice into the thermos to obtain a mixture of - 70 ℃; clamp the tube with the tube and place it in the thermos; add 9g refrigerant to the tube and close the joint; shake the oil sample and refrigerant evenly before cooling, press 10 ℃ / min The test tube is cooled for a period of time until it is close to the cloud point temperature (within 10 ℃). Then take out the test tube and observe the appearance of the mixture of oil and refrigerant. The results show that at - 53 ℃, the oil and refrigerant are uniformly dissolved without stratification.

RESULTS AND CONCLUSIONS

The powder metallurgy connecting rod forms a high density and wear-resistant film on the surface of the part through steam treatment, which not only improves the rust prevention between processes, but also effectively seals the pores on the surface of the connecting rod to prevent the penetration of the processing fluid. However, because the phosphating film on the processing surface is removed during the processing, the situation that the crystal like viscous yellow foreign matters are separated out due to the penetration of the processing fluid can not be fundamentally solved 。

The rough connecting rod is soaked in oil, the processing uses water-based processing fluid, and the finished product uses baking process. The quality of connecting rod phosphating is stable, and the connecting rod with foreign matter infiltration can be found, but the process requirements are high, and there is the possibility that all yellow foreign matters cannot be found.

Connecting rod blank is not treated, oily processing fluid is used in the whole process of processing, and baking and cleaning process is used for the finished product, which can ensure the quality status after phosphating. At the same time, oily processing fluid and refrigerant are completely soluble, which is technically feasible. This scheme can eliminate the source of yellow foreign matters.

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