THE APPLICATION OF ELECTROMAGNETIC HEATPUMP TECHNOLOGY ON THE VACUUM SALT AND THE RESEARCH ON ITS ENERGY SAVING

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Abstract: The main electricity consumption equipment in the vacuum salt system is the pumps. The driving force of all these pumps is electric machine which convert the mechanical energy into electrical energy and generate a large amount of heat. This part of heat consumes a part of electrical energy to speed up its dissipation. Some high-power motor need ancillary equipment to assist the heat dissipation, resulting in the waste of energy; the pump itself has some problem about mechanical transmission, shaft leakage, low pump efficiency. Electromagnetic pump include some characteristics of shaftless drive between pump and motor, safe static seal, no leak and integration. Therefore, this article briefly introduced the properties and features of electromagnetic heat pump technology and applied it innovatively on vacuum salt system, so as to achieve energy-saving purpose.

Key words: electromagnetic heat pump technology, vacuum salt, energy-saving

1. INTRODUCTION

A large number of pumps were used to deliver liquid, heat transfer medium in the vacuum salt system. These pumps are constituted by the pump and motor. Motor, as its driving force, is the main power equipment. Take vacuum salt system with an annual output of 600000 tons as an example, the total power of various types of electric pumps was greater than 3700kW, accounted for 90% of the overall system power consumption. Therefore, the potential of power-saving was huge, and it was significantly important salt to increase the power efficiency of motor and pump in a vacuum salt system.

In the operation of motor, the electrical power will be converted into mechanical energy and thermal energy, the vast majority of mechanical energy was consumed to drive pumps, a small part of mechanical energy was used to overcome the frictional resistance and electrical mechanical transmission. This part of heat consumes a part of electrical energy to speed up its dissipation. Some high-power motor needs ancillary equipment to assist the heat dissipation, resulting in the waste of energy. The information indicates that the efficiency of more than 80% domestic electrical product lower than the average standards of foreign advanced level by 2 ~ 5 percentage points, the average efficiency of widely used Y series motor in China is 87.3%, while the average efficiency of high-performance motor of United States is 90.3 %, the average efficiency of some super-efficient electrical products introduced over the past few years was even up to 91.7%. The increase in efficiency of motor need support of high-quality metal materials and advanced manufacturing process, which accompanied with increasing costs.. Therefore, in vacuum salt system, only the motor itself consume more than 12.7% of power consumption, which does not include the energy consumption of accelerating heat dissipation of large-scale electric motor.

There is a need of a shaft between motor and pump for power transmission. The seal, lubrication and cooling of shaft directly affect

the life and efficiency of the pump, however, pump leakage is a technical difficulties that traditional pump can't overcome. The only way to ensure the normal operation of the high-power pumps is continuous replacement of the fitting. As for some high-power pumps, it is general to use ancillary equipment for general seal, lubrication and heat dissipation. The efficiency of the current domestic pump is about 60~80%, and that of some large-scale axial flow pump is up to 90%, lower than the international technology by 2 ~ 4 percentage. Therefore, there is more than 20% of power loss for the pump itself without concerning the energy consumption of the ancillary equipment of high-power pump.

As can be seen from the above that the total power efficiency of pump group in vacuum salt system was less than 70%, and the ancillary equipment of the high-power pumps would also consume a part of energy. Therefore, how to improve the power efficiency of the pump group is an important issue that confronted the vacuum salt industry. However, the emergence and successful application of electromagnetic heat pump technology provides a new way to solve these issues. In this paper, the improvement on the existing electromagnetic heat pump technology and application of it on the vacuum salt system were discussed.

2. INTRODUCTION OF ELECTROMAGNETIC PUMP TECHNOLOGY

Electromagnetic pump was developed and manufactured on the basis of the electromagnetic pump, it converted the electromagnetic energy into heat energy and mechanical energy directly, and changed the sleeve structure of traditional motor and the and the design principle of traditional pump. The shape of motor rotor is plane ring. The rotor and impeller integrated and it realized the shaftless drive between the pump and motor, secure static seal, never leak.

The main features of electromagnetic pump:

(1) motor and pump integrated, non-shaft drive, no vibration;

(2) never leaked, using the integrated entire seal structure;

(3) low-noise, pump noise $\leq$ 47dB;

(4) high efficiency, power efficiency close to 100%;

There is less than a decade since the Electromagnetic pump was invented. It is a new environmentally friendly products and it sucessfully applied on the boiler and heating equipment and obtain a good energy saving effect, the figure for the physical map of the electromagnetic pump as follow.

At present, the variety of Electromagnetic pump product is still relatively small, the power is only 0.5 ~ 80kW, flow 0.5 ~ 200m3 / H, lift 5 ~ 30m, only suitable for relatively clean, low viscosity medium.

3. THE APPLICATION OF ELECTROMAGNETIC HEAT PUMP TECHNOLOGY IN A VACUUM SALT SYSTEM

In order to optimizate the application of electromagnetic heat pump on the vacuum salt, the vacuum pumps can be divided into two categories: first, the pumps that the conveyed media by it need to be heated, known as the heating medium pumps, the second type of pump is that the conveyed medium do not need heating, known as the cooling medium pumps, if substitute this kind of pumps with electromagnetic pump, the problem of mechanical transmission, shaft leakage, reducing noise can solved, but the effects of energy-saving are not obvious. But if the first category pumps were replaced by the electromagnetic heat pump, not only the problem of mechanical transmission, shaft leakage, reducing noise can solved, but also the characteristics of energy-saving of electromagnetic heat pump can be given full play to. the service life of pumps can alose be extended. However, the existing electromagnetic pump is not available to substitute for all the first category of all medium heat pumps, it can only substitute for the pumps with power of 80kW, flow less than 200m^3/H below, and the medium it convey is clean and low in viscosity, As for the pump groups with high power, high temperature and the medium conveyed containing particle can not adopt the existing electromagnetic heat pump directly without any improvements. In order to adapt to such needs, technological transformation of the existing electromagnetic pump technology can be performed as follow:

(1) To increase the power and flow. increase stator coil windings group power and increase the rotor (impeller) size, so that the flow of electromagnetic pump can reach 200 ~ 13000m^3/H.

(2) To improve the operating temperature.

(3) To improve corrosion resistance. Shell and rotor (impeller) made of corrosion-resistant metal material.

(4) To improve the capacity of conveying granular media. Rotor (impeller) was transformed from single-layer structure into a two-layer structure.

Through the four technological improvements mentioned above, the electromagnetic vacuum pump can not only meet the needs of vacuum salt, but also meet the needs of other chemical processes, so the electromagnetic heat pump technology has more prospect of wide use.

Just as the traditional pump groups, the electromagnetic heat pumps can also be installed with frequency converter. Since the inverter itself consume power by 1 to 3% of the total consumption, it is suggested that real-time variable flow rate or frequent starting electromagnetic pumps equipped with heat pumps and traditional inverter, For a smooth flow or non-frequent starting electromagnetic pumps should not install the traditional inverter. Inappropriate application of inverter will not only increase the power consumption, but also increased the cost of equipment investment.

4. ECONOMIC ANALYSIS

The total power of pumps groups in the vacuum salt system with annual production capacity of 600,000 tons exceed 3700kW, among which the medium heat pumps power more than 1400kW, if the alternative use of the electromagnetic pump, not only to extend the service life of pumps can save day-to-day maintenance costs of pumps and energy-saving effect is very obvious, traditional pumps by 70 percent power efficiency, the use of electromagnetic energy-saving heat pump after 1400kW × (100% -70%) = 420kW, work 7200 hours per year, the annual saving 3,024,000 kWh (degrees). Therefore, the electromagnetic pump salt in a vacuum system can be considerable economic benefits.

5. CONCLUSION

As can be seen from above, expanding the application of electromagnetic technology on vacuum salt is another effective way to save energy. It made clever use of surpluse heat of pumps, avoided the traditional technology model of just improving the efficiency of pumps. Which not only brought that the power efficiency of pumps increased to almost 100%, but also solved the formidable universal problem of mechanical transmission completely and shaft leakage problems. Therefore, it has a wide application prospect in a vacuum salt and salt chemical industry.

References

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