RPM CONTROL OF THE ELECTRIC MOTOR OF BOREHOLE PUMPS THROUGH A FREQUENCY CONVERTER

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https://doi.org/10.5281/zenodo.7466110

Abstract

This article provides information on regulating the flow and pressure of water by a pump through a frequency converter for the number of revolutions of an electric motor of borehole pumps used in crop irrigation, irrigation and the oil and gas industry, and the quality of a frequency converter. the soft start of the pump used in it, the regulation of the number of revolutions of the electric motor, energy saving, the main characteristics of its operation and the overall efficiency are shown.

Key words: Frequency converter, pump, water, underground, power, electric motor of borehole pumps.

Introduction

Submersible pumps are widely used in agricultural water supply, lowering the underground water level, water supply systems of urban and industrial buildings, oil extraction systems. This type of pump, in the well, the pump descends from the liquid and allows it to rise from a great depth. Among the submersible pumps for raising water, the most common is the water-filled construction, which has water cooling units and consists of a centrifugal pump and an electromotor protection cover.

Main part

The electric pump device is lowered into the well in the water supply pipes and hung at the mouth of the well. The start-up of the electric pump installation, the stop protection, the start-up when the well water level is below the set limit are performed by the total device . The water sucked through the type filter comes to the working wheel and goes out to the fan conveyor under pressure. The pump is single and multi-stage. The stepper consists of a blade conveyor and a working wheel. The working wheel is attached to the shaft. The thrust bearing of the pump is carried by the support bearing located in the electric motor. Water is pumped to the surface through a column of pipes. The required standard water flow height for the consumer is set by the valve. Nowadays, regulation of pumps by changing the number (speed) of electric motor revolutions is widely used. It is observed that the underground water level drops several times during the year and in the seasons . It should be noted that control of water consumption in the well pump static structural system by changing the frequency leads to a significant decrease in the efficiency of the pump (Figure 1).

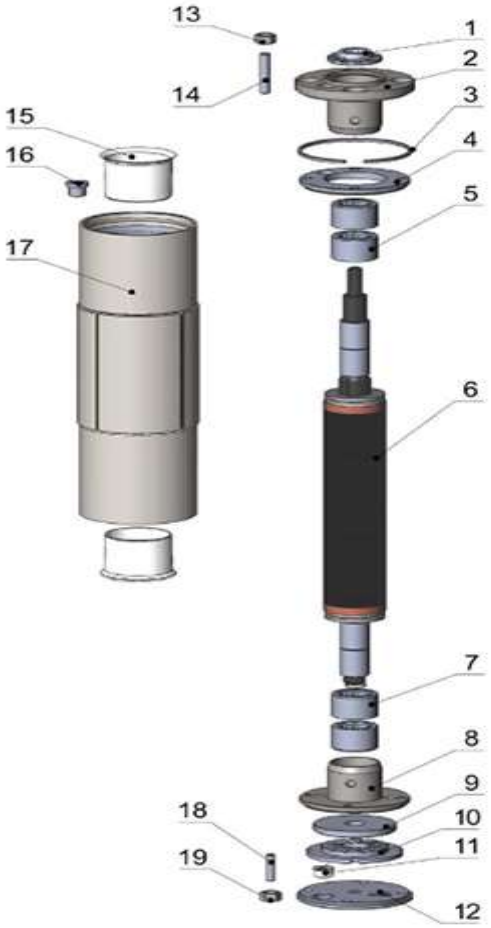

Figure 1. **WELL PUMP ELECTRIC MOTOR CONSTRUCTION SI**

1. Sand deflector
2. Dead with a pump (Fanar)
3. Condenser
4. Bearing
5. Nut
6. Puck with S ax
7 . Pin
8. Support ring
9. Flanets
10. Glass
11. Stator
12. Rotor
13. Key
14. Lower bearing housing
15. Pump support bearing (Pyata)
16. Bearing
17. Pipe
18. Filter
19. Ring
20. Flanets
21. Pin
22. Back f lanets

the pumps have non-return valves, which hold the water in the pipe column, which prevents the water in the pipe column from backing up the pump and the electric motor, while making it easier to restart the pump when the pump is stopped.

Recently, the most common pumps have been used in combination with frequency converter devices, which, by adjusting the speed of the pump, ensure a constant fluid pressure in the system regardless of consumption. Overpressure in the pipeline can be avoided with frequency control. With the help of frequency converter devices, smooth start and stop of the pump electric motor is provided, which eliminates the occurrence of hydraulic pressure, and reduces the service life of the pump and pipeline network. The frequency converter device allows you to avoid wasting electricity. Because the pump requires 10-20% of the total power of the pump during the start-up of the electric motor at maximum speed. Pumps without frequency converters run at the same speed, but consume 30-60% more electricity during start-up.

Figure 2. ETsV pump control unit with frequency converter device

The main advantage of the frequency converter in submersible pumps is the regulation of the pump speed. In addition, more reliable protection of the electric motor prevents liquid shock in the pump when starting the pump in the system, the service life of the pump equipment is almost doubled. All this shows the economic quality of using a frequency converter and the quick justification of its cost (Figure 2).

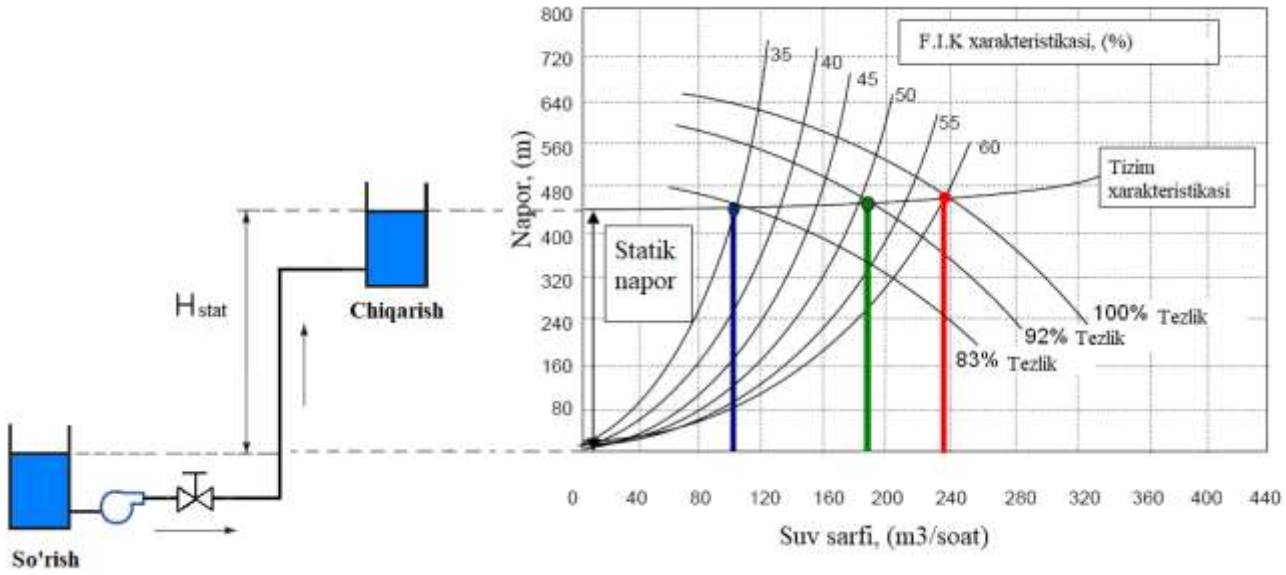

Figure 3. A graph of the change in pipe column static components when the pump is used with a frequency converter

Methodology

The main features of choosing and using frequency-controlled well pumps

1. Compared to standard asynchronous motors, there are many underground electric motors with rated current of the same power, therefore, when choosing a frequency converter, it is better to choose it with rated current and reserve power than with a large power.

2. If the frequency converter has a small volumetric power (110-120%), it is better to choose it one step higher than the motor power.

3. A voltage drop can be observed in the pump-motor cable, which in turn leads to a decrease in torque, so the use of a high-section cable is recommended.

4. When the motor cable length is more than 20-50 meters, most frequency converter manufacturers recommend to put a motor choke at the end of the converter, to which a voltage drop of 2 to 4% is applied. Otherwise, a large amount of current leakage can be observed, the overload will cause it to turn on the protection system.

5. Another disadvantage of a long cable is that excess voltage (up to 1000V) is generated due to standing waves in the motors.

6. In addition, the speed of rise of emergency short-circuit currents is reduced, and thus the electronic protection of the transformer is more reliable.

7. The use of mains inductance installed at the transformer input is also essential in these applications, as the wells are often located in remote rural areas where the quality of the mains is required. When the frequency converter is located nearby (up to 10 m), it is required to be powered by a high-power distribution transformer (Figure 3.).

Results

The following should be taken into account when using ETsV type well pumps with a frequency converter.

- in order to ensure sufficient cooling of the electric motor, the pump must work without decreasing the nominal water consumption value by more than 20%, (for example, for the ETsV 6-10 pump, it is 8 m3/h). Normally, when the pump unit is controlled by a frequency converter, it is not the pump flow that is controlled, but the pressure. In this case, the consumption may fall below the specified level. Therefore, it is recommended to install a liquid flow rate sensor (relay) that turns off the electric motor when it falls below the working range of the pump;
- in order to protect the windings of electric motors from overheating, melting of the insulation and its damage, it is recommended to install a temperature sensor that turns off the motor at a temperature of 70 °C.;
- for the normal operation of the radial support bearings, the rotation speed of the electric motor shaft should be at least 2700 rev/min.;
- to protect the pump electric motor from high frequency voltage pulses, which can melt the winding insulation and damage the electric motor. If the connection cable between the pump and the frequency converter is long, the output filters should be installed du/dt filter or sinusoidal filter.

-p ast speed limitation, the minimum output required should be a function of frequency limitation or "sleep" mode.

Conclusion

Buying a frequency converter device and getting additional equipment for it reduces electricity consumption by 30-50%, and thus prevents the life of the pump, quick breakdown, accidents and equipment failure, and also increases the functionality of the system. Therefore,

today, many manufacturers focus on the production of pump units equipped with a frequency converter, which allows to increase the working hours of pumping equipment and ensure its maximum efficiency.

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