ADVANTAGES OF USING IN A VARIABLE-SPEED ASYNCHRONOUS ENGINE IN PUMPING DEVICES

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ANNOTATION

The article provides a brief overview of the most typical pumping units that use a variable frequency drive. Information on its efficiency and application features is given, as well as information on the use of frequency converters in pumping units. The review allows you to get some idea of the main stages of the introduction of a variable speed drive in pumping units.

Key words: *Pressure, pump, capital expenditures, reduced costs, payback, dimension.*

Introduction

In view of the obvious advantages, the frequency-controlled electric drive is becoming quite widespread in pumping installations. At the present time, conditions have developed that make it possible to use it everywhere. The development of semiconductor technology made it possible to create reliable and relatively inexpensive frequency-controlled electric drives on the basis of static converters.

The use of a frequency-controlled electric drive in pumping units makes it possible to use large pumping units in the low-flow mode and, consequently, reduce their total number. Here it is appropriate to say that more powerful units have higher technical indicators, including higher efficiency (Table 1).

Table 1. Technical and economic indicators of D-series pumps

Parameter	D320-70	D1250-65	D2500-62	D3200-75	D4000-95	D6300-80
Power, kW	100	320	630	800	1250	1600
Pump EFFICIENCY	0,78	0,86	0,87	0,87	0,88	0,88
The efficiency of the engine	0,92	0,922	0,935	0,953	0,962	0,962
The efficiency of the unit	0,716	0,79	0,816	0,83	0,846	0,846
Weight, kg	1130	4245	8730	11660	12780	18666
Specific gravity, kg / kW	11,3	13,3	13,9	14,6	10,3	11,7

It is shown in [2] that the linear dimensions of pumping units grow much slower than their power and supply. As is known, the volumes (dimensions) of machines (electric motors, pumps, etc.) are proportional to the nominal values of their torque:

$$V = kM, \qquad (1)$$

where $M -$ is the torque; $k -$ is the coefficient of proportionality.

If we express the moment in terms of the operating parameters of the pumping unit and extract the cubic root from both parts of the equation (1), we get the dependence of the linear dimensions of the unit on its main parameters:

$$L = \sqrt[3]{kM} = \sqrt[3]{k} * \sqrt[3]{\frac{QH}{\eta n}}, \qquad (2)$$

where $Q -$ is the pump unit feed; $H -$ is the pump unit head; $n -$ is the pump unit rotation speed; $\eta -$ is the unit efficiency.

Methods

We believe that for the specific installation under consideration, the head values of the compared units are approximately the same. We take the parameters of the smallest of the compared aggregates as the basic ones[3.4.5.6.7]. For these conditions, after some transformations, we obtain an expression for determining the relative linear dimensions of the compared aggregates

$$L^* = \sqrt[3]{\frac{Q_l/\eta_l n_l}{Q_b/\eta_b n_b}}, \qquad (3)$$

where Q_l, η_l, n_l − are the nominal parameters of the larger unit; Q_b, η_b, n_b −are the nominal parameters of the base unit;

From the expression (3), it follows that the linear dimensions of the enlarged unit in comparison with the basic unit increase to a lesser extent than its feed increases.

Thus, the use of a frequency-controlled electric drive under certain conditions not only does not increase the capital investment, but also reduces it somewhat (by a certain amount of dK).

Calculations have shown that the use of a frequency-controlled electric drive in combination with the enlargement of the unit power, depending on the purpose of the station and other specific conditions, can reduce the specified costs by 20-50 % [1.2.8.9.10].

Results and Discussion

The feasibility study of the use of a frequency-controlled electric drive in pumping units is carried out in the following sequence.

1. Make up hydraulic and electric circuit diagrams compare the pumping systems.
2. Determine the composition of the main equipment of the compared pumping units: pumping units, valves, valves, check valves, cells of switchgears, control devices (frequency converters, etc.).
3. They assemble the main equipment of the compared pumping units.
4. Determine the capital costs for the basic and new options for electrical equipment K_{el}, pumping equipment K_{pum}, hydro-mechanical equipment K_{hm}, and construction part K_{con}. The cost of electrical and hydro-mechanical equipment is determined in accordance with the price lists of companies and equipment manufacturers. For a preliminary estimate of the cost of a frequency-controlled electric drive and additional capital costs associated with the use of a frequency-controlled electric drive, the graphs shown in fig. 1. and 2. can be used. The cost of the construction part can be determined by the aggregated specific indicators of the cost of

construction of pumping stations, contained, for example, in, taking into account the current inflationary coefficients of the cost of construction[1.6].

Conclusions

Depending on the calculated payback period of the ACS equipped with a variable frequency drive, a decision is made on the expediency of its use in a pumping unit. At present, 2-3 years are considered an acceptable payback period. In any case, the payback period should not exceed the service life of the ACS equipment and the frequency-controlled electric drive, that is, 10-11 years.

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