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«Energy-efficient pumping installations at agricultural production facilities»

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In order to improve the energy performance of the electric drive of agricultural production facilities, the urgent task is to search for calculation methods, which requires solving the following subtasks:

• analysis of the reasons for the overestimation of the installed capacity of the electric drive;
• analysis of the effect of uneven load curve;
• the choice of calculation methods and the results of the comparison of electricity losses with different methods of flow control.
Solution methods

The joint operation of a centrifugal pump on a hydraulic network is illustrated in Figure 1, where the pressure-flow characteristic of the pump is shown - the dependence of the generated head $H$ on the flow rate $Q$ (curve 1) - and the characteristic of the hydraulic network - the dependence of the pressure loss in the pipeline on the flow rate (curve 2).

In case the deviation of the real resistance of the hydraulic network from the calculated value, instead of the calculated curve 2 (in Figure 1 and 2.) We get the curve 3 in Figure 2. In order to return to the previous flow rate, a higher power pump is necessary, having a pressure-flow characteristic corresponding to curve 4.

Because the number of nominal pump powers is discrete, the developer, in order not to risk, chooses a pump of the nearest greater power, which has a pressure-flow characteristic lying above curve 4 (see curve 5 in Figure 3).

In solving problem of choice of calculation methods and the results of the comparison of electric power losses with different methods of flow control, the static characteristics of the hydraulic network elements (Figure 4) and the mechanical characteristics of the electric drives and pumps (Figure 5) were used.
Conclusions

Results, implementation

• It was found that the best results are observed in electric drives with frequency converters and valve cascade: here the total losses in QMIN mode are only about 10% of the base value, which is explained by minimal losses in pipelines, when there is no need to use valves.

• It is shown that with parametric control of the speed of an asynchronous electric drive with a phase-rotor, the loss in hydraulic elements (pump and network) has the same value as with frequency control (about 10% of the base value), but slip losses increase by 12%.
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