

“Evaluation of Effectiveness of Proportional Pressure Control of Variable Speed Centrifugal Pumps in Water Supply systems”

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Control, efficiency, proportional, pump, water supply.

PUMP EFFECTIVENESS EVALUATION TOOL IF PROPORTIONAL PRESSURE IS USED IN COMPARISON WITH CONSTANT PRESSURE CONTROL IN WATER SUPPLY SYSTEMS

Nowadays, more attention is paid on the improvement of energy efficiency level.

About 20% of the total electrical energy produced in the world has been consumed by pumps and pumping systems and almost half of that can be saved up [1].

Centrifugal pumps in water supply system are normally controlled via constant pressure [2]. The proportional pressure control mode is the most efficient mode of the control for booster pumps in water supply systems. Thus it's very crucial to estimate the potential reduction of energy consumption, if the proportional pressure control is used in comparison with constant pressure control.

Usage of the proportional pressure control in public water supply systems can crucially influence the total efficiency and reliability level of the system in a positive way.

The proportional pressure control is generally recommended to be used in the systems where the total pressure drop is mostly dedicated to the piping system [3]. Thus the proportional pressure control is advisable to use in water supply systems with relatively long piping network.

In order to analyze the consumption of electrical energy, if the proportional pressure control with different deviations from head value of duty point at zero flow is used, the load profile of the pumping system should be taken into account.

It has been assumed that annual operation of pumping system is 3285 hours and the load profile [3] is divided into five parts with different flow values: 100%, 75%, 55%, 35% and 12% of flow rate in duty point [1].

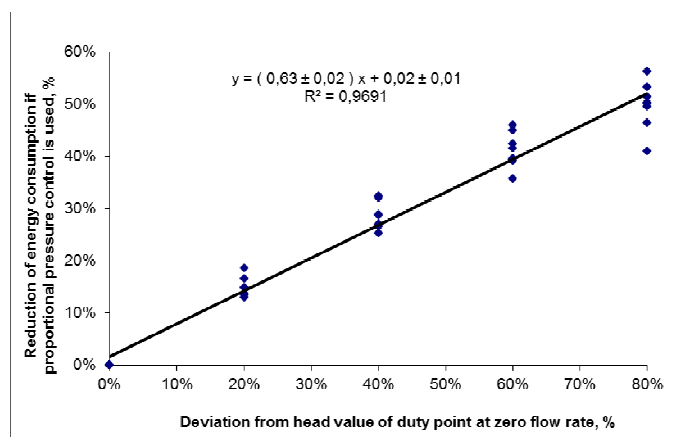


Fig. 1. Reduction of energy consumption, if calculated the proportional pressure control with different deviations from head value of duty point at zero flow rate is applied (in comparison with constant pressure control)

Each flow component corresponds to certain duration of pump operational time in the following way [3]:

100%-5%,

75%-9%,

55%-14%,

35%-27%,

12%-45%.

The energy consumption, having realized a variety of the proportional pressure variants, has been compared with the energy consumption if constant pressure control is applied.

During the analysis of the calculated proportional pressure control with different deviations (20%, 40%, 60% and 80%), there has been carried out the calculation of annual energy consumption for centrifugal pumps in the research (Fig. 1.).

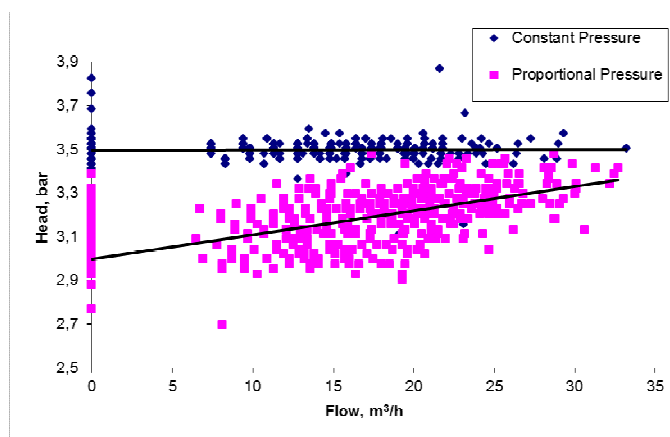


Fig. 2. Measured flow and head values if the proportional and constant pressure control modes are used

The regression equation of linear trend type and the respective coefficient of determination have been derived.

The equation can be used as a tool for evaluation of the potential reduction of energy consumption at different deviations from head value of duty point at zero flow. The potential reduction of energy consumption is estimated in comparison with the usage of constant pressure control, if the value of duty point remains invariable.

Having realized the theoretical analysis using the estimation equation, it has been found that consumed energy reduction is up to 11,5%, if the deviation from head value of duty point at zero flow is 15%.

Making experimental analysis with the measurement of flow and head (Fig. 2) as well as energy consumption, it has been found that the consumed energy reduction is up to 10,5%.

The error is 8,7%.

REFERENCES

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