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Effect of gas content in the pumped liquid on the characteristics of a torque flow pump

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Introduction

Is considering one of the ways to increase the ability of a dynamic pump to pump gas-liquid mixtures – the application of the vortex principle of energy transfer

The degree of influence the two-phase stream on the flow parameters in the pumps flow part and its characteristics, in general, is determined primarily by the value of the volumetric gas content:

$$\beta = q/(q+Q),$$

where q, Q – is the volumetric flow rate of gas and liquid, respectively.

Research methodology

- Experimental researches the influence the value of the volumetric gas content on the performance characteristics of the torque flow pump of the "Turo" type;

- Theoretical research.

Scheme for research is embodied in a torque flow pump, which is able to pump mixtures with a gas content of up to 0,40-0,45 without additional devices for preparing the mixture.

Research objectives:

- Development of a physical model of the gas-liquid mixture flow in the flow part of a torque flow pump the «Turo» type;

- Determination the mechanisms influence of the gas component in the pumped medium on the performance curves of the torque flow pump the «Turo» type.

Results

Results of experimental researches

The characteristics of the torque flow pump at different inlet gas content were obtained in the region at the capacity 0,56Q, 0,75Q, Q, 1,13Q.

To the value of β = 0,06 – 0,07 there is some growth the parameters (2 – 4 %) of the tested pump.

Head and efficiency of the pump begin to decrease sharply, thus decrease capacity of the pump is not so sharp at β = 0,20.

Up to β = 0,32 – 0,34 head and efficiency do not change, and power and supply begin to increase.

Results of theoretical research

- The head does not depend on the density of the medium.
- The common action on the gas bubble moving in the interblade channel of the impeller of the lifting force and the frontal force, and the uneven distribution of pressure across the width of the channel leads to the lag of the gas velocity from the liquid and accumulation its in some places of the impeller.
- The gas accumulated in the interblade channel changes the "geometry" of the impeller and, accordingly, the components of the speed triangle.
- At a certain value of the volumetric gas content, a significant gas cavity is formed at the non-working side of the blade and creates a wedge-shaped gas zone.
- The gas zone reduce the effective cross section of the impeller, especially at the outlet.
- The output of the gas-liquid flow from the impeller is happened on the working side of the blade with a reduced exit angle and with increasing flow speed.
- Meridional component of absolute speed increases with decreasing effective cross section of the impeller at the outlet. The impeller transmits energy to the medium which is pumping as kinetic energy by increasing the fluid flow speed. At the outlet, at high gas content, appear new triangles of flow velocities

Conclusions

- It is determined that changes in the characteristics (before the failure of the parameters) of the pump occur due to the influence of the gas factor on the operation of the impeller.

- The influence of the gas component in the pumped medium on the performance characteristics of the torque flow pump of the "Turo" type has been experimentally investigated. It is established that for this pumps type the value of the critical gas content is equal to β crt ≤ 0,40-0,45 without additional devices for preparing the mixture.

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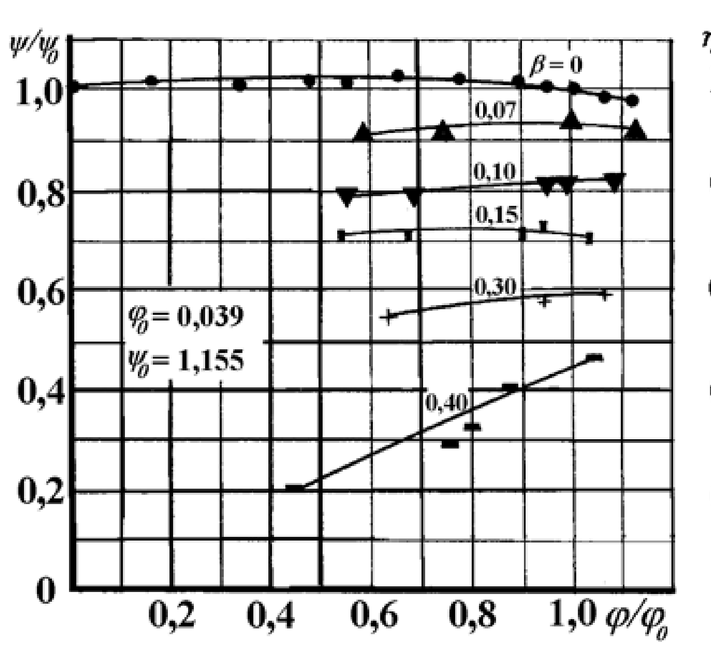

Figure 1. Influence the volume gas content on the head characteristic of the pump

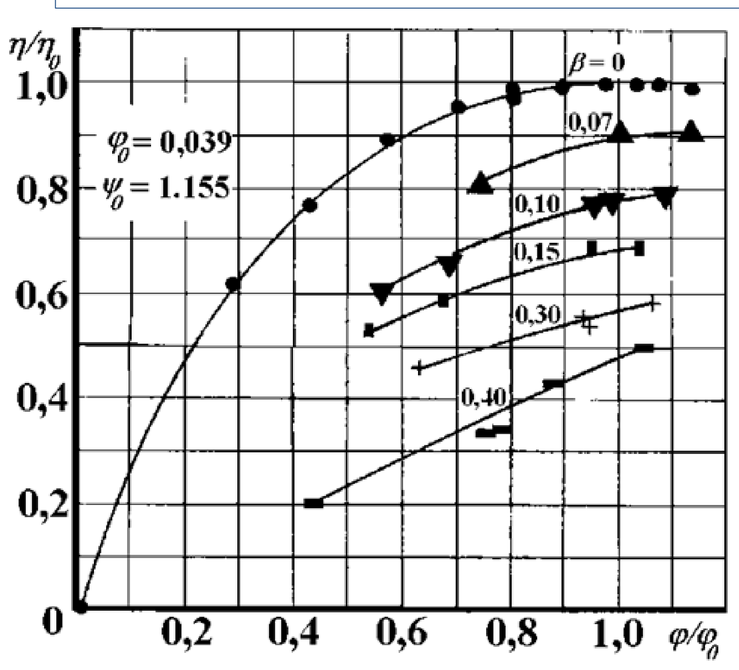

Figure 2. Influence the volume gas content on the efficiency of the pump

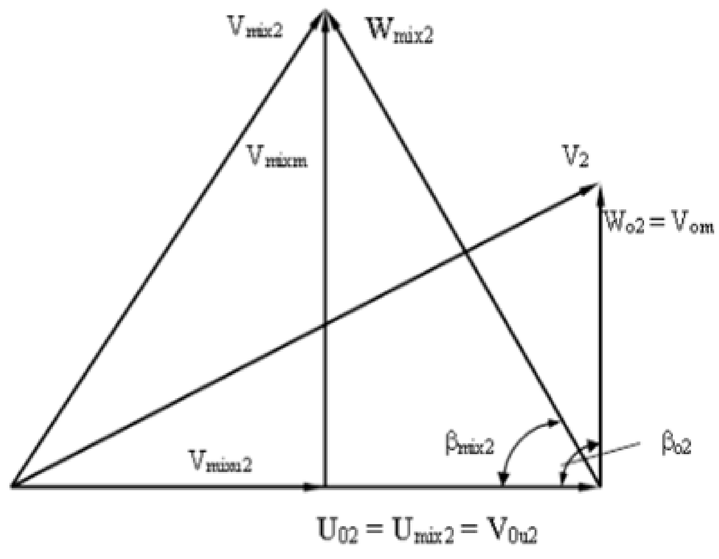

Figure 3. Triangles of flow velocities at the outlet of impeller

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