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Article



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CHANGE IN THE FLUID FRICTION VELOCITY ON THE SURFACES OF THE IMPELLER BLADES OF A CENTRIFUGAL PUMP

Abstract: The results of computer calculation of the fluid friction velocity on the surfaces of the impeller blades of a centrifugal pump under conditions of a rotor shaft rotation speed of 2000 rpm were presented in the article. The change in the fluid friction velocity on the blade surfaces along the entire length of the chord was graphically demonstrated. The values of the friction velocity on the suction and back faces are compared with different orientations of the impeller blades.

Key words: blade, friction velocity, suction face, back face, centrifugal pump.

Language: English

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Introduction

The impeller blades of the centrifugal pump are subjected to the greatest load of all the elements of the device, since they drive the fluid from the inlet to the outlet. The geometry of the impeller blades of the centrifugal pump must comply with official documents [1-2]. The general characteristics of centrifugal pumps, depending on the type, blade configuration and other parameters, are presented in [3-4].

The main area of research related to the operation of centrifugal pumps is to increase productivity without reducing the service life. To achieve this optimization, the authors performed theoretical, practical and computer experiments [5-7].

In the article, the authors, using a computer program for engineering analysis, calculated the friction velocity of the fluid on the suction and back faces of the blades in one revolution of the impeller around its axis. These results will allow us to describe the friction velocity in the fluid flow and the velocity profile near the flow boundary [8-9]. Also, according to the results of the study, it will be possible to assess the loading of the impeller blades.

Materials and methods

The object of the study were the suction and back faces of the impeller blades of a two-dimensional model of the centrifugal pump. One impeller rotation cycle was simulated with a rotor shaft rotation speed of 2000 rpm. The geometric parameters of the centrifugal pump parts and the modeling conditions are presented in the work [10]. As in [10], the suction and back faces of the three impeller blades were used to compare the fluid friction velocity.

Results and discussion

The simulation results are presented in the Table 1. On the three blades of the impeller, located in

different positions, the suction and back faces were highlighted, according to which the values of the fluid friction velocity were read.

It is noted that the friction velocity on the suction faces of the impeller blade varies in the range of 0.125...0.725 m/s, and the friction velocity on the back faces of the impeller blade varies in the range of 0.12...0.85 m/s. The friction velocity varies over a wide range over the entire length of the blade chord. Areas with increasing and decreasing friction velocity are observed. At the same time, changes in the friction velocity on the back face, the impeller blades in question, have almost the same nature: a gradual increase in the parameter to the maximum value, followed by a decrease in the parameter value in the direction of the inlet of the centrifugal pump. The maximum value of the friction velocity is marked on the back face of the blade, indicated in the last row of the Table 1. On the back face of the impeller blades, the maximum friction velocity can be reached both in the direction of the diffuser cavity and in the direction of the inlet.

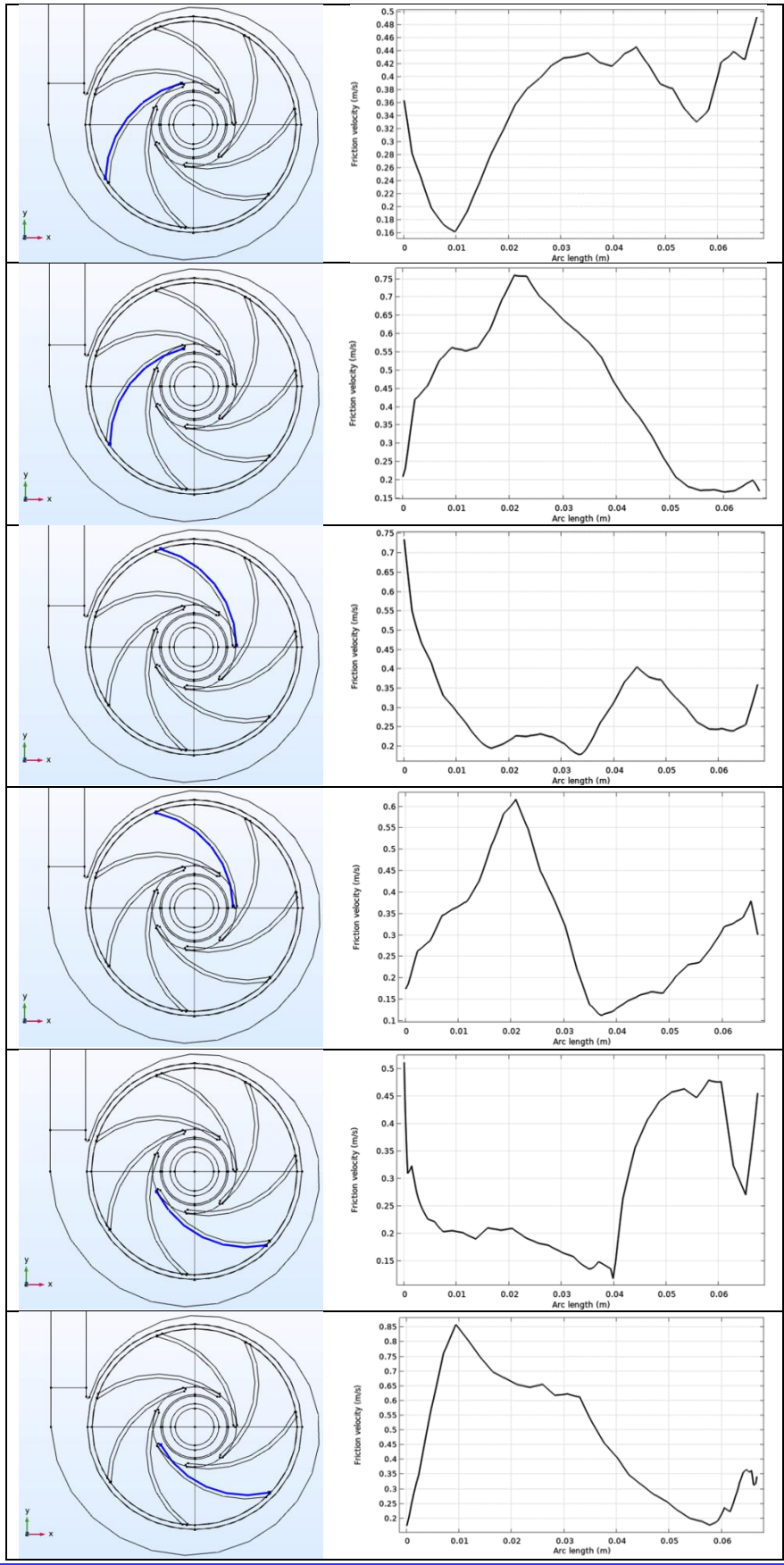
Conclusion

Thus, based on the constructed dependencies, an analysis was carried out of the change in the fluid friction velocity from the chord length of the impeller blades of the centrifugal pump. The calculated values of the friction velocity varied in the range of 0.12...0.85 m/s at a rotational speed of the rotor shaft of 2000 rpm. The blade with a sharp increase in the friction velocity over a short chord length is the most loaded. Thus, it can be concluded that, depending on the position of the blade, the suction and back faces are subjected to variable loads, which affects the service life of the impeller elements.

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Table 1. The studied faces and the dependence of the fluid friction velocity on the length of the chord of the impeller blades of the centrifugal pump.



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