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The dissertation entitled

Modeling elements of liquid discharging of the Pitot tube pump

Abstract

The Pitot tube pumps, also known as pumps with rotating casing, of simple construction, and low weight are applied everywhere where it is necessary to discharge low capacity with, at the same time, high total head. This PhD document is a continuation of the research connected with the optimization of the rotating casing by means of the pitots of an oval inlet. The results obtained extended to the laboratory tests constitute the starting point to the considerations and research presented in the dissertation and enabled to formulate the following thesis:

There is a set of geometrical parameters of the pitot tube, which with the constant inlet's area and unchangeable dimension of the rotating casing generates the maximum total head at the same time contributing to the increase of the total efficiency of the pump.

During the modification of the pitot tube and an internal channel 8 pitot tubes with oval-circle inlet were modeled. The prepared CFD simulations, aiming at understanding the phenomena at the inlet enabled to localize the most inefficient zones and back flow disturbing the free flow. It appeared that the work of the inlet cross section presented in the technical books does not correspond to the theoretical assumptions, generating the high disruptions and anomalies in the front, upper part

of the pitot tube. The obtained results in the form of the best shape of the oval-circle inlet contribute to extensive understanding of the phenomena in the pitot tube's inlet. The analysis of the velocity and pressure fields showed that the highest value of pressure is possible to gain in the upper part of the pitot's inlet whereas the bottom part of the pitot's inlet works improperly. Taking into consideration the conclusions, the following 6 pitot tube's inlets were modeled of the shapes, which so far had not been mentioned in the literature, with the turned triangular shape of the pitot's inlet. This idea was aiming at the utilization of the best upper part of the inlet at the same time reducing the worst bottom part of the inlet. As a result of the CFD simulations it appeared that the newest pitot tubes work better than the best model of the oval-circle inlet group. The proposed shape of the inlet's pitot tube contributes to the increase of about 12 percent of the pressure with regard to the basic pitot tube model installed on the basic pitot tube pump, which leads to the increase of the pump's efficiency.

In addition the modeled internal channel of the pump stabilized the flow in the discharge collector causing the increase of the pump's efficiency by 4 percent.

To complement the results of CFD simulations, pitot tubes with the largest head for the oval-circular and triangular inlets made with the rapid prototyping methods (FDM method) were installed to the pump model and physical examinations were performed. The results confirmed the validity of the CFD simulations and enabled the determination of geometrical relations of the inlet's cross section and its dimensions in relation to the width of the rotating casing.

The complete CFD simulations and tests using the rotating casing of constant dimension caused the head and pump efficiency increase, which fully proved the thesis posed in the work.