LOCAL PARAMETERS OF THE LIQUID AT THE OUTLET OF THE FORMED SUCTION INTAKE OF VERTICAL AXIAL-FLOW PUMPS

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There are introduced numerical computations results of velocities, pressures and velocities measured using the Pitot probe at the outlet of the formed suction intake with and without the rib (Fig. 1).

There have been given conclusions of the comparative analysis of pressures and velocities computed numerically and measured using the Pitot probe. These conclusions have formed the basis for the verification of the unsteady flow computation method for the formed suction intakes proposed by the Institute of Turbomachinery of Technical University of Łódź. The evaluation criterion was the difference between the average RANS flow velocity and the average velocity from measurements.

Knowledge of velocities computed numerically and their circumferential components c_u, axial components c_a and radial components c_r at the formed suction intake outlet, also enabled the flow evaluation in terms of meeting the acceptance criteria given in the ANSI 9.8-1998 American National Standard for Pump Intake Design.

According to the standard ANSI 9.8-1988, a flow suppose to meet the following requirements:

- averaged in the time of 10 min, a liquid swirl angle Θ in the pump inlet cross-section suppose to fulfill the condition $\Theta \leq 5°$, a momentary (up to 30 sec) deviation $\Theta \approx 7°$ is acceptable,
- non-uniformities of a velocity profile, in relation to an average value of a measuring surface area, less than 10% in an every point of a cross-section,
- velocity fluctuation in a given point of a cross-section less than 10% in relation to a averaged value at the time during a measurement.

Introduced in the article, distributions of circumferential velocity components c_u, occurring at the formed suction intake outlet with the rib were shown in the Figure 2.
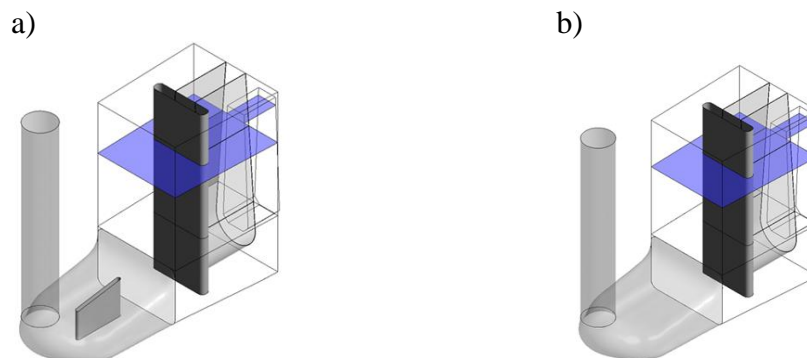
a)   b)

Fig. 1 Formed suction intake with (a) and without the rib (b).
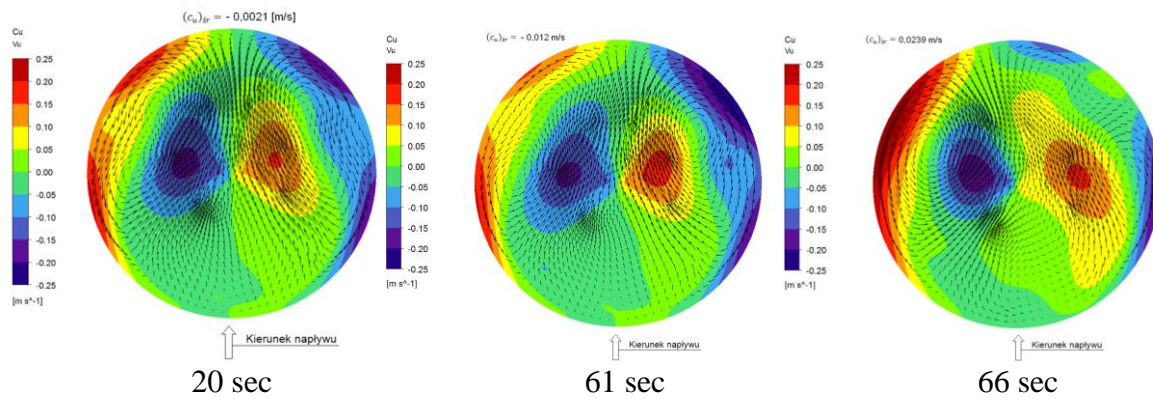
| 20 sec | 61 sec | 66 sec |

Fig. 2. Distributions of velocity vector fields imposed on distribution fields of circumferential velocity components c_u for 20, 61 and, 66 sec.

From these figures it is visible that in spite of average values of the circumferential component c_u oscillate around zero, there occur two, approximately symmetrical vortices, which presence is going to have an influence on delivery conditions.

On this basis it was stated that the recommended by the ANSI 9.8-1998 standard criterion applying to the swirl angle Θ does not guarantee obtaining the irrotational inflow at the impeller.

There was determined the influence of the rib on the local parameters at the formed suction intake outlet.

In this article it was also discussed the structure of the pump intake channels model test stand and the measurement program.

References

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