

SYNOPSIS OF THE FORMED SUCTION INTAKE DESIGN METHOD FOR A VERTICAL AXIAL-FLOW PUMP

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The article presents a concept of the formed suction intake design method algorithm for vertical axial-flow pumps.

Input data for design of formed suction intakes according to the proposed algorithm are flow parameters of the pump nominal work point:

- HN – nominal head of the pump,
- QN – nominal flow rate.

On the basis of these parameters, the pump selection is made from the catalogue, in which are given the geometrical parameters substantial for its' construction, including a diameter of an inlet. Most often, the inlet diameter of a pump is equal to the outlet diameter of the formed suction intake. Other dimensions of the formed suction intake are based on the diameter of its outlet according to the ANSI 9.8-1988 standard. Afterwards on the basis of this geometry and the nominal rate of delivery QN, numerical computations of the steady flow are carried out.

Next stage of computations involves the geometric parameter optimization of the formed suction intake using one of the chosen design optimization methods. Objective functions in the chosen multiobjective optimization method are closely related with the two flow acceptance criteria given in the ANSI 9.8-1998 standard:

- minimal possible liquid rotation angle in the pump inlet cross-section (standard recommends less than 5°)
- minimal possible non-uniformity of the velocity profile in the arbitrary point of the pump inlet cross-section to the average velocity determined as the quotient of a flow rate and the cross-sectional area of the pump inlet (standard recommends the acceptable non-uniformity limit up to 10%).

Final design solution of the formed suction intake should meet the above objective functions.

Flow delivery head to the pump HS determines unequivocally the location of the formed suction intake in relation to the liquid level in the lower reservoir (natural reservoir or the cooling tower container).

In the article there are also introduced conclusions of the comparative analysis of the velocity numerical computations and measurements using the Pitot probe in the formed suction intake outlet cross-section, tested in the laboratory of the Turbomachinery Institute of Technical University of Lodz (Fig. 1).



Fig.2 View of the model of the cooling water pump suction intake

References

1. American National Standard for Pump Intake Design. ANSI/HI 9.8-1998. Hydraulic Institute. 9 Sylvan Way, Parsippany, New Jersey 07054-3802, www.pumps.org
2. Błaszczuk A., Najdecki S., Papierski A., Staniszewski J. Model studies of the cooling water pump type 180P19 suction intake at the stand 8 of the Unit A in Patnow Power Plant. Report of the work stage I and II, archives of the Institute of Turbomachinery TU of Łódź 1542, 2006.