Effect of the volute tongue geometry on the performance of a spurt pump

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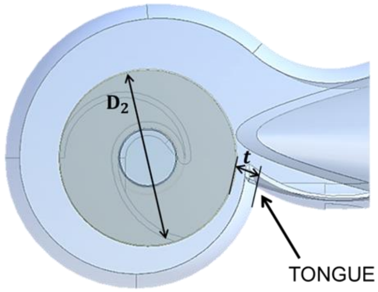
Long Abstract

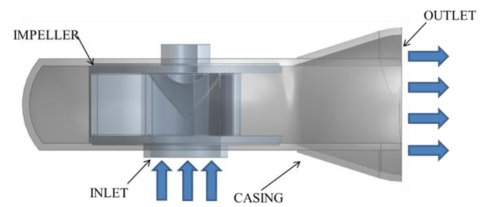
Introduction

As the industry develops, the throughput of various kinds of waste liquids according to production has been continuously increased. Especially, the demand of underwater slurry pump used in the waste water treatment field has been rapidly increased as the environment conservation becomes one of the crucial elements of the strategic enterprise management [1]. The spurt pump which is a type of centrifugal pump is mainly used to transfer high-viscosity materials such as slurry and sewage. This pump has an advantage to transfer a large amount of materials in short time by a specially designed impeller. Since disturbed and separated flows are generated in the vicinity of the tongue of the pump casing, the clearance between the outer circumference of the impeller and the volute tongue is a crucial design factor. In this study, the effect of the clearance between the impeller and volute tongue (t) (see Fig. 1) was numerically investigated using the commercial code, ANSYS CFX. In addition, the performance of the pump was evaluated on the basis of the pump head, efficiency, pressure distribution and total loss coefficient.

Methodology

For the flow analysis inside the spurt pump, three-dimensional (3-D) geometry was designed by using UG NX ver. 8.5 and ANSYS ver 17.1 Design Modeler, based on the actual model (see Fig. 1) [2]. The reference model investigated in this study is composed of impeller and casing. Grid systems were prepared by applying tetrahedron and hexahedron elements to the spurt pump. In order to evaluate the grid dependency according to the number of grids, the pump head was investigated from 100,000 to 1,000,000 elements. In addition, the inflation grid system with 10 layers was applied to the clearance between the casing and impeller. The working fluid is water and the mass flow rate is 58.16 kg/s at a rotating velocity of 1800 rpm, whereas the heat transfer in the analytical model is neglected due to no heat transfer in the working fluid. The flow region is separated by rotating and stationary regions and the effect on the rotation of the impeller is considered by applying the MRF (Moving Reference Frame) method. The pressure at the inlet of the spurt pump is assumed as a static pressure condition. The turbulent flow was modeled using the shear stress transport (SST) model which has been shown to give relatively accurate predictions in fluid machinery analysis [3].





(a) Volute tongue of spurt pump

(b) 3-D modeling

Figure 1. Schematic of the modeled spurt pump

References

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