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Study on Optimization Design and Two-Phase Flow of a Side Channel Pump

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Side channel pump is a kind of radial vane pump and can be understood as a combination of a positive displacement pump and centrifugal pump. It is entitled in this way because this pump has a side channel on the axial side of the impeller.

In recent years, side channel pumps are receiving increasing attention due to the high demand for lower specific pumps. As a regenerative pump, the head of the side channel pump increases many times among the radial impellers. However, the separate study on suction side blade profile is hardly seen in the open references. How to design a side channel pump with a better performance is still a challenging topic because of the complex flow inside the pump. This book conducts CFD-simulations on the flow and concludes that a vortex standing in the passage becomes weaker, if the triangular shape is applied. The numerical work was validated by the comparison between the simulated result and tested result. The author based its evaluation method on the exchanged mass flow which confirms that the performance of the side channel pump can be improved by increasing the angle on the suction side of the blade.

This book extends the research to finding the ability of the side channel pumps to transport liquid with some gas inside. The side channel pumps are better used for gas-liquid transportation under some industrial conditions compared with other vane pumps. The blade suction angle greatly influences the hydraulic performance of the side channel pump, but studies on the effect of blade suction angle on the performance of this kind of pumps under two-phase flow operating condition have not been conducted yet. The author has presented an experimental investigation on the performance of side channel pumps under gas-liquid two-phase flow operating condition. The effect of inlet gas volume fraction (IGVF) on the performance of the side channel pump with three different blade suction angles are compared in detail. The experimental data obtained could serve as a design reference to two-phase flow side channel pumps.

Lastly, the efficiency of the side channel pump is lower than other vane pumps such as centrifugal pumps and axial flow pumps. This effect is mainly caused by great losses inside the side channel pumps. Published references about where losses occur and its generation mechanism are also fewer because the losses always affect the hydraulic performance in pumps. The characteristics of the losses in side channel pump were investigated by the author calculating the entropy production in flow, in which the second law of thermodynamics was applied.

The results in this thesis could be used to supply reference for designing better

performance and wider applications of the side channel pumps.