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The Internal Flow Investigation of a Centrifugal Pump

by

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ABSTRACT

This paper provides the results of a detailed flow investigation within a centrifugal pump equipped with a vaned diffuser. The measurements made with a laser-Doppler velocimeter were carried out at the impeller design point. In a previous paper concerning the same machine, El Hajem (1998) found a jet-wake structure developing at the impeller exit. During the actual study, measurements were obtained in the impeller and the diffuser at different measuring planes relative to the diffuser vanes. Results are presented as animations reconstituting a temporal evolution of the flow at the diffuser inlet.

Unsteady velocity measurements obtained in phase with the impeller angular position gave access to the flow inside the impeller channels where three sections were explored. For each section, results were obtained as a function of the position of impeller blades relative to the diffuser vanes. Thus time resolved details of the flow could be examined for a better understanding of the complex unsteady flow existing between the two interacting blade rows.

The analysis of the impeller flow field indicates the presence of a complex, unsteady and periodic flow. It is organised in a jet-wake structure. The wake is characterised by low relative velocities and is localised in the suction side/shroud corner. At this flow rate, it seems that presence of the vanes has only a limited effect on the impeller flow structure, except when the blades suction side are facing the diffuser vanes.

At the impeller discharge, the time-resolved sequences show that the mixing process of the unsteady and periodic flow leaving the impeller is affected by the presence of the diffuser. At the leading edge, at the suction side of diffuser vanes, the flow is rapidly mixed. Whereas, when approaching the diffuser throat, the flow still shows its periodic character observed at the impeller outlet. This indicates that the diffuser is subject to unsteady inlet conditions that can alter its performances.

