



Slip factor correlations for mixed-flow impeller

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Abstract

Some slip factor correlations for centrifugal impeller have been corrected by impeller exit inclination angle to be used to mixed-flow compressor impellers. Results show that: (1) slip factor correlations of centrifugal impeller can be used to mixed-flow impeller while no proper mixed-flow slip factor models exist. (2) Equivalent blade number of mixed-flow impeller has critical value. Only little differences between results calculated by various slip factor correlations while equivalent blade number beyond the critical value. (3) Blade number, impeller exit inclination angle and exit blade angle of mixed-flow impeller are dominated over slip factor, but blade turning rate and flow coefficient have to be taken into account for more exact solution.

Key words: *Mixed-flow compressor impeller, Slip factor, Exit inclination angle correction, Equivalent blade number*

1. Introduction

For an impeller with an infinite number of blades, the exit flow angle should be the same as the exit blade metal angle. In the real world, however, the exit flow angle deviates from the blade guidance at the impeller exit due to the finite number of blades. Accurate modeling of the flow slip against direction of rotation is essential for correct prediction of the mixed-flow impeller performance. The process is characterized by a slip factor. Most correlations available for calculation of the slip factor are based on axial and radial impellers. (Carter and Hughes, 1946; Lieblein, 1960; Wiesner, 1967; Chen, 2005; Backstrom, 2006) In a mixed flow impeller, the flow at the exit of the impeller

has both axial and radial flow direction components and fluid flow is relatively complicated compared with axial and radial impeller. All of them bring great difficulties for the design of a mixed-flow machine. But the slip factor correlation for mixed-flow impeller is relatively rare. Qiu (GT2007-27064) has given unified correlations which can be used to axial, radial and mixed-flow impellers. However, there are no mixed-flow cases presented in the validation study for such machines. And Qiu concludes that it should be a safe interpolation to state that the proposed method can also be applied to mixed flow impellers.

This paper compared some slip factor correlations with experiment data to find proper correlations that can be