Numerically calculated rotor dynamic coefficients of a pump rotor side space

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ABSTRACT

A procedure was tested to determine rotor dynamic coefficients on the basis of numerical, three-dimensional flow simulations in the labyrinth seals and the rotor side space of a pump using a commercial CFD-code. Choosing an adequate, rotating co-ordinate system made steady calculations possible. Rotor dynamic coefficients could be identified from the regression of calculated forces.

A test case of plain seal configurations in combination with an intermediate chamber, for which detailed experimental data were available, was used to verify the CFD results. On the one hand simplified calculations of a plain seal configuration were performed, on the other hand three-dimensional calculations were done on the entire test case geometry. The agreement of numerically determined rotor dynamic coefficients with the experimental data and with the bulk-flow theory of Childs proved to be good. Furthermore, a three-dimensional flow simulation of an entire pump rotor side space was performed, demonstrating that the proposed method for calculation of rotor dynamic coefficients can be applied to very general cases.

Keywords: turbomachinery seals, rotor dynamic coefficients, pump rotor side space, CFD calculations, rotating co-ordinate system