Abstract

More than one third of the power of modern low pressure steam turbines is generated in the last two stages of the turbine. Therefore in the area of last stage/diffusor/exhaust hood improvements are of particular meaning and have great influence on the efficiency and the generated power. Up to now practicable suggestions for a quick and precise fluid mechanical dimensioning and optimisation of exhaust hoods in an industrial environment in literature are sparse. In this work a method is presented which enables a quick and precise fluid mechanical dimensioning and optimisation of exhaust hoods already in the phase of design. This developed method is especially suitable for an industrial environment.

Interaction between last stage and exhaust hood causes complex three dimensional fluid phenomena. These phenomena have to be taken into account in a physically correct way. For this behalf an algorithm is developed, which parts the calculation area into two reasonable parts. A database is the core of the presented calculation method. This database contains the exhaust characteristics e. g. distribution of pressure and velocity after the last stage. By the developed method it is possible to analyse the area of last stage and exhaust hood in connection with each other numerically in an acceptable time span.

The developed coupled calculation is a generic method and can be applied on manyfold combinations between last stages and exhaust hoods. It is possible to use any numeric program for fluid flow calculations. It has only to be granted, that the CFD-programs in use get the main fluid relations physically correct. For the present work commercial CFD-Codes were used and validated with numerous experimentally measured data. It shows that the programs in use are suitable for the occuring fluid flow conditions. The functionality of the developed coupled calculation method is proved by numerous fluid flow calculations in a real steam turbine.

The developed method for the separation of the complex calculation area of last stage/diffuser/exhaust hood can be used in principle in the whole turbomachinery field e. g. for pumps or inlet volutes. The presented method is suitable for solving fluid flow problems physically correct, which couldn't be solved otherwise or only with much effort. For the use of the coupled calculation a geometry is required which can be parted into two overlapping areas. Additionally it has to be possible to describe all relevant quantities at the interface between the calculation areas in dependence of a characteristic parameter.

Consequently a method is available enabling an optimal fluid mechanical dimensioning of complex geometry with a relatively low effort. Using the developed method on exhaust hoods it is possible to gain additional power of up to several MW for new power plants as well as for plants already in use.