Design of an axially concave pad profile for a large turbine tilting-pad bearing

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To improve operational safety and/or achieve higher load capacity of large turbine tilting-pad bearings an axially concave pad profile is presented. The thermal and mechanical stress of the loaded pads of a test bearing in load between pads configuration has been analyzed in detail. The bearing with a double tilting support is lubricated by spray-bars and can be described by the following specifications: Five pads, 0.23 nominal preload, 60% offset, 56° pad arc angle, 500 mm inner diameter, 350 mm pad length and 1.28 per mille relative bearing clearance. Both film thickness and pressure distribution have been measured in a very high resolution. Pad temperatures are measured by the means of 100 thermocouples which are located 5 mm behind the sliding surface. The test procedure and test rig are described in detail. A fluid film calculation program in combination with a finite-element program is used to simulate the deformation of a single pad under high circumferential speeds. In this context, the axial and tangential heat transfer coefficients of the pad surface, which act as boundary conditions for the calculation of the 3D temperature distribution, are determined using an optimization process. Herein, the match of predicted and measured pad temperatures is the goal. It can be shown that there must be a huge difference in heat transfer in axial and tangential direction in order to match the large measured temperature gradient in circumferential direction. Based on the measured deformed profile the code is used to derive a concave pad profile, which will result in an axially non-arched sliding surface under the expected thermal load. Therefore, an iterative simulation procedure is used. By decreasing the axial arching of the pad and thus the large film thickness at the axial ends using an improved profile designed for a specific operation point, the minimum film thickness and maximum pad temperature can be influenced beneficially. Hereby, either better operational safety or higher load capacity of the bearing can be achieved.

The comparison of measurement data and calculation results shows very good agreement regarding the pad deformations. The results indicate that by axially concave profiling of the loaded pads of a large tilting-pad bearing for a specific operation point, the static characteristics in the form of temperature, film thickness and load capacity can be improved.

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