Research Project: Temperature Calculation

Extended Calculation Tool for the Contact Temperature of Rotary Shaft Seals

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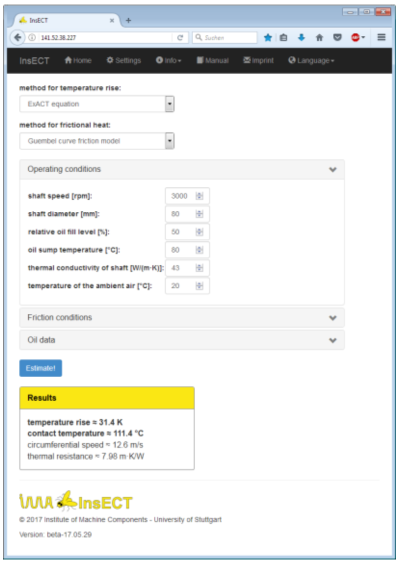
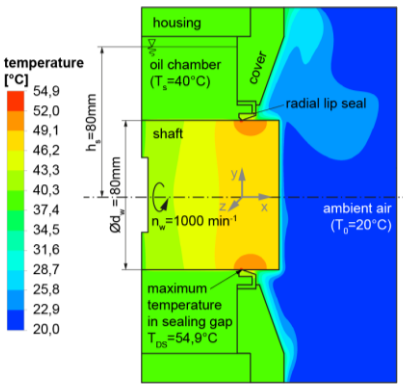
Friction torque test bench



Calculation tool InsECT



CHT simulation

Motivation/ Background

For rotary shaft seals, the contact temperature can be used to evaluate the risk of thermal damage. In the past, complex measurements or sophisticated simulations were required to determine the contact temperature. The InsECT web app, which can be accessed free of charge, was developed at the IMA and can be used to approximately calculate the contact temperature. However, only the most significant influencing factors have been incorporated thus far.

Aim and approach

The aim of the research project was to investigate further factors influencing the contact temperature and to integrate all relevant ones into the InsECT calculation tool. For this purpose, friction torque and temperature measurements were taken on a friction torque test bench alongside Conjugate Heat Transfer simulations (CHT) using the ANSYS simulation software.

Results

- An additional protection lip on a rotary shaft seal increases the thermal stress, especially if a vacuum can form between the main lip and the protection lip.
- The friction torque in the sealing system – and therefore its power loss/dissipated heat – is strongly influenced by the lubricant. The analyzed oils do not show a clear correlation between viscosity and friction torque. For precise statements, the respective tribological system (shaft, seal and oil) must be tested on a friction torque test bench.
- Water and water-glycol mixtures transfer the frictional heat much better than oils, but tend to cause increased wear on the seal.
- An amorphous carbon film, thermal spray coatings and nitrocarburization of the shaft have no significant influence on heat generation and transfer.
- Hollow shafts do not significantly reduce heat transfer. In the case of shaft sleeves, heat transfer is only significantly reduced in the case of very thin-walled sleeves on a base shaft with poor thermal conductivity. Shaft shoulders with a smaller diameter can reduce heat transfer if they are located on the air side and in direct proximity to the sealing contact.
- Rolling-element bearings in immediate proximity to the seal can significantly impact the availability of lubricant and the fluid temperature near the seal. Universally applicable statements are not possible due to the wide variety of bearing designs.

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