NUMERICAL ANALYSIS OF HERMETIC SEALING MECHANISM OF PTFE LIP SEAL WITH PUMPING STRUCTURES

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Elastomeric lip seals are used to seal rotating shafts in all areas of mechanical andautomotive engineering. The elastomeric lip seal is a frequent and reliable sealing systemin millions of cases. Based on its good static sealing and the active dynamic sealing mechanism it is accepted by the market. However, limits are set to its area of application.The load on the lip seal during its use, for example at high ambient temperatures and high shaft speeds leads to high temperatures at the seal edge. Also the high specific friction work leads to overheating. This degrades the elastomer and the fluid. Elastomeric lip seals are ageing very fast under such high-loads. An even bigger problem is the comparative low chemical resistance.

For these reasons elastomeric lip seals are being substituted more and more by sleevetype lip seals made of polytetrafluorethylene (PTFE) compounds. The PTFE lip seals can be used in a temperature range up to 260 °C and at higher circumferential speeds. Due to their good tribological attributes they can also be used at sparsely oiled sealing areas or for the sealing of poorly lubing fluids. Its universal chemical resistance is another major advantage. Because of its remarkable properties PTFE is widely used in sealing applications. In contrast to radial shaft seals made of elastomers, PTFE lip seals don't possess an automatic pumping mechanism. Therefore PTFE lip seals often have pumping structures in the contact area between seal and shaft. These pumping structures can significantly reduce or prevent leakage. For numerical research on seals, pumping structures in the contact area are problematic because they often require 3-dimensional simulations.

It was performed following research program:

- Setting up the numerical models in Ansys Workbench,
- Solving the numerical problem,
- Evaluation of the results,
- Validation of the results by comparison with experimental data,
- Documentation of the research process and results.

The challenges among others are:

- Meshing the 3D model, fine mesh in the contact area necessary, large deformation, element degradation could require remeshing,
- Nonlinear contact, convergence difficulties, appropriate contact algorithm,

Nonlinear material properties.