THE INFLUENCE OF MICROSCOPIC AND MACROSCOPIC GAP GEOMETRY ON ENERGY DISSIPATION IN LUBRICATING GAPS OF DISPLACEMENT MACHINES

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The lubricating gap represents one of the central design elements in displacement machines. An optimal gap geometry, i.e. gap shape and surface quality, influences significantly the efficiency, life, reliability and costs of the machine and thus of whole fluid power systems. It is the aim of this research project to extend the scientific knowledge concerning the physical processes inside the lubricating gaps of displacement machines and investigate the mechanisms, which micro and macro gap geometry variations cause which effect on the energy dissipation. Macro geometry stands for gap shape, and micro geometry denotes the quality or roughness of the sliding surfaces. A specific choice of the macro- and micro gap geometry should on the one hand support the development of pure viscous friction and thus reduce mixed friction, and on the other hand the gap shape variations can influence the gap flow in a way to reduce the amount of viscous friction and the volumetric gap flow simultaneously. For the investigation the gap between piston and cylinder of a swash plate type axial piston machine is chosen. This gap has an extensive potential for further improvement due to its special situation caused by the high loaded piston and the complex movement.

The project divides into a theoretical part and an experimental part. Within the theoretical part suitable piston macro geometries are determined with the aid of the simulation tool CASPAR, which has been developed at the Institute for Aircraft Systems Engineering. The simulation has already shown that certain spherical piston contours improve viscous friction, the gap flow and the load capacity of the gap simultaneously, while cylindrical pistons still call for a compromise. The experimental investigation is based on the *Tribo Pump*, a special test device to measure the friction forces between piston and cylinder under comparable operating conditions, i.e. at the rotating cylinder block and with a kinematics, comparable to conventional designs. The necessary contoured test pistons are produced within a co-operation project at the Fraunhofer Institute for Production Technology IPT Aachen by high precision hard turning. Measurement data have already shown the strong impact of the piston surface quality and the macro geometry on the beginning and amount of mixed friction. For certain operating conditions a special spherical piston has successfully opposed mixed friction and has lead to a friction force reduction among factor four compared to the cylindrical contour.

The *TRIBO pump* - a test device for measuring friction forces between piston and cylinder in axial piston machines