

## THIN FILM LUBRICATION OF A HYDRAULIC ROD SEAL EXPERIMENTAL STUDY USING ELLIPSOMETRY

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### ABSTRACT

Hydraulic cylinders are widespread linear actuators and have become indispensable in daily life machinery. They are used under harsh conditions in a variety of industries like aeronautics, agriculture machinery, heavy industry, mining or medical technologies. One of the critical components of a hydraulic cylinder is the rod seal. If the rod seal fails, leakage is the result. Consequences are downtime and environmental damages. For these reasons the rod seal has to be well designed.

The variety of industries need individual and customized sealing systems, but all of them demand zero leakage, a low friction coefficient, little wear and a long lifetime. These requirements strongly dependent on the lubrication conditions in the sealing gap.

Simulation models to analyse the lubrication conditions of rod seals are subject of decades of research. In recent papers Salant simulated fluid film generation depending on sliding speed [1]. Further theoretical studies have been summarized by Nikas [2]. Analytical models do not completely explain the experimental data sufficient, since tribological mechanisms in the sealing gap are not completely understood.

After an outstroke there is always a thin oil film on the hydraulic rod, Fig 1. The oil film allows conclusions on the lubrication conditions and the gap height of the rod seal. Hörl has shown that this film is in nanometer-scale and that it can be measured precisely using ellipsometry [3]. Compared to other measuring methods, ellipsometry can be used to analyse fluid film generation on practical hydraulic sealing systems and operating parameters like stroking velocity, fluid pressure and temperature. Measurements can be made around the circumference of the rod. Due to high vertical and lateral resolution the ellipsometer allows the analysis of stick slip phenomena in axial direction, Fig. 1.

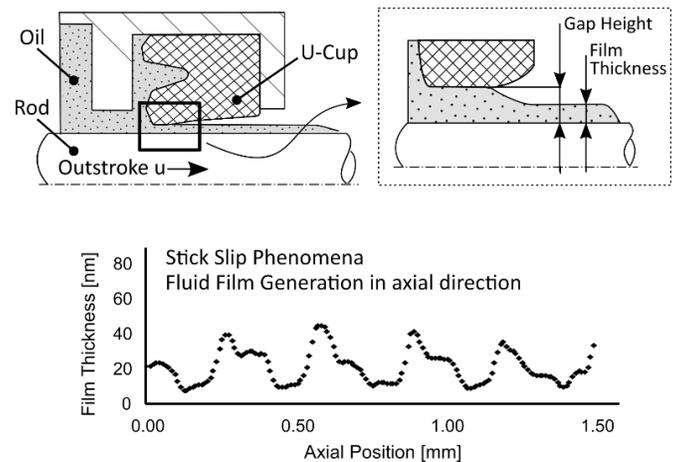


Fig.1 Film Thickness on a Hydraulic Rod

Ellipsometry is presented as a promising used measurement method to analyse the lubrication conditions of hydraulic rods. Experimental data show the correlation between the stroking velocity and the film thickness on the hydraulic rod. Furthermore the influence of the fluid viscosity on the gap height is shown. Finally the gap height, the viscosity and the measured friction are discussed. The presented experimental data allow conclusions on the lubrication conditions in the sealing gap. Thus a deeper understanding of thin film lubrication is obtained.

### REFERENCES

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