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Measurement of thin liquid film thickness between two mechanical surfaces in relative movement using the conductimetry technique: Application for hydrodynamic lubrication

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Abstract:

This paper presents an approach for the measurement of liquid film thickness in contact with a rough surface, based on electrical conductance sensor. This type of sensor consists of electrodes implanted on the wall and flush with an electrolyte solution representing the liquid film. Assessing of the generated current between a pair of electrode is used as a measure of the film thickness. The liquid film is contained between two parallel surfaces that one of which is coated with a certain roughness, while the other is smooth. The electrical probes are fixed on the smooth surface and the facing rough surface is removable allowing a free move of the wall. In this way, a rotational or a sliding motion is imposed on the rough wall allowing a browse of an entire surface relative to the electrode, in order to determine the influence of roughness on the film thickness measurements. In addition, a series of signal acquisition was carried out with imposed pressures on the upper plate for the characterization of the effect of the compression of the film on the measured thicknesses. The principle of this electrochemical technique is briefly explained, as well as how the lateral distance between the electrodes impacts the measuring range limit. The experimental setup is described and used to study liquid film flow with several configuration of the wall surface. The obtained results demonstrated the feasibility of this type of non-intrusive estimation, as it was possible to estimate the variable film thickness which is depending on the peaks and valleys of the rough surface. This is promising because measuring this parameter remains difficult. Finally, the analysis of the results made it possible to synthesize the advantages and limitations of this method.

Keywords: *Conductimetry, rough surface, film thickness, electrochemical probes*