

VISCOSITY MEASUREMENT IN-SITU AT HIGH PRESSURE USING ULTRASOUND

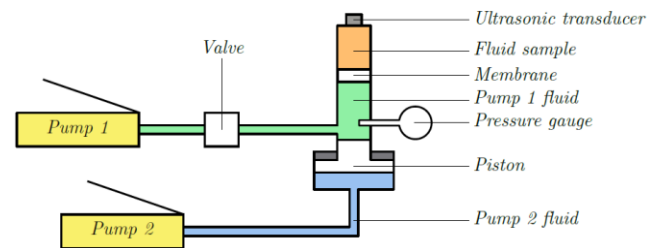
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KEYWORDS

- Fluid lubrication
- Rheology
- Experiments in tribology
- Viscosity

ABSTRACT

Machines in industry transmit motions under various speeds and loads, leading to high temperatures, shear rates, and pressures in contacts. Lubricant viscosity is crucial to separate surfaces in contact and ensure good efficiency. Viscosity depends on the operating conditions; its knowledge under operating conditions can thus prevent failures. Conventional viscometers cannot replicate tribological contacts, especially the impact of high pressure.

Ultrasound is an in-situ and non-destructive technique that has been used for predictive maintenance and to measure wear or film-thickness. It is based on reflectometry: a shear ultrasonic wave is sent in the test piece. At the interface with the lubricant, the wave is partially transmitted and reflected. The reflected wave is measured and is compared to a reference in order to compute a reflection coefficient. Recently, adding a matching layer improved the sensitivity of shear waves to

liquids and thus led to new opportunities to measure lubricant viscosity using ultrasound [1].

A high-pressure cell is instrumented with ultrasonic equipment (Figure 1). Several fluids are pressurised from ambient pressure up to 500 MPa. Ultrasound signals are acquired as well as temperature and pressure recordings. The impact of pressure on the ultrasound measurement is assessed.

Fig.1 The instrumented high-pressure cell

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- [1] M. Schirru, M. Varga, “A Review of Ultrasonic Reflectometry for the Physical Characterization of Lubricated Tribological Contacts: History, Methods, Devices, and Technological Trends,” *Tribol. Lett.* 70, 129, 2022.