

Fluid Property Measurements for Tribology

Scott Bair^{C, S}

Georgia Institute of Technology, School of Mechanical Engineering, Atlanta, GA, U.S.A.
scott.bair@me.gatech.edu

Tribology is the study of interacting surfaces with relative motion; encompassing friction, material wear and lubrication. Elastohydrodynamic lubrication (EHL) is the important mechanism of separating elastically deforming surfaces with a thin film of highly pressurized liquid. This pressure substantially influences the properties of the liquid. In spite of the very obvious implications for industry and transportation, little attention is paid to these EHL films until they fail to prevent contact. The thickness of the film and the energy dissipated in shearing the film are of primary interest. Energy dissipation in EHL films contributes to the energy loss of the entire machine. EHL research has developed over the last sixty years in an odd way. Viscosity is easily the most important property of the liquid. Viscosity, however, has been treated as an adjustable parameter so that the favored assumptions regarding viscosity dependences will result in agreement with experiment while the capability of viscometers to provide useful measurements has not been acknowledged. Indeed, a recent review[1] of the field reported that the use of viscometers to measure viscosity is controversial because of the discrepancy between viscometer data and the viscosity that has been extracted from friction experiments using popular assumptions. The situation has changed in the last four years with the first full numerical simulations of the EHL problem using viscosity and its dependences on temperature, pressure and shear measured with viscometers. New tribological phenomena are now being predicted by analysis before being observed and validated experimentally. The techniques of measuring viscosity under very severe conditions of pressure and shear stress will be discussed.

[1] Spikes, H.A., "Sixty Years of EHL," *Lubrication Science*, Vol.18, 2006, pp.265-291