Development of a Falling Body Viscometer to Operate up to 300 MPa. Application to Vegetable Oils

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One of the goals of our research project is to study, from a theoretical and experimental point of view, the viscosity and the pressure-viscosity coefficient of lubricants such as vegetable and synthetic oils over wide pressure intervals. From these properties, the central film thickness in elastohydrodynamic lubrication can be determined, the knowledge of this quantity is crucial to develop new lubricants for gears and hydraulic fluids. In this work we present a new falling body viscometer (visLPT2) that has been designed and implemented in our laboratory to study liquids, from moderate to high viscosity, at pressure conditions up to 300 MPa. The apparatus is similar to that previously designed by Daugé et al. [1]. In this viscometer a cylindrical sinker, with a hemispherical end, falls vertically in the fluid under study. The fluid is forced to flow through the space between the sinker and the tube. The equipment has been calibrated by using diisodecyl phthalate (DIDP) which has been recently recommended as reference fluid for moderate viscosity measurements [2]. The good accuracy of the viscometer was verified after comparing experimental results of squalane with literature data which can be reproduced within 4 %. The visLPT2 apparatus, together with a commercial rotational viscometer that operates only at atmospheric pressure, have been used to study the viscosity of a vegetable and a mineral lubricant from 313.15 to 363.15 K and from 0.1 MPa to 250 MPa. Comparisons between the central film thicknessess obtained for the mineral oil and the vegetal oil as a function of the temperature are presented.

[1] Daugé P., Baylaucq A., Marlin L., Boned C., *J. Chem. Eng. Data* 46 (2001) 823–830.
[2] Caetano F.J.P, Fareleira J.M.N.A., Fröba A.P., Harris K.R., Leipertz A., Oliveira C.M.B.P., Trusler, M. J. P. and Wakeham W. A.; *J. Chem. Eng. Data* 2008, 53, 2003–2011.