A Study regarding to the Connections of Electrochemical Properties of Metals and Lubricants Rheology in Cylindric Taylor-Couette Flow

Nicolae-Adrian Palusan*, Ioan-Mihai Costea**

Lubrifin & Co., 50, Harmanului Sreet, 2200 Brasov, Romania,
*e-mail: apalusan@lubrifin.ro - Web page: http://www.lubrifin.ro/
**e-mail: costea@lubrifin.ro - Web page: http://www.lubrifin.ro/

ABSTRACT

In order to perform time-dependant viscometric measurement on viscous fluids, having a non-newtonian behaviour related to a long "characteristic time" a new type of viscometer with a sensitive dynamic has been built up in a co-operation between our Research laboratory and Tribology laboratory of Technical University of Brasov and Chemical Instruments laboratory of Timisoara Technical University.

A typical measurement is that of relaxation of rotational velocities when the both cylinders are subjected only to the viscous resistance.

The Couette cell is composed from two moving concentric cylinders (the outer cylinder the mover and the inner cylinder is the moveable) [1]. The inner cylinder, which is moving supported by an air bearing (for frictions elimination), is interchangeable and we can obtain the variation of the gap dimension (between the cylinders) and the built material of inner cylinder.

When a viscous fluid is sheared between two concentric cylinders undergoing differential rotation, the free surface of the fluid is deformed as a consequence of the shearing motion, and too a consequence of both, the gap dimension (between the cylinders) and the built material of inner cylinder (different surface tension effect for different material).

In this paper, it is considering, only four inner cylinders, with different cover material type of cylindrical surface (gold, copper, nickel and steel (iron)), and the same cylindrical surface roughness (very low Ra, 0.24μm), for the study of influences of this materials on the flow.

Experiments were carried out with two different fluids, a 90% water – 10% glycerin solution, and a emulsion with 5% mineral oil (which were contained a un-ionic emulsifier). All four cylinders were used with all two fluids at the four different rotational speeds, of outer cylinder (the mover cylinder), only in counter-clockwise direction. Because, the gap between the cylinders was thin (only 1mm), the Weissenberg effect (the climbing fluid up the inner cylinder) was neglected.

Gold is completely chemical inactive to water, and is no wettable by water. Nickel is chemical passive to water (because it forms complex combinations with inactive chemical character to water), but is wettable by water. Copper and steel are chemical active to water and they is wettable by water. Steel (iron) is more electro-positive than copper.

Supplementary, in emulsion cases, were significant the effect of emulsifier, the dispersion level, and the level of shear stress of the emulsion particles [2]. Also the particles had introduced a geometric effect. But the rheological behaviour in flow time was in the same direction.

The results are applicable to rheological and tribological behaviours of lubricants water based for metal working fluids and hydraulic fluids water based.

REFERENCES

[1] Ravey, J.C.: Dognon, M.: *Transient Rheology in Couette Apparatus*. Rheologica Acta, 19(1), 51-59, 1980.

[2] Mason, T.G.: Weitz, D.A.: *Optical Measurements of Frquevency-Dependent Linear Viscoelastic Moduli of Complex Fluids.* Physical Review Letters, 75 (14),1250 – 1253, 1995.