PRELIMINARY MEASUREMENT OF THE VISCOSITY OF A LIQUID METAL BY A CONCETRIC CYLINDER METHOD

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The dynamic viscosity of liquid metals are low (in the range of 1-10 mPa.s) and are generally measured with an oscillating vessel type viscometer, where the metal experiences a low shear rate and the theory assumes Newtonian behaviour.

Concentric cylinder viscometers enable the viscosity to be measured as a function of shear rate although they are not preferred method for the determination of liquids with low viscosities since there are difficulties associated with the alignment of the stationary cylinder coaxially with the revolving cylinder. End-effects, inertial-effects, presence of Taylor vortices are other commonly observed flaws in this measurement [1]. Despite these drawbacks, the concentric cylinder method remains practically one of the only methods of measuring viscosity of liquids for a wide range shear rates (low values of 1 s^{-1} [3] to high values of 1,000,000 s^{-1} [4]).

A modified concentric cylinder type viscometer is presented which has the outer cylinder rotating and the inner cylinder free to oscillate, being suspended by a torsion wire. The rotation of the outer cylinder leads to greater stability of the liquid in the gap between the two cylinders [2]. Fig.1 shows the schematic of the machine, which has been developed at Brunel University in collaboration with Ravenfield Industries for the viscosity measurements. Preliminary results (Fig.2) using Newtonian liquids show the stability of the machine while measuring the viscosity of standard viscosity oils from PSL, UK.

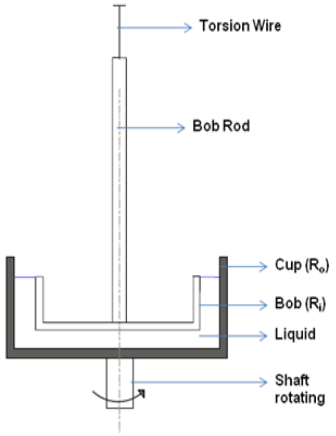

Fig.1. A Schematic Diagram showing the working principle of the machine.

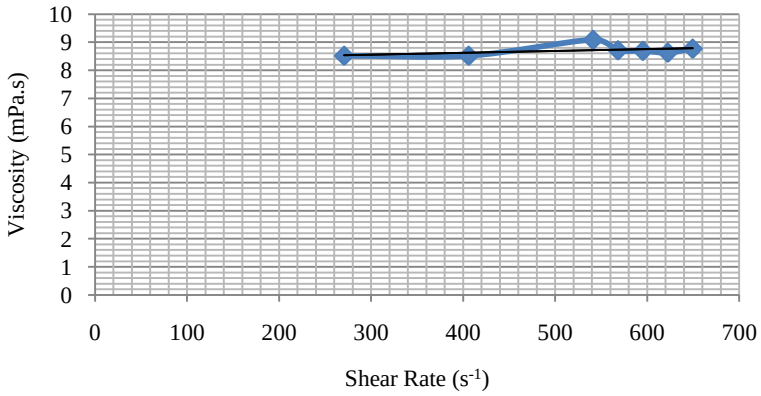

Fig.2. The variation of viscosity in standard calibration oil S6 with shear rate. Intercept value viscosity = 8.3498 ± 0.01 mPa.s (At 20 ^{o}C, Dynamic Viscosity = 8.124±0.018 mPa.s, PSL Certified value).

References:

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[3]Kaye, A. and Saunders, D.W., J. Sci. Instrum., Vol. 41, (1964), pp. 139-144
[4]Manrique, Jr., L.A. and Porter, R.S., Rheol. Acta 14, (1975), pp. 926-930