Tests of Working Equations for the Oscillating Quartz- Crystal Viscometer

Stephen Richardson and William Wakeham [C, S]
Department of Chemical Engineering, Imperial College London, London, United Kingdom
w.a.wakeham@soton.ac.uk

Viscometers based upon the torsional oscillations of a cylindrical quartz crystals have been employed since the middle of the last century for measurements on fluids of expanding variety over wide ranges of temperature and pressure. Most of these instruments have been used within a laboratory context for measurements on well-characterised fluids but more recently attempts have bene made to use similar instruments in the rather more extreme environment on logging tools with oil and gas wells. As electronic instrumentation has improved the precision of the instruments has been enhanced considerably but the accuracy of the devices has been limited by the absence of a complete analysis of the combination of the electro-mechanics and fluid mechanics involved, largely because the early work, which led to the first working equation, derived from electrical engineering analogues.

Recently, the present authors have conducted a complete analysis of the oscillating quartz-crystal viscometer and that has led to the establishment of rigorous conditions under which two different working equations for the instrument have been derived both of which provide the ability to determine the viscosity of the fluid surrounding the crystal. In this paper we examine several instruments that have been used for the measurement of the viscosity of simple fluids with respect to both equations. For each of the instruments the viscosity derived from the two working equations is dramatically different indicating that in some unknown fashion the practical instruments depart form the ideal model upon which the theory is based.