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THE ADVANTAGE OF DOUBLE-GAP CYLINDERS TO MINIMISE THE UNCERTAINTY OF VISCOSITY MEASUREMENTS

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Abstract
Concentric cylinders are one of the two most common geometries for measuring shear properties in rotational rheometers, especially those of fairly mobile liquids. For a given rotational speed the rheometers are usually equipped with purpose-built hardware and software that measures the torque and converts both those quantities into a shear rate and stress, or shear viscosity. To obtain these latter quantities the software controlling the rheometers implement equations assuming the fluids under scrutiny have a constant viscosity. Unfortunately that is not the case and most of the fluids have a shear-thinning behaviour.

In this paper a procedure is presented for establishing the uncertainty of viscosity measurements in concentric cylinder geometries. The emphasis is put on assessing the error due to the assumption of a constant viscosity fluid and examples are based on measurements of the viscosity of aqueous solutions of 0.4% CMC and 0.25% xanthan gum using the Physica UM/MC 100 rheometer. The low viscosity of the solutions required measurements to be carried out with the more sensitive double-gap geometry and the results of the analysis show this geometry to be doubly beneficial: it provides higher measured stresses than a single concentric cylinder and the assumption of a constant viscosity introduces nearly symmetric errors in each of the gaps, thus minimising the overall uncertainty of the final result.