

Can an Instron Tensile Machine Be an Extensional Rheometer?

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Extensional rheology complements shear rheology by analysing material deformation under different stress conditions. While shear tests are primarily straightforward to perform as the equipment and methodologies for shear testing are well-established, extensional rheology instruments have evolved over decades to address challenges such as high-temperature testing of molten polymers and predicting sample geometry under large deformations.

A key method for handling geometry changes under high stress involves controlling the cross-head speed via a loop program during tests, as implemented in the VADER 1000 rheometer. However, this technique is limited to high temperatures, requiring samples to adhere to the plates. It works best for low-viscosity materials (e.g., polymer melts and solutions), restricting its use for many commercial polymers and industrial conditions.

To broaden the range of measurement temperatures, we report here the possibility of achieving the full control of extensional rheological tests with the innovative TestProfiler method integrated into the Bluehill Universal software by Instron. The validity of the method was evaluated by analysing a commercial polystyrene sample in its molten state. The results obtained by applying a loop-controlled true strain rate profile using an Instron 68TM-10 instrument were found in good agreement with those measured with a VADER 1000 device and with the Extensional Viscosity Fixture (EVF) developed for the Advanced Rheometric Expansion System (ARES).