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CHOICE OF POLYMER SAMPLES GEOMETRY FOR MEASUREMENT OF ELONGATIONAL VISCOSITY USING SER UNIVERSAL TESTING PLATFORM

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Summary: *The aim of this contribution consists in verification of invariantness of uniaxial elongational measurements using the SER Universal Testing Platform with respect to the dimensions of polymer samples applied. There is shown that for sufficiently broad region of admissible widths and thicknesses the results are identical. For these measurements there was used LDPE Escorene (Exxon, U.S.A.).*

1. Introduction

Generation of purely uniaxial elongational flow of polymer melts is very uneasy problem. It seems that each hitherto developed device for measurement of uniaxial elongational viscosity also produces - to some extent - a planar flow. During the last period there has been questioned - based on this reasoning - the applicability of a SER Universal Testing Platform (Sentmanat (2003), Fig.1) and was recommended the range of rectangular dimensions of polymer samples for which measurements of uniaxial elongational viscosity is possible to take into account, Yu et al. (2009).

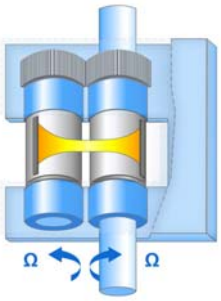

Figure 1 Sketch of the SER Universal Testing Platform.

The SER Universal Testing Platform ranges among the experimental devices for which there is a possibility to apply polymer samples aspect ratios (width/length) of which can attain

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very moderated values (even approaching a unit value from below). This strikingly contrasts to the 'classical' devices from the 80s' working with very oblong shapes of polymer materials. Hence purely theoretical conclusions in Yu et al. (2009) should be compared with the experimental analysis.

The present contribution aims at the measurements of transient uniaxial elongation viscosity of low density polyethylene material using the SER unit for different rectangular shapes of polymer samples with the emphasis on the comparison of the individual measurements.

2. Experimental

Measurements were carried out using the SER Universal Testing Platform from the Xpansion Instruments; the model SER-HV-P01 was applied with a Physica MCR501 rotational rheometer host system. For the measurement of transient elongational viscosity of a polymer melt at temperature of 180, 190, and 200°C there was used a convection heated measuring chamber CTD450 equipped with a camera system. The low density polyethylene (LDPE) Escorene used in the experiments is produced by the company Exxon, U.S.A. The width of the rectangular samples consecutively attained 12.7, 11.0, 9.3, 7.4, 6.5, and 4.2 mm. The thickness varied across a sufficiently broad interval 0.3-1.0 mm. The fixed active length 12.7 mm is given by the geometry of the SER unit. Transient uniaxial extensional viscosity was measured under the extensional strain rates 0.0316, 0.1, 0.316, 1.0, 3.16, and 10 s^{-1}.

For all three temperatures there were documented the identical results for all chosen widths and thicknesses as depicted in Figs.2-4.

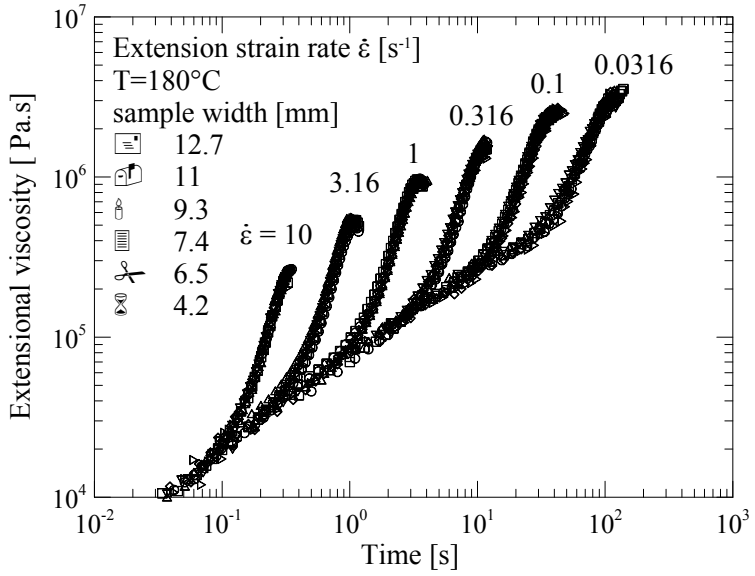

Figure 2 Comparison of uniaxial extensional viscosity measured with various widths and thicknesses of the samples at temperature of 180 °C.

3. Conclusion

There is shown that the recommended theoretical upper limits by Yu et al. [2] of rectangular samples, i.e. width < 0.8 mm and thickness < 0.4 mm, can be ignored due to experimentally verified invariantness of polymer samples with respect to their widths and thicknesses in the ranges measured.

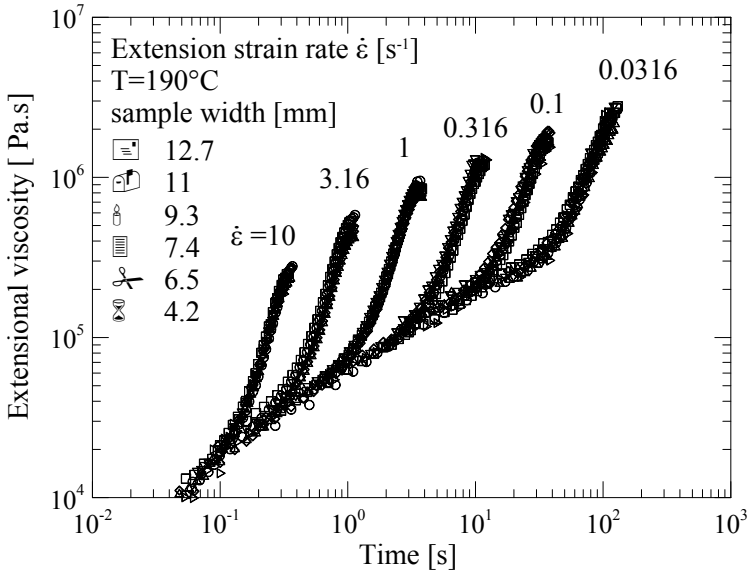

Figure 3 Comparison of uniaxial extensional viscosity measured with various widths and thicknesses of the samples at temperature of 190 °C.

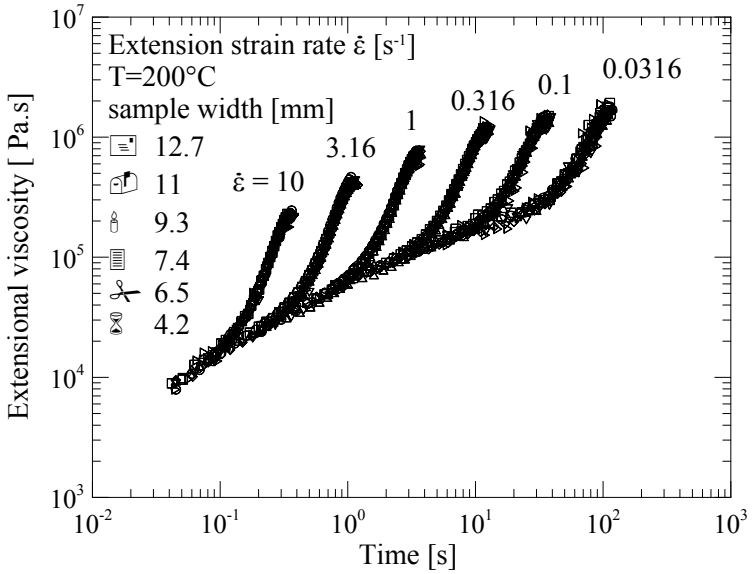

Figure 4 Comparison of uniaxial extensional viscosity measured with various widths and thicknesses of the samples at temperature of 200 °C.

4. Acknowledgement

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5. References

Sentmanat, M.L. (2003) Dual wind up extensional rheometer. US Patent No. 6578413.

Yu, K., Marin, J.M.R., Rasmussen, H.K. & Hassager, O. (2009) Modeling of Sentmanat Extensional Rheometer, *5th Annual European Rheology Conference*, 9-11 April, 2009, Cardiff, U.K., CD ROM.