HOME WORK N°1
Phenomenological Constitutive Model

J.P.M. Correia
(jpm.correia@unistra.fr)

Experimental Results

Uni-axial compression tests were performed at room temperature on two polymers (PC and PMMA) and with different strain rate values.
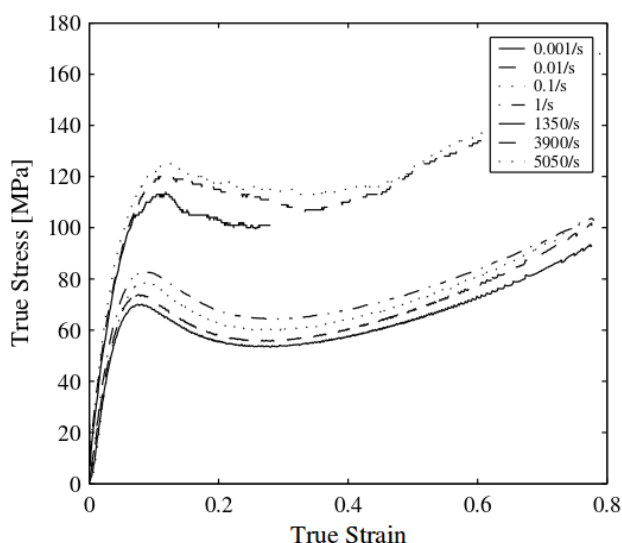

Figure 2: True stress-true strain behavior of Lexan PC across six decades of strain rate. Reported high-rate strain rates are averages across the duration of the reported data.
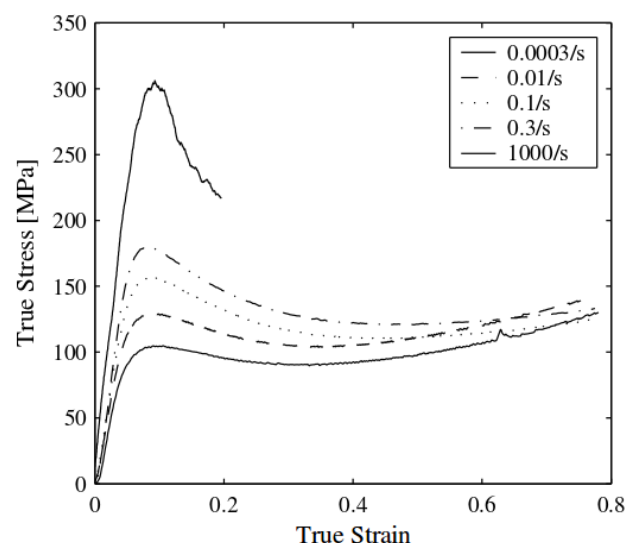
Figure 3: True stress-true strain behavior of G Plexiglas PMMA across seven decades of strain rate. Reported high-rate strain rates are averages across the duration of the reported data.

The comments of Mulliken and Boyce on the stress-strain curves :

"In figures 2 and 3, the yield strength of both PC and PMMA are found to increase with increasing strain rate. In PC, the overall shape of the stress-strain curve is generally the same at all rates. PMMA, on the other hand, exhibits a significant reduction in apparent strain hardening at moderate strain rates, as seen in the work of Arruda et al [17]. This has been shown to be due to the adiabatic test conditions at these rates ; some fraction of the plastic work is converted to heat. Thus the polymer experiences thermal softening with increased plastic straining; the yield stress of PMMA is more temperature sensitive than that of PC and thus thermal softening is observed only in the PMMA data. Also, PMMA behavior appears to transition from ductile to brittle at a strain rate between the ranges of the two apparatus employed"

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➔ Write a FORTRAN code with the constitutive model proposed by Duan et al. (2001). For validation purposes, reproduce the different figures presented in the paper of Duan et al. (2001).

➔ Write in FORTRAN a code to identify the values of the material parameters used in the constitutive model. Report the material constant values in a table.

➔ For both polymers, reproduce the experimental stress-strain presented curves with your FORTRAN code. Plot in a same figure the predictions and the experimental curves.

➔ Write a presentation with your results and your comments.