High pressure characterization of polymers

INTRODUCTION

When an elastomer is cooled below its glass transition temperature (Tg), it loses its elasticity and becomes brittle. For elastomer O-rings, that are used for sealing purpose, Tg thus corresponds to a lower limit of use. Problems arise when they are used in high pressures systems, as their Tg may be shifted to higher temperatures.
The MICROCALVET, with its high pressure capability, is the most suited to investigate the Tg dependence vs. pressure as it allows purely isobaric temperature scanning experiments.

EXPERIMENT

Three 360mg samples of the same elastomer O-ring were heated between -40°C and 20°C at a rate of 1K/min under nitrogen pressures of 1, 100, and 400 bar.

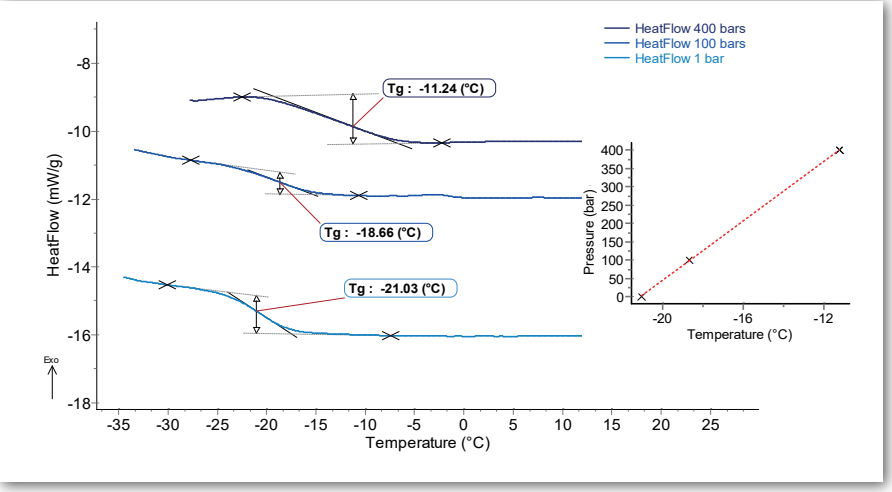

Figure 1: Determination of elastomer glass transition temperature under 1, 100, and 400 bar of nitrogen.

RESULTS AND CONCLUSION

Glass transition temperature (Tg) can be determined at each pressure thanks to the heat capacity change of the elastomer. It is noticed that Tg increases with pressure, with a shift of about 10°C between 1 bar and 400 bar.
As a first approach, the evolution of Tg is described by a linear equation on the tested pressure range with a R^2 value of 1.

INSTRUMENT

MICROCALVET

-45°C to 120°C

HIGHEST HEAT MEASUREMENT ACCURACY
3D sensor based on Peltier elements with Joule effect calibration.

MODIFIABLE TEMPERATURE CONDITIONS
for increased flexibility and replication of real life conditions.

CONVENIENT INTERCHANGEABLE CRUCIBLES AND CELLS
to perform even the most demanding experiments using one instrument :
- high pressure (1000bar) and high vacuum
- pressure measurement and control
- mixing experiment

EXTERNAL COUPLING CAPABILITY
designed to increase your research options including manometry, BET instrumentation, gas analyzers, humidity controllers and gas panels