Characterization of Heat Shrink Films Using DMA Film/Fiber Clamps and Controlled Force Mode

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ABSTRACT

The shrinkage characteristic of polymer films is detected with the DMA Q800 using film/fiber clamp in controlled force mode.

INTRODUCTION

Dynamic mechanical analysis (DMA) is an analytical tool that measures the modulus (stiffness) and damping (energy dissipation) properties of a materials as it is deformed under periodic (oscillatory) load. The DMA Q800 with its optical encoder to measure displacement and air bearings for "frictionless" support makes it the preferred measurement tool for small deformations and thin.

Heat shrink films are used in packaging to provide a taut cover that permits the viewing of the product while protecting its appearance. A manufacturer of heat shrink films was faced with a quality problem. One production line produced film that in end-use shrank a modest amount and provided the desired taut package appearance. Another production line produced film that over shrank crushing the package and providing an unacceptable product presentation. In order to troubleshoot this production problem, the Q800 DMA was used.

EXPERIMENTAL

The film is cut with two parallel razor blades in small strips of known widths. The film is mounted in the film/fiber clamp and the length is measured at the start temperature of 40 °C by the DMA measure mode. The shrinkage of the film is monitored under a constant static force of 0.1 N with a temperature ramp of 5 °C/min up to 150 °C.

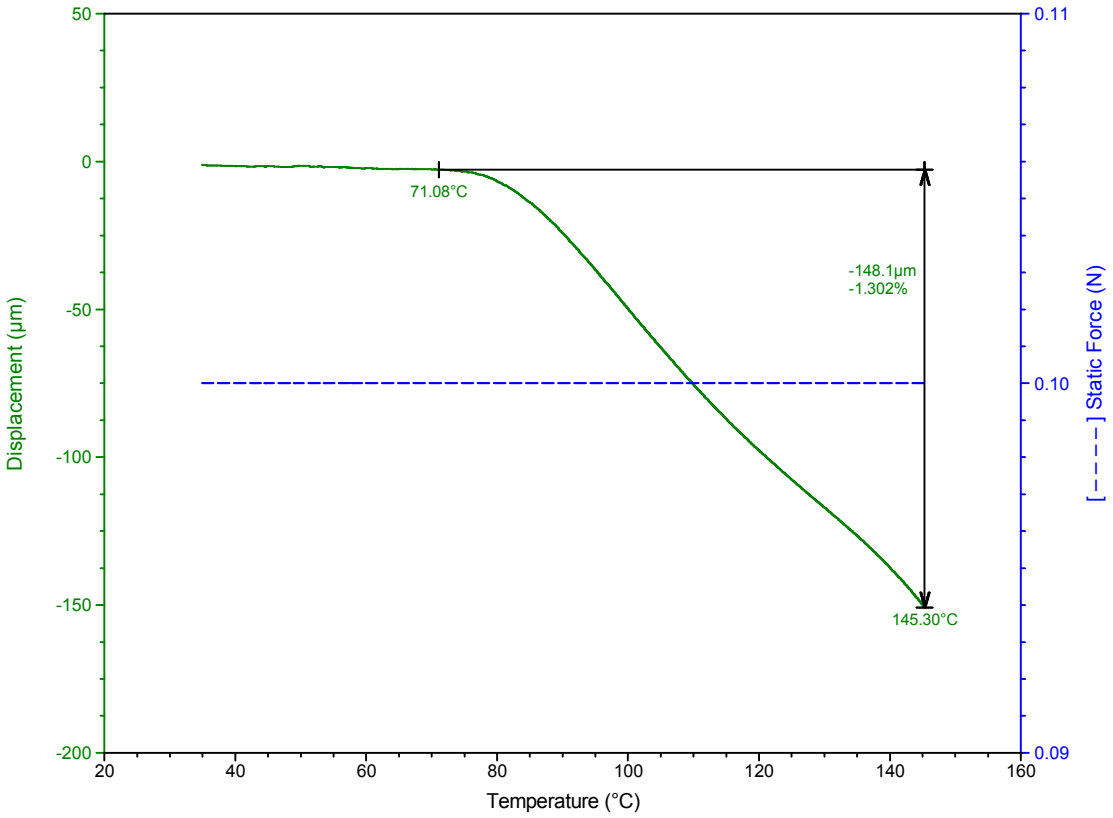

Figure 1 - Polymer film with strong shrinkage

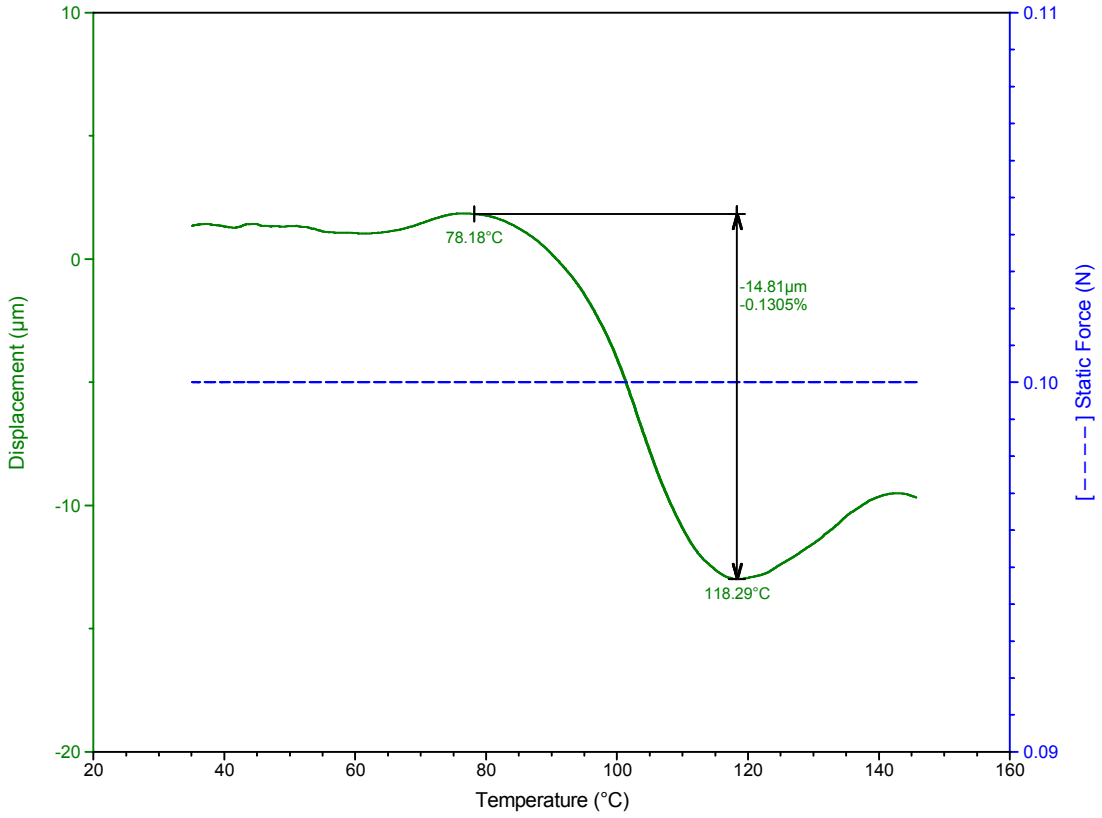

Figure 2 - Polymer film with normal shrinkage

RESULTS AND DISCUSSION

The shrinkage behavior of the two polymer films is easily monitored. The excessive shrinkage film in Figure 1 shows a 148 µm (1.3 %) length change while the normal shrinkage film in Figure 2 shrinks only 14.8 µm (0.13 % of the length) reaching a maximum in displacement at 118 °C. At higher temperatures the film softens and the displacing force becomes weaker until the motion reaches his limit. The polymer film in Figure 1 has a constant shrinkage between 70 and 145 °C.

CONCLUSION

The shrinkage characteristics of polymer films are easily monitored with the DMA Q800 using the film/fiber clamp in the controlled force mode.

KEYWORDS

dynamic mechanical analysis, expansion and contraction, films and fibers, polyolefin, thermoplastic polymers

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