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Specific Volume of P/E Random Copolymers

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Introduction
P/E Random Copolymers have a minor volume, but an important economical share in the PP global market. Main application areas are film, rigid packing (injection moulding) and pipe applications.

Figure 1 Health care (left), textile and flower packaging (center) and stationary films (right)

Since specific volume is the key parameter for the final shape of a product, e.g.: Injection moulding, a custom designed dilatometer was used for the quantification of parameters like shear and cooling rate on specific volume.

Material and methods
Materials
A homopolymer (Borealis HD234CF) and three P/E RACOs with different ethylene contents of 3.4%, 5.2%, and 7.3% respectively (Borealis RD204CF, RD226CF, and RD208CF) were investigated in this study. All grades have a melt flow rate of 8 g/10 min (230 °C/2.16 kg), a weight-average molecular weight (Mw) of 310 kg/mol, and a polydispersity (Mw/Mn) of 3.4 [1].

Methods
A fully automated custom designed dilatometer was used in this study. The experimental procedure used was as follows: The samples in the experiment were molten at the thermodynamical melting point and kept at this temperature for 10 minutes to erase the memory of their former structure. Next, the samples were pressurized and subsequently cooled. A unique feature of this dilatometer is the optional application of a defined shear step (total shear and shear rate were set) at a set temperature during the cooling period. In this way the influence of flow during processing can be studied in a systematic way.

Figure 2 Dilatometer (left), experimental procedure (right)

Results
The experiments were performed at different elevated pressures of 100bar, 200bar, 400bar and 600bar and cooling rates of 0.1°C/s and 1.5°C/s respectively.

Figure 3 Polymer series at 100 bar (left), and at 600 bar (right)

Additional experiments with a total shear of 135 and a shear rate of 67s⁻¹ were performed at a temperature of 141°C.

Figure 4 iPP HD 234 CF (left), P/E RaCo Polymer RD 208 CF (right)

Conclusions
□ Dependent on the composition the transition temperatures of the materials shift to lower temperatures with increasing ethylene content.
□ A pronounced influence of flow on specific volume was found

References: