Abstract

The development of modern polymerization processes allows the preparation of complex (co)polymers with different chemical composition, molar mass, architecture, microstructure and/or end-group functionality.

In the first part of the PhD thesis, the aim was to investigate the influence of the microstructure on the chromatographic behavior of copolymers as well as on their properties in solution and in the solid state (thermal properties). For this purpose, I studied three gradient copolymers and one block copolymer with differently distributed repeating units of propylene oxide (PO) and propylene phthalate (POPA) along the copolymer chains. All copolymers had comparable molar mass averages of both components and comparable chemical compositions as well as narrow distributions in molar mass and chemical composition, to avoid the influence of both parameters on the chromatographic behavior of the copolymers in liquid chromatography under critical conditions (LCCC) and gradient liquid adsorption chromatography (gLAC) on columns packed with a reversed stationary phase that was polystyrene cross-linked with divinylbenzene (PS-DVB) or silica coated with C18 alkyl chains. On both reversed stationary phases, the gradient copolymers eluted from the column according to the increasing strength of the gradient in gLAC or LCCC for the POPA component. The differential scanning calorimetry results showed that the gradient copolymer with the strongest gradient has two glass transition temperatures like a block copolymer, which correspond to the glass transition regions of the corresponding homopolymers. On the other hand, the gradient copolymer with the weakest gradient exhibits one broad glass transition region, similar to a random copolymer. As in the above cases, the microstructure also affects the solution properties of the copolymers, since a higher volume fraction of the thermodynamically poor solvent was required to observe the turbidity of the copolymer solution with increasing gradient strength in the comonomer distribution along the copolymer chains.

The second part of the PhD thesis dealt with the development of a liquid chromatography method for end-group characterization of recycled polyether polyols (RP). The chemical recycling of polyurethane (PU) foams can result in polyol chains of different lengths, which also differ in the type of the end-groups (hydroxyl and/or aromatic amine) when the urethane groups in the PU foam structure are incompletely degraded. Since the type of the polyol end-groups is important in the synthesis of PU foams from RPs, I developed an HPLC method using the liquid adsorption mechanism (LAC) to separate the polyol chains according to the end-group functionality on a SHARC 1 column. The quality of the separation depended on the composition of the mobile phase, mainly on the amount of formic acid and ammonium formate additives in the mobile phase. The successful separation of partially aromatic amino end-functionalized polyol chains from fully hydroxyl-functionalized polyol chains allows the quantification of the latter in RPs.

Key words: liquid chromatographic techniques, multi-detection system, gradient copolymers, microstructure, light scattering, thermal properties, recycled polyol, end-group functionality.