THE LEGO APPROACH IN POLYOLEFIN ANALYSIS – LINKING MOLECULAR AND PHYSICAL PROPERTIES OF COMPLEX POLYOLEFINS

Harald Pasch[a,b], Paul Bungu[b], Anthony Ndiripo[b]

[a] Borealis Polyolefine GmbH, 4021 Linz, Austria, harald.pasch@borealisgroup.com
[b] Department of Chemistry and Polymer Science, University of Stellenbosch, 7602 Matieland, South Africa, hpasch@sun.ac.za

Information regarding the molar mass distribution (MMD) and chemical composition distribution (CCD) of complex polyolefins (e.g. Impact Polypropylene Copolymers, IPC) is important in order to fully understand materials' behaviour and properties during processing and application. The precise analysis of such materials having multivariate distributions is a difficult task and a single separation method is often not able to provide comprehensive information. Preparative fractionation e.g. by TREF is a first important step to obtain fractions (still being distributed regarding MMD and CCD) that can be analyzed/fractionated further by advanced analytical techniques.

Recently, a number of advanced techniques have been developed that enable the comprehensive analysis of TREF fractions by combining different fractionation or spectroscopic techniques. Different chromatographic techniques can be combined to provide dual information on molar mass and chemical composition (2D-LC). Combining selective fractionation with e.g. FTIR spectroscopy enables to monitor chemical composition and E/P crystallinity across the SEC or HPLC elution profiles (SEC-FTIR, HPLC-FTIR).

The thermal properties of selected TREF, SEC or HPLC fractions can be analyzed by fast scanning differential scanning calorimetry (Hyper DSC or Flash DSC) that overcomes the problem of co-crystallization that occurs when standard DSC is used.

Depending on the complexity of the material to be analyzed different fractionation, spectroscopic and thermal analysis techniques can be combined in a LEGO approach to provide maximum information on the molecular heterogeneity. In the present paper different setups will be discussed. They will be used e.g. for the comprehensive analysis of the most important IPC components – the crystalline phase, the rubber phase and the 'segmented copolymer' phase. Another topic to be addressed will be the comprehensive analysis of low density polyethylene (LDPE).

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