New approach in describing the chemical composition distribution in uni- and multimodal ZN-Polyethylene.

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Copolymers of ethylene and α-olefins synthesized with Ziegler Natta (ZN) catalysts are heterogeneous in terms of molecular weight (MW) and chemical composition (CC). The incorporation of short chain branches and their distribution along and across the polymer chains together with the molecular weight distribution define the properties of the final product.

The broadness of the molecular weight distribution (MWD) and chemical composition distribution (CCD) are highly influenced by the chemistry of the catalyst and the polymerisation conditions. One important goal in the development of ZN catalyst, besides increasing the catalyst activity, is to optimize the catalyst formulations by modifying the response of the respective catalyst sites to H_2 and comonomer in such a way to enable tailoring of the MWD and CCD. Therefore it is crucial to be able to characterise the microstructures of ethylene and α-olefins copolymers in detail.

The MWD of PE is normally determined by Gel Permeation Chromatography (GPC)[1], where the characterisation of the CCD of PE is commonly done by Crystallization Analysis Fractionation (CRYSTAF) or analytical - Temperature Rising Elution Fractionation (a-TREF) and recently also by Liquid Adsorption Chromatography (LAC).[2,3]

Quantification of the CCD from the analytical results, e.g. CRYSTAF or TREF curves with the minimal number of experiments is essential for ease differentiation between various catalyst systems in regards to their potential to form narrower CCD. Several quantifying approaches like Cw, Cn,[4] Tw, Tn[5] and CDBI[6] have been developed in the past.

In this presentation a new approach is presented which enables quick and accurate way to distinguish, quantify and compare the performance of various catalyst systems in regards to Chemical Composition with only one CRYSTAF experiment. Applying the same approach on two-dimensional separation techniques like TREF followed by GPC (Cross Fractionation Chromatography (CFC))[7] the CCD quantification of complex multimodal ethylene-α-olefine copolymers is also presented.

References:

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