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The necessity of theoretical approach to interpretation of SEC experiments

In the past, the size-exclusion chromatography (SEC) was considered something impenetrable and complicated process including the interaction with the stationary phase. The SEC models usually describe the interaction of the polymer molecule with the walls of the pore from mechanistic and thermodynamic view and the relation between microscopic and macroscopic parameters was not examined. The model by Giddings and Eyring was the first chromatography model which related the constants of adsorption on microscopic with the resulting elution curve or band-broadening function (BBF) on the macroscopic level. The plate-height model by Martin and Synge was treated approximately and resulted into theoretical plate-height given by variance of BBF related to the distance its maximum to the point of injection as an empiric quantity. The separation system for analyzes of high-molecular-weight polymers was thus judged from analyses of low-molecular-weight substances as toluene. Thus, there is no feedback between the operational conditions, concentration and flow-rate and the efficiency of separation. The flow-rate 1 ml of solvent per min is a typical example of doing an experiment in some way because everybody makes it in this way. The only advantage of this rate is an easy re-calculation of time on volume. Our results, supported by several other reports, demonstrate a profound dependence of experimentally obtained distributions on the flow-rate. Although these results are relatively new, their explanations go back to the ideas of J C Giddings, in particular of the transversal diffusion in the chromatography column. The description of the chromatography separation as observation at a fixed point of the longitudinal concentration profile, developing in time, gave way to the possibility to estimate the closeness of the SEC separation to the theoretical model and to find the ways to approach the separation to the ideal one. The dependence of the skew (tailing) of elution curves is an example (Fig. 1).

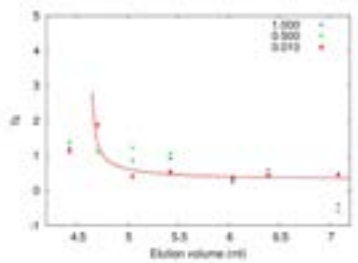

Figure 1: Skew (tailing) of elution curves calculated as a function of elution volume. The flow-rate in ml/min is given with the points.

Biography

Miloš Netopilík studied Physical Chemistry in Charles University, Prague (1982), Postgraduate studies in Institute of Macromolecular Chemistry, Czechoslovak Academy of Science, Prague), PhD (1984) with thesis: Degradation of polymers by shear stress, and a Magister degree in Luce Sparsa (Light Scattering) at Universitas Lucis Spargentis, Wyatt Technology Corporation, Santa Barbara, CA in 1998. Since 1984, he is a Research Fellow in the Institute of Macromolecular Chemistry, Czechoslovak Academy of Sciences, Prague. In 1998, he became Senior Research Fellow at the Institute of Macromolecular Chemistry, Czechoslovak Academy of Sciences, Prague.

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