507e Preparative Gradient Elution Chromatography for the Optimized Separation of Ternary Mixtures

Yichu Shan, Andualem Damtew, and Andreas Seidel-Morgenstern

Gradient elution is widely applied in analytical chromatography to reduce the separation time and/or to improve the selectivity. Increasingly the potential of modulating the solvent strength during gradient operation is exploited in preparative liquid chromatography. The purpose of this paper is to investigate theoretically and experimentally the effect of optimizing free parameters available in gradient chromatography (extents and shapes of gradients) on the productivity of isolating a target component in a multicomponent mixture. An equilibrium stage model was used to quantify and compare different modes of operation (isocratic and various variants of gradient elution). In a first stage, optimal conditions were identified theoretically for the production of the second eluting component in a ternary mixture. The strong impact of the shape of gradients on process performance is elucidated. These predictions were validated experimentally using the separation of cyclopentanone, cyclohexanone and cycloheptanone on a RP-C18 stationary phase using mixtures of water and methanol with varying compositions as the mobile phase.