

Studies of Dispersion Phenomena in Micropellicular HPLC Columns

Hui Guo

Recent studies in the literature have suggested that the A term in the equation for the plate height, which is the term accounting for interparticle dispersion, is more significant than previously thought, and may largely determine the column performance in a variety of preparative and analytical high-performance chromatographic processes. In this study, this hypothesis is examined, and the factors which determine interparticle dispersion in a chromatographic column are studied experimentally and theoretically using HPLC columns containing micropellicular (nonporous) particles so that intraparticle mass transfer is eliminated as a plate height contribution. Single and bi-directional plate height experiments, including versions of these experiments which probe axial variations in the plate height, were performed, as well as arrested flow experiments where the 2D band shape in the column was visualized. To analyze the data, the Giddings coupled transport theory was used to produce a version of the A term, analogous to the A term suggested recently by Knox, but which accounts directly for the effects of the elute retention factor, the column diameter to particle diameter ratio, and the local values of the radial and axial dispersion coefficients. By using this combined experimental and theoretical approach, our study provides a better understanding of the connection between the column packing process, the structure of a packed chromatographic bed, and the performance of a chromatographic column.