2.7 µm superficially porous particles are being seen as an alternative to fully porous 2 µm particles for high speed and/or high resolution HPLC separations. More recently, we also developed new the superporous silica particles having a 1.5 µm solid core, a 0.5-µm thick porous shell and 1.2 µm core, called “Poroshell 120”, for faster separation of small molecules. These 2.7 µm superficially porous silica particles have very narrow particle size distribution, and show comparable efficiency to fully porous 2 µm particles, but only about half of the back pressure of 2.5 µm particles. There are several publications which experimentally and theoretically studied the unique chromatographic performance of these superficially porous particles 1-4.

The column of superficially porous particles has a reduced plate height consistent with its size, much lower than the value of 1.7, which has been traditionally considered as the “limit” for excellent columns of totally porous particles. The lower reduced plate height mismatch is explained by the combination of lower axial diffusion term (due to the solid core in the particle) and a lower axial dispersion term (due to a narrow particle size distribution) 5.2 The study on particles with different shell thickness and different particle size distribution, showed how shell thickness and particle size distribution affect the column performance regarding the efficiency, back pressure and van Deemter plot, and compared these superficially porous particles with totally porous particles.

Introduction

Totally Porous Particles vs. Poroshell 120

Space Pack SP (¡úm)

2.7µm Totally Porous Particles

2.7 µm totally porous particles of 1.26, similar to 2 µm totally porous particles.

The high efficiency of Poroshell 120 particles, similar to sub 2 µm totally porous particles.

Shells have 10–50% larger effective pore sizes than 2.7 µm totally porous particles.

The Huang efficiency of Poroshell 120 particles is due to its unique shell structure and different particle size distribution, and exhibit efficiency of sub-2 µm totally porous particles and about half of the backpressure.

2.7 µm Poroshell 120 particles have very narrow particle size distribution, and exhibit efficiency of sub-2 µm totally porous particles and about half of the backpressure.

A term is affected by the particle size distribution (PSD): the particles with larger PSD have the larger A term.

B term is mostly affected by the shell thickness; the particles with thicker shell have the larger B term.

For small molecules, the C term does not change much for different shell thickness of superficially porous particles.

There is no much difference of C term between 1.8 µm totally porous particles and 2.7 µm superficially porous particles.

The superior performance of superficially porous particles is due to the combination of narrow particle size distribution (narrow A term), lower shell (small B term due to the core shell structure), and the similar C term to 1.8 µm totally porous particles.

Results and Discussions

Objectives of the Study

Study how the shell thickness affects performance

Prepare superficially porous particles with the same particle size but different shell thickness.

Study how the particle size distribution (D_P, D_v) affects performance

Prepare superficially porous particles with the same size but different particle size distribution.

Compare 2.7 µm superficially porous particles with 1.8 µm totally porous particles.

Use van Deemter plot to study how shell thickness and particle size distribution affect A, B and C term.

Poroshell 120 Physical Properties

2.7 µm superficially porous particles have same shell thickness and different particle size distribution, and show comparable efficiency to totally porous sub 2 µm particles.

Poroshell 120 Particles Have Very Narrow Particle Size Distribution

Poroshell 120 Particles Size Distribution is 25% Narrower

What is Thought about High Efficiency of Superporous Particles

A term: efficiency and size distribution

B term: only efficiency and size distribution

C term: efficiency, size distribution and superficially porous particle shell thickness

Superporous particles have smaller area, lower efficiency and smaller A term compared to totally porous particles.

Superporous particle core diameter is determined by high efficiency and small A term.

Core diameter is determined by high efficiency, small A term and small C term.

The high efficiency of Poroshell 120 particles is due to its unique shell structure and different particle size distribution.

Reference

W. Chen, T.C. Wei, W. Long, Poster presentation, Pittcon 2009, in Florence, Italy


