Abstract & Introduction

Superficially porous particles (commonly referred to as SPP or "core-shell" particles) have been proven to provide fast and efficient separations. These particles feature a solid, impermeable core enveloped by a thin, porous layer of silica that decreases the diffusion path and reduces peak dispersion. As a result, significant improvements in efficiency and sensitivity can be achieved over fully porous particles of similar dimension.

In this presentation the performance of 5 µm SPP particle columns will be compared to columns packed with traditional 5 µm and 3 µm fully porous particles (FPP). The relationship between pressure and efficiency will be explored. In addition, run time, signal to noise ratio, peak width, and resolution will be evaluated in several chromatographic experiments. Each experiment will be performed using identical method conditions for each particle.

Through these experiments we hope to demonstrate the following advantages of 5 µm SPP particle columns over columns packed with traditional 5 µm and 3 µm FPP particles. When used in the development of new assays, they allow the chromatographer to obtain fast run times and excellent method performance without changes in instrumentation. When substituted into existing methodologies which utilize 5 µm and 3 µm FPP columns, 5 µm SPP columns have the potential to dramatically decrease analysis times while improving efficiency and sensitivity.

FPP to SPP: Increase Efficiency, Decrease Pressure

One of the primary advantages of SPP is its ability to provide increased column efficiency, often with similar or even reduced backpressure, when compared to conventional FPP. By increasing efficiency while decreasing pressure, the user can achieve faster analysis times without changing instrument. As shown in Figure 1, column backpressure decreases by approximately 50% on average across the instrument flow rates tested (0.2 to 2.0 mL/min) when switching from a 3 µm FPP column to a Raptor 5 µm SPP column. Although the 5 µm FPP column displays comparable pressure to the Raptor 5 µm SPP column, it is at the expense of efficiency.

Figure 1: Switch from a 3 µm FPP column to a Raptor 5 µm SPP to cut backpressure in half

The ratio of theoretical plates (N) at optimal flow divided by pressure can be used as a measure of efficiency for a column. When compared for each column, the Raptor 5 µm SPP column has double the number of plates per unit pressure as the 5 µm FPP column, and four times the number of plates per unit pressure as the 3 µm FPP column (Figure 2).

Figure 2: Focusing on plates per unit pressure, switching from 3 and 5 µm FPP columns to Raptor 5 µm SPP columns offers clear advantages

FPP to SPP: Decrease Run Times, Increase Sensitivity

The invention of SPP has provided analysts with fast separations without the need for expensive Ultra High Performance Liquid Chromatography (UHPLC) instruments, thereby increasing sample throughput without capital investment. To investigate the increased speed and efficiency of superficially porous particles, the Raptor Biphenvyl 5 µm SPP column was compared to columns packed with fully porous 3 and 5 µm particles by performing an assay using identical instrument and isocratic method conditions.

In Figure 3, the last analyte eluted on the Raptor Biphenvyl 5 µm column in 7.1 minutes resulting in a 45% decrease in analysis time compared to the 3 µm and 5 µm fully porous particle columns, which had run times of 13.6 and 12.9 minutes respectively. In addition, a 43% improvement in efficiency was observed for the Raptor Biphenvyl 5 µm SPP column over the 5 µm FPP column. The 3 µm FPP column displayed only slightly less efficiency but nearly double the backpressure of the Raptor Biphenvyl 5 µm SPP column.

Figure 3: Cut analysis times almost in half by switching to 5 µm SPP with lower pressure over 3 µm FPP and far superior efficiency over 5 µm FPP

Conclusions

Raptor LC columns offer the speed of superficially porous particles with the resolution of the highly selective USLC stationary phases. This new breed of chromatographic column allows you to more easily achieve peak separation and faster analysis times without expensive UHPLC instrumentation.

Figure 4: Increase resolution and decrease analysis time by switching from FPP to Raptor SPP columns.

Figure 5: Raptor 5 µm SPP columns also provide increased sensitivity over 3 or 5 µm FPP columns.