

Efficiency Gains Using Monodisperse Fully Porous Particles (MFPP) in HPLC Analysis



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WHY PARTICLE SIZE DISTRIBUTION MATTERS

In HPLC packed beds, particle size distribution (PSD) has a profound impact on bed structure, flow uniformity and ultimately , chromatographic performance.

MONODISPERSE

- Uniform bed structure
- Consistent flow paths
- High efficiency
- Excellent reproducibility

NON-MONODISPERSE

- Irregular packing
- Uneven flow paths
- More dispersion
- Lower reproducibility

WHY MONODISPERSE PARTICLES GIVE BETTER PACKED BEDS

1

MORE UNIFORM FLOW PATHS
Uniform interstitial spaces create consistent solvent velocity and minimise preferential channels and Eddy diffusion – reducing the A-term in the Van Deemter equation.

2

REDUCED PACKING HETEROGENEITY
More uniform local density and permeability throughout the bed. Fewer stagnant zones and microchannels leading to narrower peaks and higher plate count.

3

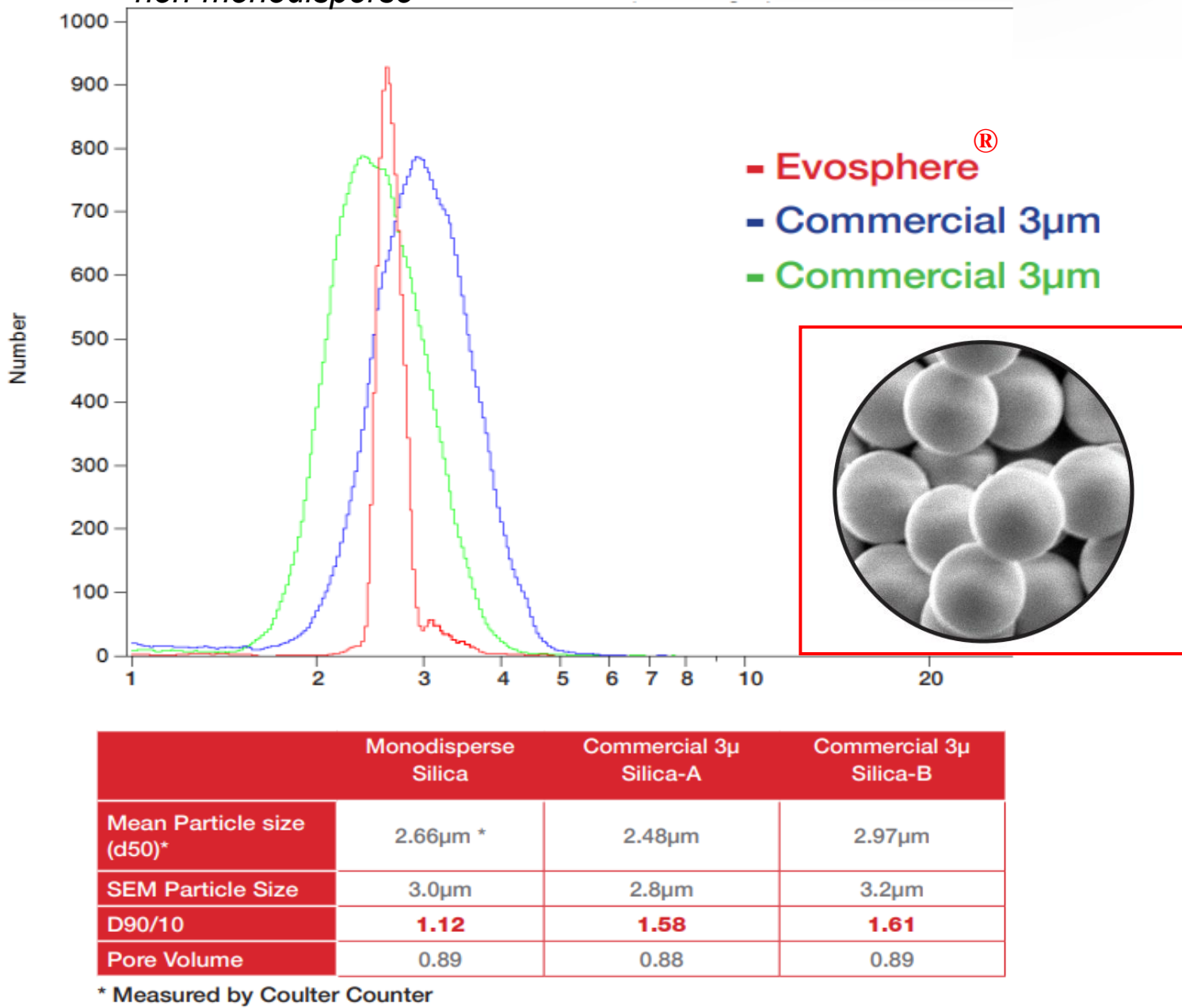
BETTER RADIAL HOMOGENEITY
More consistent particle arrangement at the column wall reduces wall effects and radial velocity gradients – critical in narrow bore and UHPLC columns.

4

MORE REPRODUCIBLE BED COMPRESSION
Particles settle and compress uniformly during packing due to absence of differing sedimentation rates. Minimises segregation, inlet voids and axial density gradients.

PRACTICAL IMPACT IN HPLC

Figure1: Size distribution data of commercial monodisperse silica vs non-monodisperse



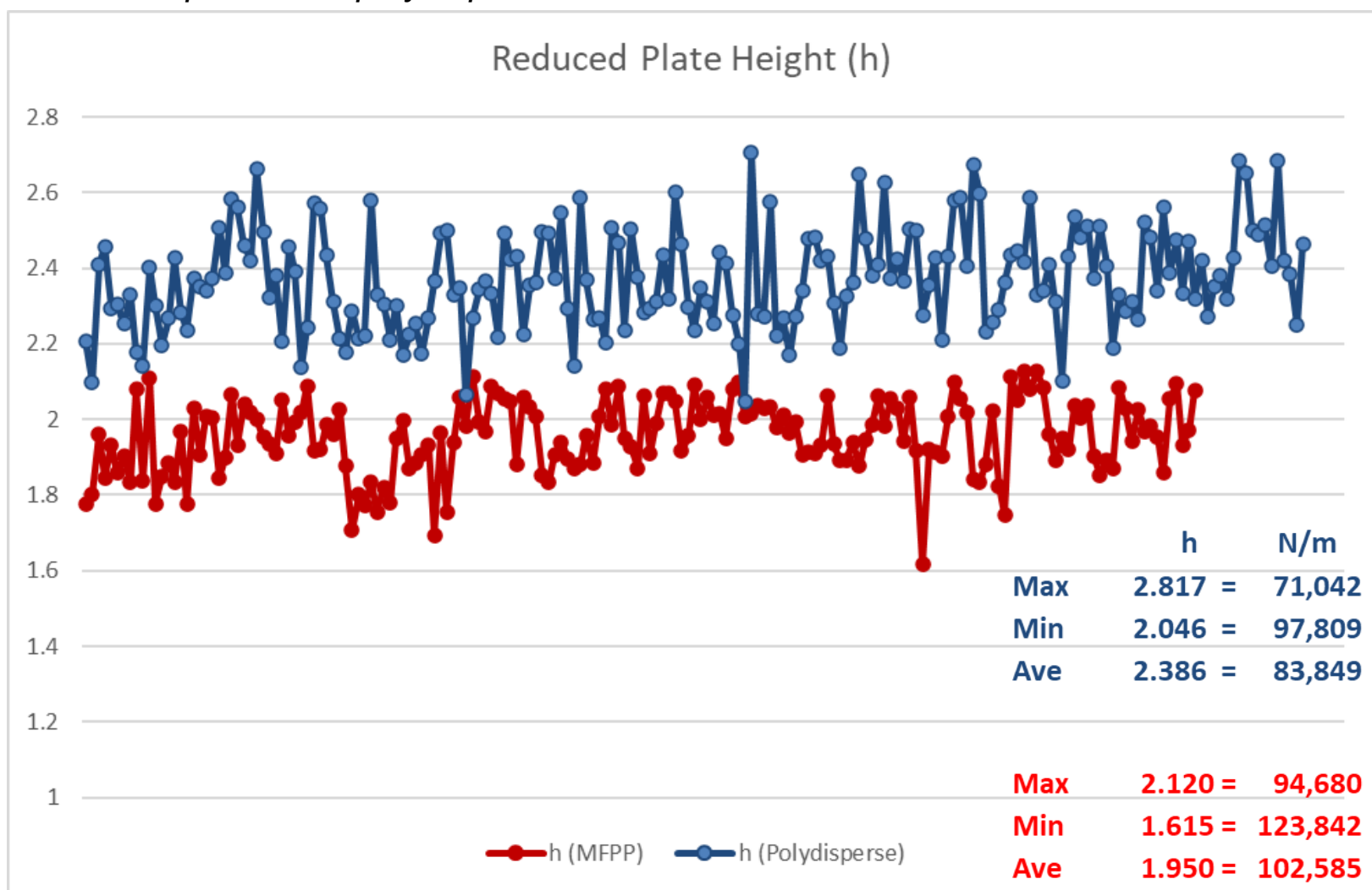
The reduced flow path in columns packed with monodisperse particles is primarily a consequence of the improved packed bed structure, although monodispersity is the enabling factor that allows that packing structure to form.

COLUMN PLATE COUNT- Theory versus Reality

Although there are many references to columns being packed with reduced plate heights of 2 and below using polydisperse particles, this work is often performed in a research environment and is not necessarily a true reflection of the column performance that the customer will receive.

Column manufacturers have to balance performance of the packed column and the economy of a manufacturing process that generates variable results. Hence the customer will receive a column that performs within a specified range and not the theoretical optimum.

Figure: 2 Column manufacturing data – Comparison of reduced plate height for monodisperse and polydisperse silica C18 columns



However, when packing with monodisperse particles these reduced plate heights of < 2 are routinely achieved, allowing the analyst to benefit from the increased column efficiency.

In Summary

