Waters Lab Highlights

An Internal Communication
of Applications and Techniques

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RADIAL COMPRESSION - A PROVEN TECHNOLOGY FOR LC

PART II OF TWO PART SERIES

Radial Compression. The best way to optimize and stabilize the packed bed structure is a technique referred to as radial compression. By applying pressure (i.e. compression) along the radial axis of a flexible tube containing the packed bed, the column wall is able to mold around the column packing, giving a more homogeneous packed bed, thereby increasing column efficiency. Because radial compression gives a reproducible packed bed structure and a uniform permeability and homogeneity that has not been observed in steel columns of equivalent particle size and dimension, both wall effects (1) and the prevalent problems of column channeling and voiding can effectively be eliminated. Elimination of these detrimental phenomena and improvement of packed bed structure results in increased reliability and reproducibility of column efficiency as well as an increased useful column life.

The explanation of the significant difference between radially-compressed and conventional steel columns is based upon a reduction of the eddy diffusion occurring in the column (2). Using radial compression and squeezing the particles together into a tightly packed bed minimizes the interstitial velocity's contribution to eddy diffusion (A term of the Van Deemter equation). This is in agreement with suggestions by Horvath (3) that the interstitial velocity (between the particles and along the walls) is a most significant contribution to band broadening.

In fact, radial compression has caused the rethinking of theoretical predictions about packed beds. Halasz (4) has shown that for conventional, packed LC columns the average particle diameter can be calculated from the permeability of the column. For a case in point, a nominal 10μ particle size was packed into a steel tube and also into a cartridge which was subsequently placed under radial compression. The permeability of both "columns" was measured and the corresponding average particle size was calculated (4). For the steel column the calculated value was 10 μm, as expected, but for the radially compressed cartridge calculated value was 7.5 μm: approximately a 25% effective decrease in apparent particle size! This demonstrates quite dramatically the previous statement that 10μ particles do not behave the same in all columns. Under radial compression 10μ particles give the same performance as 7.5μm particles in a steel column.

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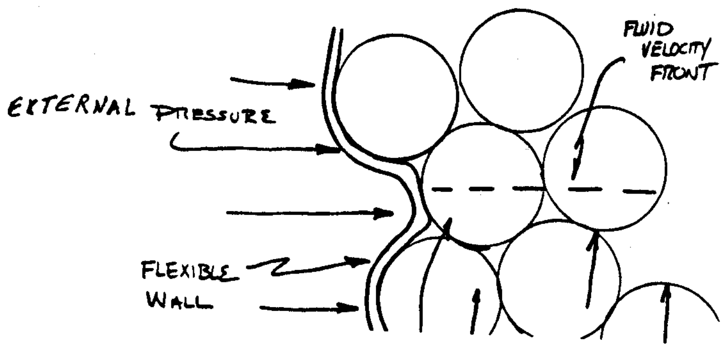
In generalizing this finding to the case of radially-compressed 4 micron particle size materials (e.g. NOVA-PAK™), it can be seen that the performance equivalent to that of 3 micron materials can be obtained through radial compression without the frequently observed disadvantages of voiding and reduced column lifetime of steel columns packed with 3 micron particles.



FLOW THROUGH A RADIALLY-COMPRESSED CARTRIDGE. SINCE THE BED IS TIGHTLY PACKED, BAND SPREADING DUE TO EDDY DIFFUSION IS GREATLY REDUCED AND EFFICIENCY IS HIGH.

1. C.H. Eon, J. Chromatogr., 149, (1978) 29.
2. J.S. Landy, J.L. Ward, J.G. Dorsey J. Chromatogr. Sci., 21 (1983) 49.
3. B.L. Karger, L.R. Snyder, C. Horvath, An Introduction to Separation Science, John Wiley & Sons, New York, 1973.
4. J. Asshauer and I. Halasz, J. Chromatogr. Sci., 12, (1974) 139.