High-Speed, High-Temperature Analysis with Prominence HPLC

High-speed HPLC is normally achieved by using a column packed with small particle packing material and increased linear velocity (flow rate) of mobile phase. However, this approach increases backpressure on the instrument components and column due to the increased column flow resistance (which is inversely proportional to the square of the particle diameter). The pressure increase severely limits the amount that analysis time can be shortened. One way to resolve this problem is to increase column temperature. This has the effect of reducing viscosity, and accelerating diffusion of the substances while decreasing resistance to flow in the column.

Utilizing standard components, Prominence supports temperature operation up to 85°C, enabling, high-speed analysis at lower pressures, while achieving/maintaining performance/throughput levels not seen in more expensive instrument configurations.

Prominence Support for High-Speed Analysis

It is a characteristic of HPLC columns that efficiency is highest at a particular mobile phase linear velocity. This relationship is typically expressed using the following van Deemter equation.

$$H = Ad_P + B/\nu + Cd_P^2\nu$$

where H is the theoretical plate height (column length required to obtain 1 theoretical plate; the smaller this value, the greater the efficiency), d_P is the packing particle diameter, and ν is the mobile phase linear velocity. The applicability of smaller packing material for performing higher-speed separation is attributed to the decrease in the A term (eddy diffusion) and the lack of deterioration in efficiency at high flow rates through the C term (interphase mass transfer) in the equation.

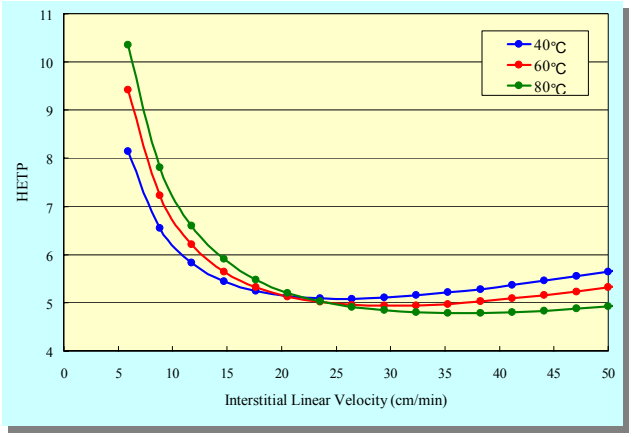
Additionally, separations performed at high temperatures have an effect similar to that of decreasing particle diameter because the coefficient C decreases as temperature increases. The resistance to column flow is inversely proportional to temperature, meaning column pressure at 80°C is about 40% lower than that at 40°C.

This highlights the importance of temperature as a factor in accelerating separation, demonstrating that analysis time can be effectively shortened by raising the column temperature while increasing the mobile phase flow rate.

High-Temperature, Fast LC with Prominence

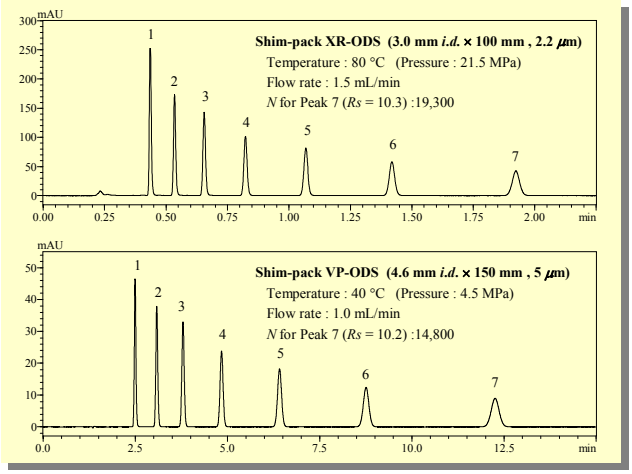
The figure at right shows an example of high-speed analysis using a 2.2μm packed column at a temperature of 80°C. The data clearly proves that separation, compared to normal conditions, can be obtained in less than 1/6 the time. Moreover, with the 2.2μm packed column (3mm I.D. x 100mm L.), the pressure did not exceed 21.5MPa (3120psi or 215MPa/m), even at a flow rate of 1.5 mL/min.

This demonstrates that Prominence can effectively perform high-speed, high-temperature analysis utilizing an existing instrument configuration.



Chromatographic Conditions: Column: Shim-pack XR-ODS (3 mm *i.d.* x 50 mm, 2.2μm); Mobile Phase: Water/Acetonitrile (30/70, v/v); Detection: 245 nm; Sample: Alkylphenones.

Effect of Temperature on Separation Efficiency



Other Chromatographic Conditions: Detection: 245 nm.

Peaks: 1: Actophenone, 2: Propiophenone, 3: Butyrophenone, 4: Balenophenone, 5: Hexanophenone, 6: Heptanophenone, 7: Octanophenone.

Comparison of High-Temperature, High-Speed Analysis and Conventional Analysis

Access to your success
SHIMADZU

SHIMADZU CORPORATION
3, Kanda-Nishikicho 1-chome, Chiyoda-ku,
Tokyo 101-8448, Japan
Phone: 81(3)3219-5641 Fax. 81(3)3219-5710

SHIMADZU SCIENTIFIC INSTRUMENTS
7102 Riverwood Drive
Columbia, MD 21046, USA
Phone: 800-477-1227 Fax: 410-381-1222