

Application News

High Performance Liquid Chromatograph

Achieving Solvent Reduction and Lower Running Costs with Nexera™ X4

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User Benefits

- ◆ Using narrow-bore columns enables a substantial reduction in solvent consumption.
- ◆ Nexera X4 features a low-dispersion design with minimized internal volume, enabling sharp peak shapes even when using narrow-bore columns.

Introduction

In recent years, there has been growing interest in sustainability within analytical laboratories. In liquid chromatography, the large volumes of organic solvents used as mobile phases present challenges from both environmental and cost perspectives. One approach to reducing solvent consumption is to downscale analyses by using small-diameter columns. Such solvent-saving strategies not only contribute substantially to lowering running costs, but also reduce the amount of waste solvent, enabling more environmentally conscious laboratory operations. However, analytical downscaling requires effective suppression of band broadening within flow channels and highly accurate low-volume injections. Nexera X4 (Fig. 1) delivers exceptional instrument performance that meets these demands and provides stable analytical results even when small-diameter columns are used. This article presents a case study in which analysis was downscaled and solvent consumption was significantly reduced by combining Nexera X4 with a 1-mm-ID column (Shim-pack™ NovaCore C18-HB).

Analytical Conditions and Target Compounds

The analytical conditions and target compounds are summarized in Table 1. In this study, a mixed standard containing eight small-molecule pharmaceuticals was used as a model sample. For this sample, an analysis using a 1-mm-ID column was applied as a scaled-down approach.

Table 1 Analytical Conditions and Target Compounds

System : Nexera X4	
Sample : (A) Antipyrine, (B) Benzoic acid, (C) Salicylic acid, (D) Hydrocortisone, (E) Furosemide, (F) Naproxen, (G) Probenecid, (H) Diclofenac	
Mobile phase	
Pump A :	0.1% formic acid in water
Pump B :	Acetonitrile
Column : Shim-pack NovaCore C18-HB ¹ (50 mm × 1.0 mm I.D., 1.7 μm)	
Analytical conditions	
B Conc.	: 5%(0 min)→70%(3 min)→5%(3~8 min)
Column Temp.	: 50 °C
Flow rate	: 0.1 mL/min
Mixer	: Micro mixer
Sample loop Vol.	: 15 μL
Injection Vol.	: 0.3 μL
Detection	: 254 nm (SPD-M40 X4, STD cell)

*1 P/N : 227-32901-01



Fig. 1 Nexera™ X4

Reduction of Solvent Consumption Using a 1-mm-ID Column

Fig. 2 shows the chromatograms obtained under the conditions listed in Table 1. Fig. 3 compares solvent consumption for column inner diameters of 1.0, 2.1, and 3.0 mm. Switching from a 3-mm column to a 1-mm column reduces solvent consumption by approximately 9-fold, while switching from a 2.1-mm column to a 1-mm column achieves a reduction of about 4.5-fold. These reductions not only help lower running costs but also contribute to reducing environmental impact by decreasing the volume of waste solvent.

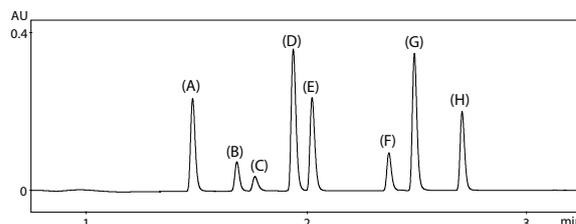


Fig. 2 Chromatogram Using 1-mm-ID Column (Peak labels correspond to those in Table 1.)

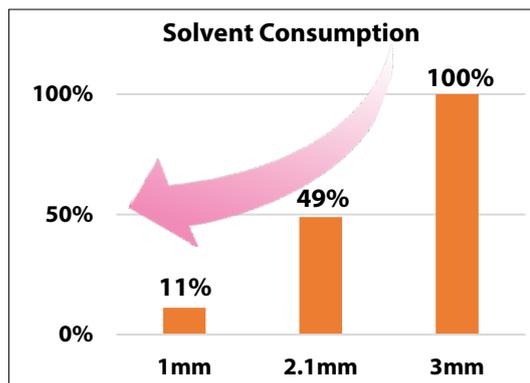


Fig. 3 Comparison of Column Inner Diameter and Solvent Consumption (Linear velocity kept constant across column IDs.) (Using the 3 mm column's solvent consumption as 100% for comparison)

■ Maximizing the Performance of 1-mm-ID Columns with Nexera X4

When using 1-mm-ID columns, minimizing extra-column dispersion caused by system flow channel is essential for maximizing the inherent performance of the column. Fig. 4 compares chromatograms obtained with Nexera X4 and a typical UHPLC system using a 1-mm-ID column. While Nexera X4 provides sharp peak shapes, the typical UHPLC system shows broader peaks due to the influence of extra-column dispersion. With its low-dispersion design and minimized internal volume, Nexera X4 enables full performance of small-diameter columns.

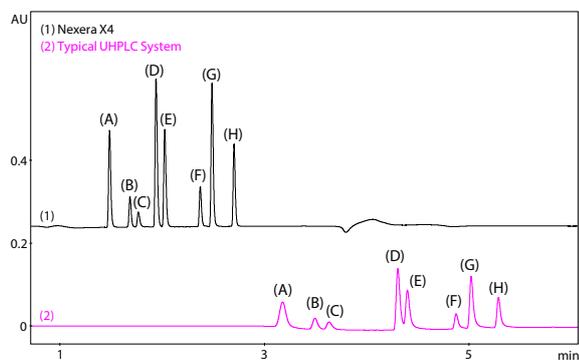


Fig. 4 Comparison of Chromatograms Using 1-mm-ID Column
(1) Nexera X4, (2) Typical UHPLC System
(Peak labels correspond to those in Table 1.)

■ Conclusion

This article introduced an approach for reducing solvent consumption by using small-diameter columns. Reducing solvent usage not only lowers running costs but also contributes to reducing environmental impact by decreasing the amount of waste solvent. Although suppressing dispersion within the flow path is essential when scaling down an analysis, Nexera X4 maximizes the performance of small-diameter columns through its low-dispersion design.

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