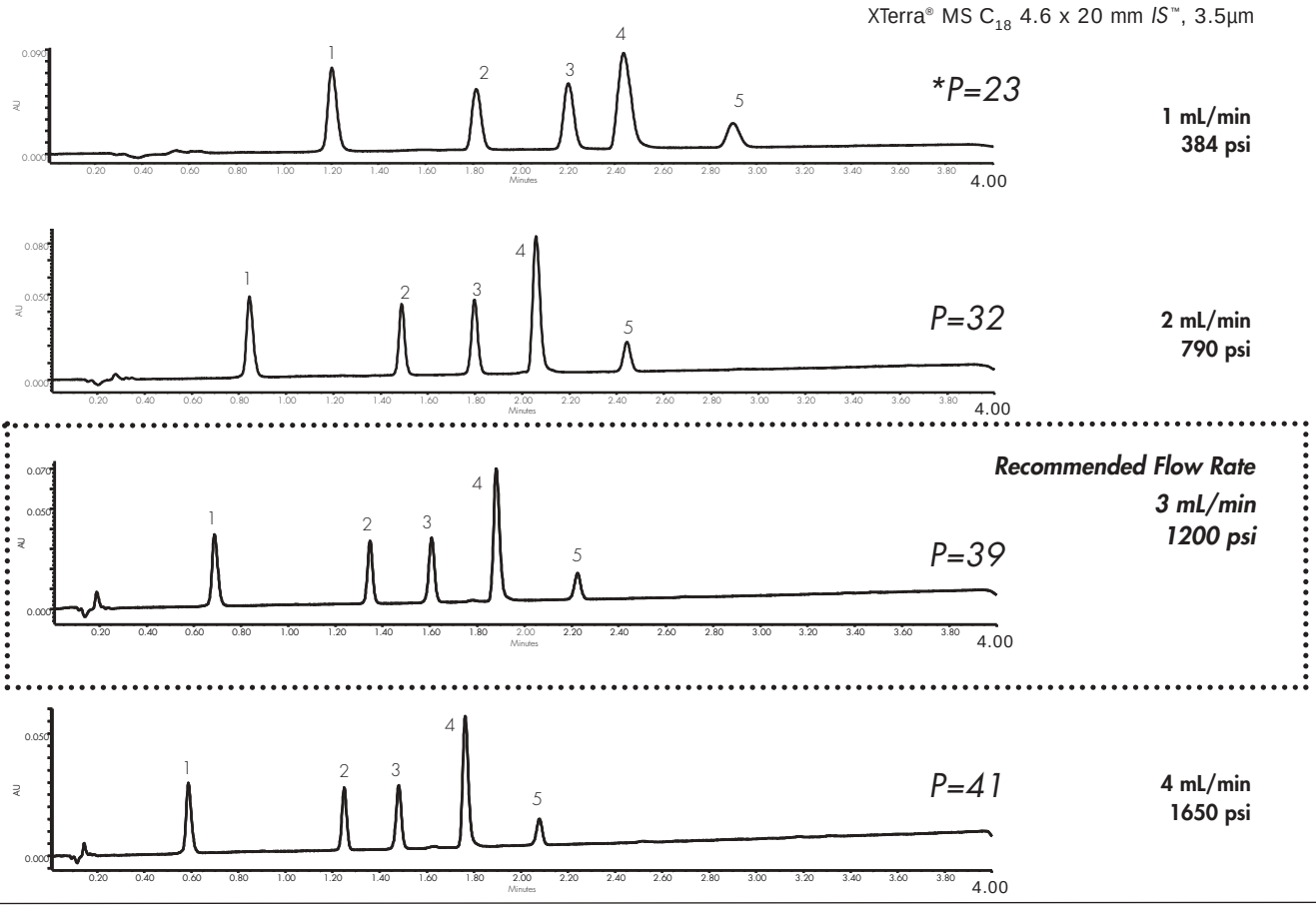
INTRODUCTION

MAXIMIZING PEAK CAPACITY: EXPERIMENTAL RESULTS



**P= Peak Capacity*

COST ANALYSIS

You can realize significant cost savings when reducing analysis times using *IS*™ columns. With a separation on the 150 mm length column with 25 minute cycle time, it would take nearly 3 months to analyze the samples. Using the *IS*™ columns (20 mm length) the same set of samples would only take 14 days.

The solvent cost includes the cost of Acetonitrile (ACN), plus the cost of disposal of ALL of the solvent waste. The combined total is nearly $2300 in the example using the 150 mm column, but only about $800 for the 20 mm IS™ column. A savings of $1507 for one study!

Additional cost savings can also be determined through improved instrument utilization, labor costs, etc.

CALCULATION OF SOLVENT SAVINGS

Assume that 5000 samples need to be analyzed for a study

	4.6 x 150 mm	4.6 x 20 mm *IS*™
Cycle time	25	4
Total time for 5000 samples (hours)	*2083 (87 days)*	*333 (14 days)*
Flow rate (mL/min)	1.4	3
Total solvent consumption (L)	*175*	*60*
Amount ACN Consumed (L) (~ 25% is ACN)	43.75	15
Cost for ACN ($ 42.50/L)	$1860	$640
Cost for waste disposal (~ $2.50/L)	$438	$151
Total solvent costs	*$2298*	*$791*

Cost savings of $1507 in solvents alone

BENEFITS OF NARROWBORE CHROMATOGRAPHY

HPLC system changes may be required to scale down to 2.1 x 20 mm columns. However there are several benefits that should be recognized:

- Lower flow rates for columns with narrow inner diameters (equal to or less than 2.1 mm)
- Narrowbore columns allow for the direct flow of eluent into a mass spectrometer — eliminating the need for flow splitting.
- Narrowbore columns increase sensitivity — therefore smaller injections can be made and smaller amounts of material can be quantified.

Successful narrowbore chromatography requires further optimization of the HPLC instrumentation.

2.1 X 20 mm *IS*™ COLUMNS CAN FURTHER REDUCE COST

It is important to note that if we are changing the inner diameter of the columns, then we need to scale the cross sectional areas of the columns and multiply by the flow rate to obtain our new flow rate.

TO SCALE A FLOW RATE FOR DIFFERENT INTERNAL DIAMETERS

$$\frac{(d_2)^2}{(d_1)^2} \times F_1 = F_2$$

d_1 = Diameter of original column
d_2 = Diameter of second column
F_1 = Flow rate on original column
F_2 = Flow rate on second column

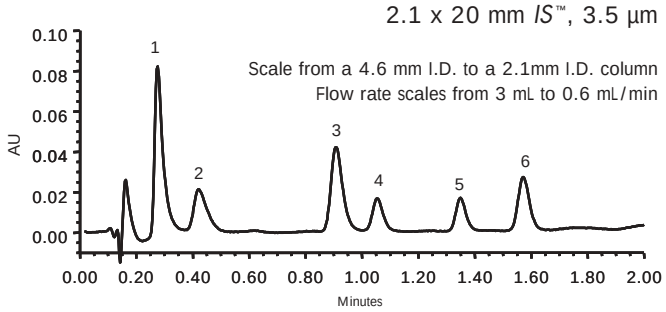
Original flow rate on a 4.6 mm I.D. column = 3mL/min

The flow rate on a 2.1 mm I.D. column:

$$\frac{2.1^2}{4.6^2} \times 3 \text{ mL/min} = 0.63 \text{ mL/min}$$

Additional benefit is increased sensitivity

SEPARATION USING NARROWBORE COLUMNS



We can save further on the solvents by running the separation on a 2.1 mm I.D. column. We scale the flow rate to 0.6/mL. We can do the calculations for the shorter column and now have negligible costs in solvents — a savings of over $2000!

REDUCE SYSTEM VOLUME FOR NARROWBORE COLUMNS

To Reduce System Volume for 2.1 x 20 mm IS™ columns from 80 µL to ~ 25 µL:

- Optimize Detector flow cell (use a microbore flow cell)
- Use 0.005 inch I.D. tubing
- Minimize all tubing lengths — remove any excess tubing and extra connections (unions, tees). (We recommend that the tubing length from the column to the detector be as short as possible).
- Use precise tubing connections (factory pre-cut tubing is recommended).
- Flow splitters can cause additional bandspreading, broadened peaks.

CALCULATION OF SOLVENT SAVINGS IN NARROWBORE COLUMNS

	4.6 x 150 mm	2.1 x 20mm *IS*™
Cycle time	25	4
Total time for 5000 samples (hours)	2083 (87 days)	333 (14 days)
Flow rate	1.4	0.6
Total solvent consumption (L)	175	9
Amount ACN consumed (L) (~ 25% is ACN)	43.75	2.25
Cost for ACN ($42.50/L)	$1860	$96
Cost for waste disposal (~$2.50/L)	$438	$23
Total solvent costs	$2298	$119

Cost savings of $2179