



New 3-Micron Polysaccharide-based Chiral Columns for Fast HPLC and SFC

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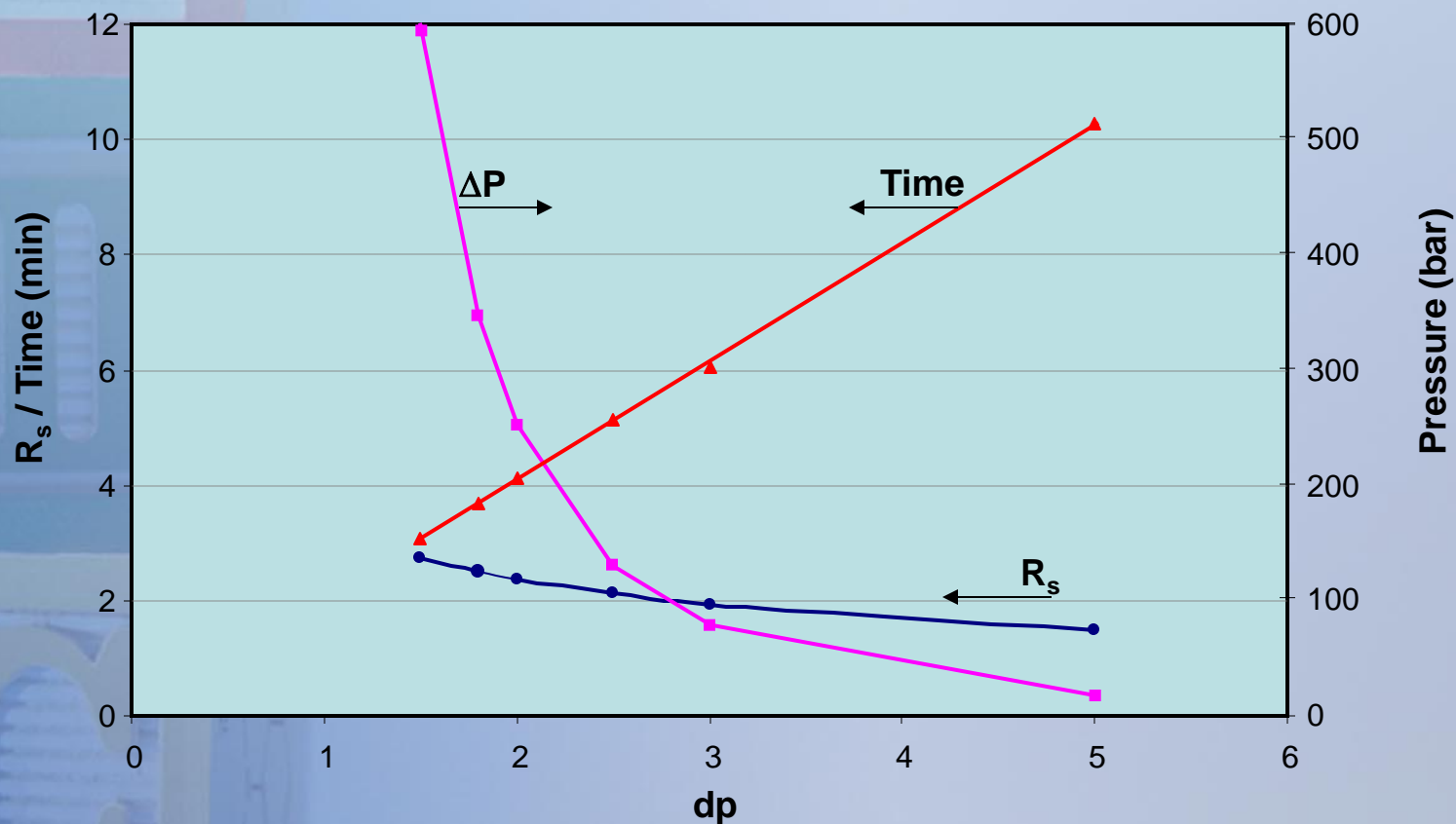
Benefits of 3-Micron Columns

- High Speed separations
 - Reduction in analysis time
 - More samples per day
 - Reduction in cost per sample
- High efficiency separations
 - Higher resolution for difficult samples
 - Higher precision from higher resolution

Why Stop at 3-Microns?

- Pressure
 - 3-Micron columns give attainable pressure drops at high flow rate
 - Pressure increases dramatically with smaller particles
[$\Delta P = f(1/d_p^2)$]
- Equipment
 - Conventional HPLC systems cannot reach the high pressures needed for very small particles
 - Conventional HPLC systems need modification for very small particles

Pressure, R_s and Particle Size



Calculated for methanol at the optimum flow velocity for each particle

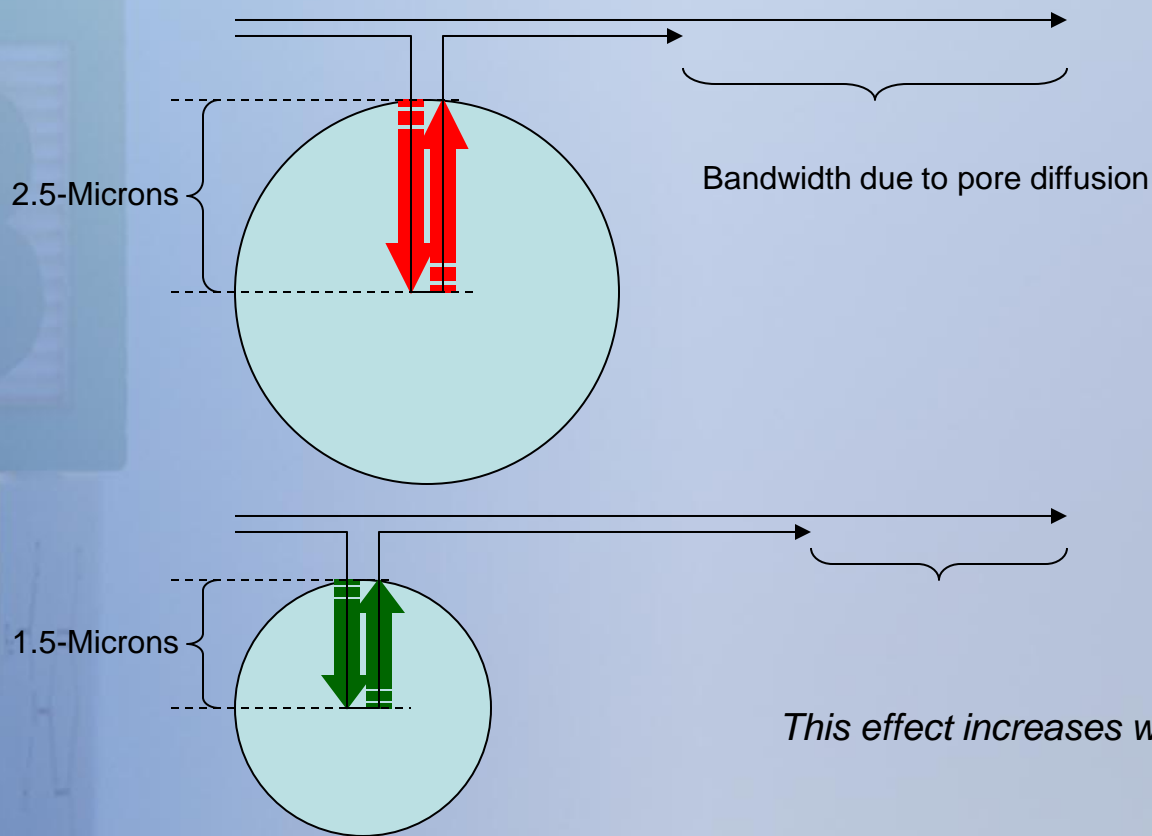
Effect of Equipment on Performance

CHIRALPAK® AD®-3	Agilent 1200 SL (ECV optimized)		Agilent 1100 (standard)		Relative Loss (%)	
	N ₁	N ₂	N ₁	N ₂	N ₁	N ₂
250 x 4.6 mm I.D.	32030	30969	31360	30900	2.1	0.2
150 x 4.6 mm I.D.	15800	15620	15200	15160	3.9	2.9
50 x 4.6 mm I.D.	6660	6500	6360	6410	4.5	1.4

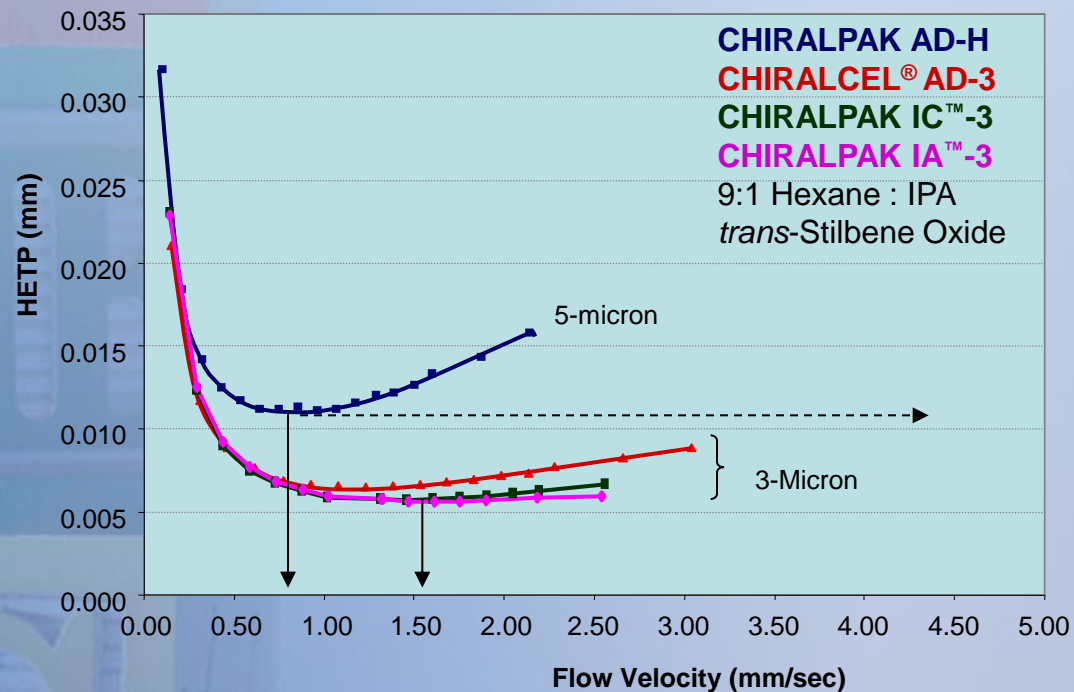
(Trifluorophenylethanol; n-hexane/2-propanol 90:10; 1 mL/min, 210 nm, 25°C)

The 3-Micron columns may be used in conventional (*but modern*) HPLC units without significant loss in performance, even with the smaller columns. *With older units, small volume flow cells and narrow diameter capillaries may be needed for optimum performance.*

Reduction in Particle Size Gives Faster Mass Transfer



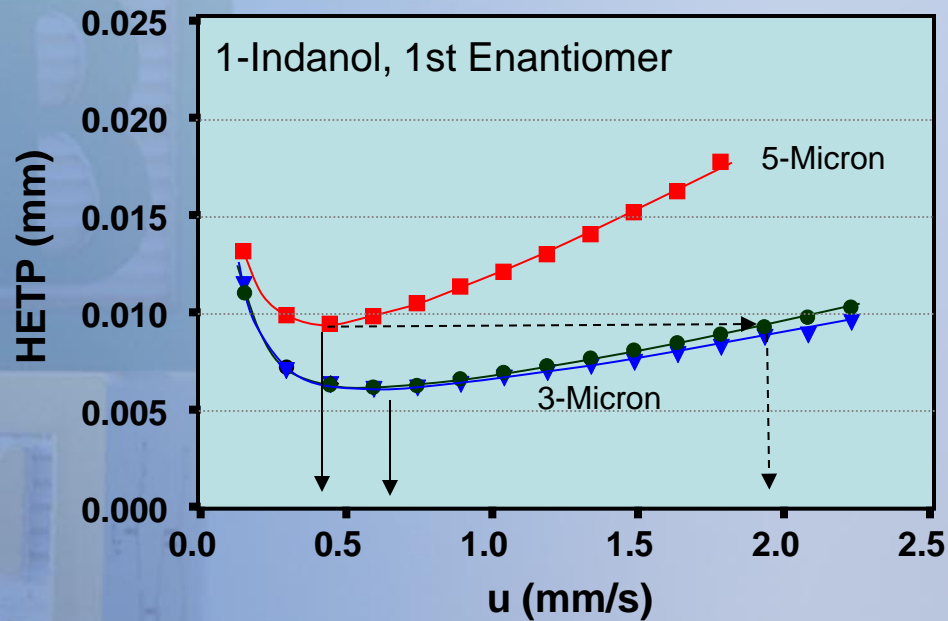
Van Deemter Plots: 3- vs 5-Microns



- **Higher optimum flow rate with smaller particles leads to faster analyses and higher efficiency**
- **Smaller HETP allows shorter columns – and faster analyses**

Van Deemter Plots – Reversed Phase

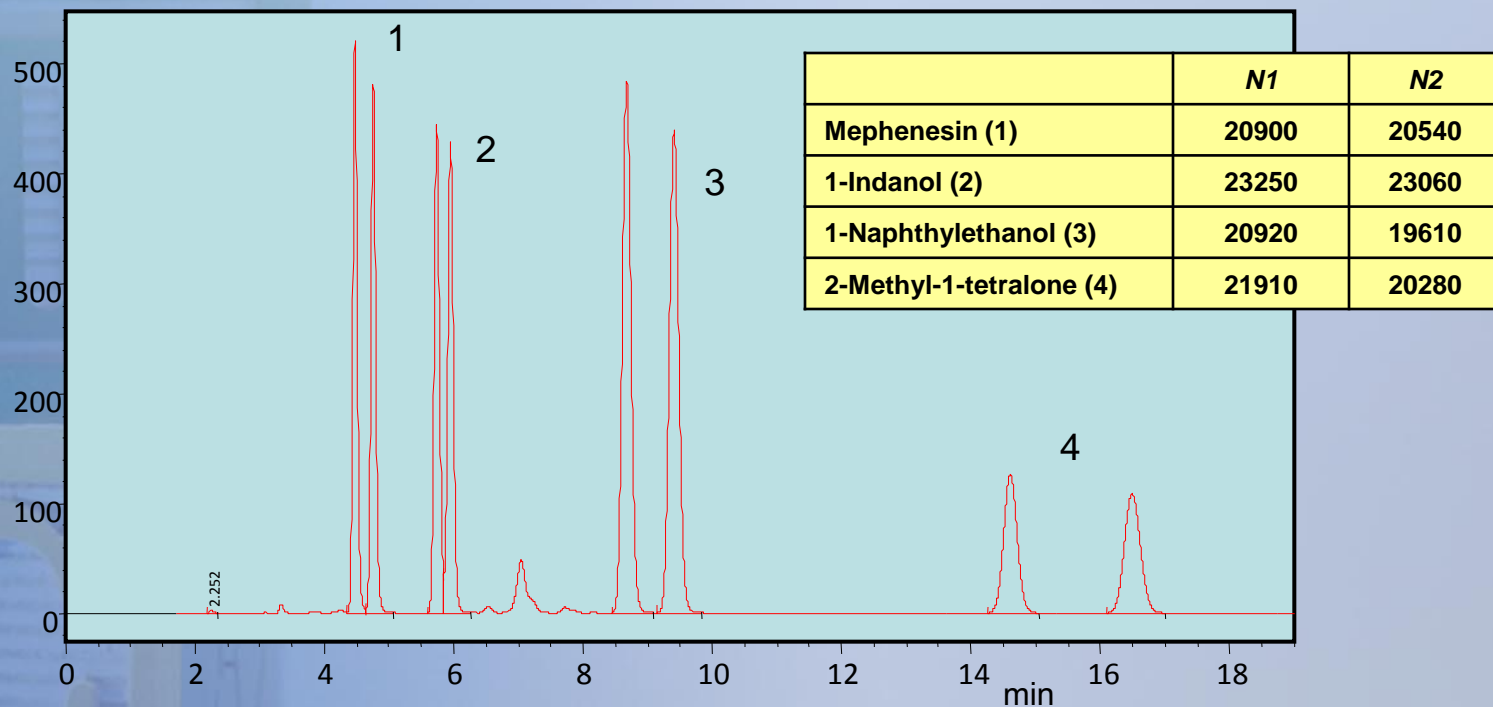
Mobile phase: Water-Acetonitrile 60:40 (v/v)
Detection: 210 nm
Temp.: 25°C
Sample volume: 1.0 microl



- ▼ CHIRALPAK AD-3R
- CHIRALPAK AD-3R
- CHIRALPAK AD-RH

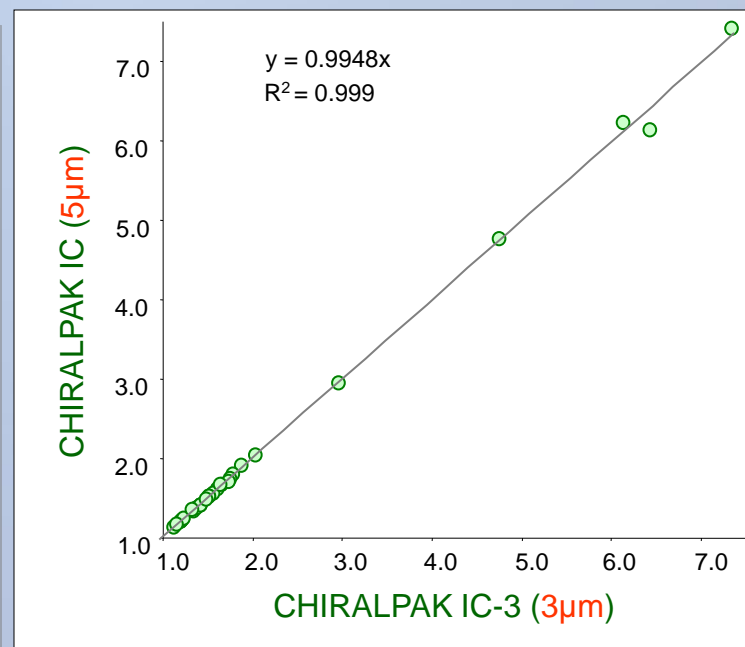
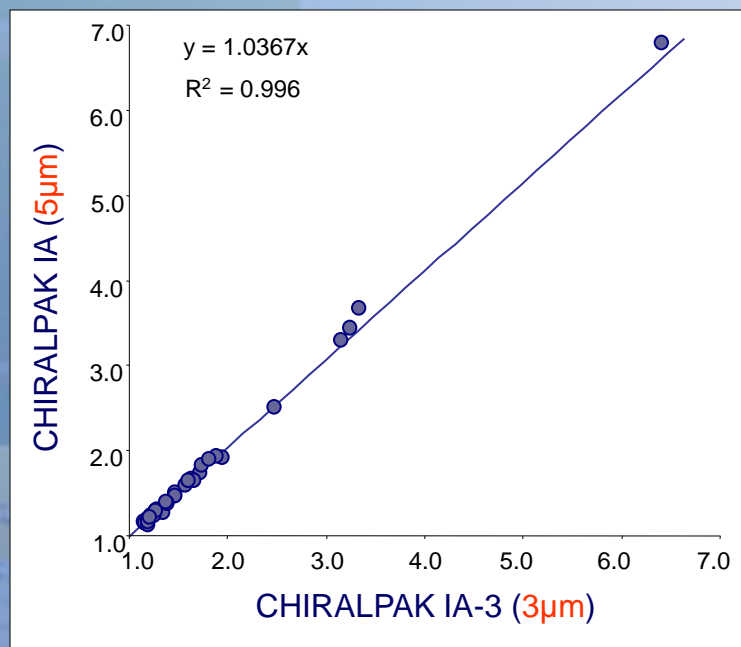
Reversed Phase Tests – AD-3R

CHIRALPAK AD-3R 150 x 4.6 mm
40% ACN – 0.2M KH₂PO₄
0.5 ml/min; 25°C



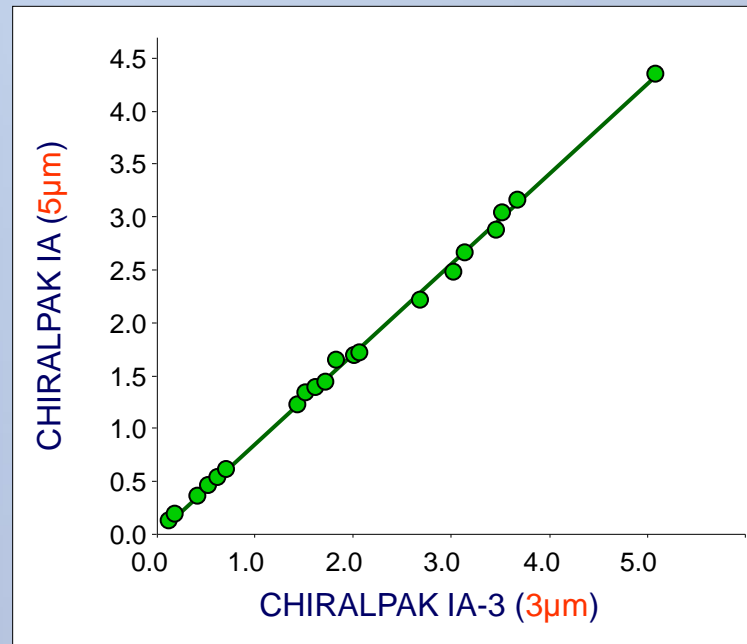
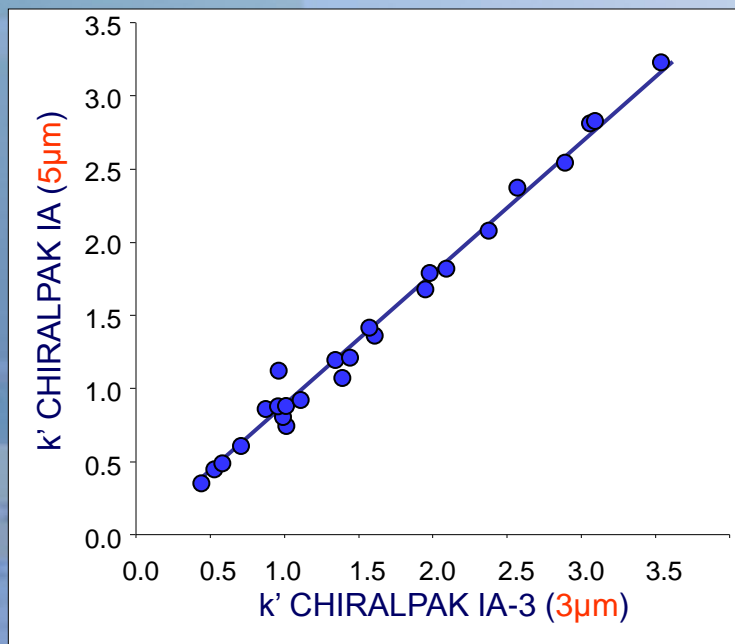
After 3 week pressure stability test

Selectivity: Transfer From 5-Micron



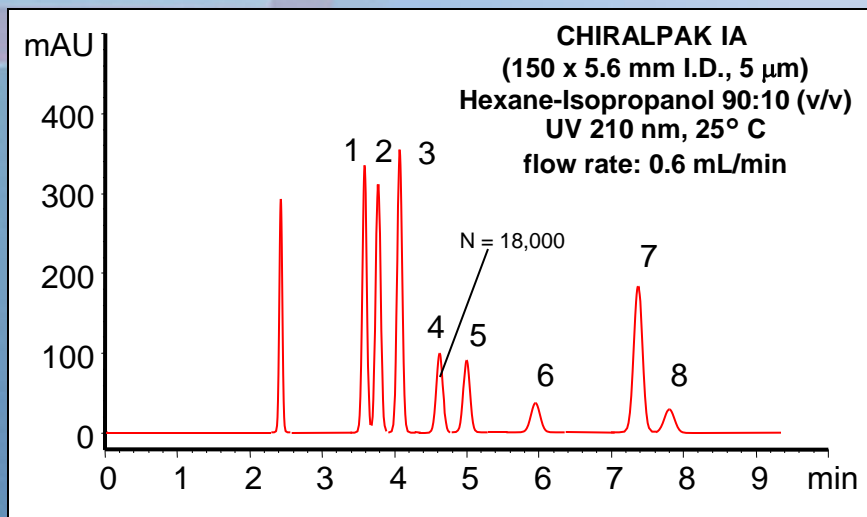
Effortless method transfer from 5- to 3-Micron columns

Retention Factors: Transfer from 5-Micron



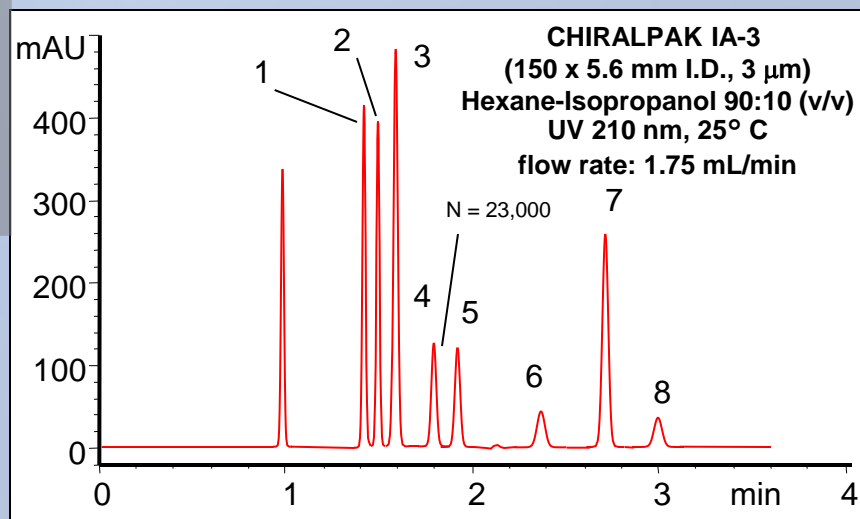
Effortless method transfer from 5- to 3-Micron columns

Transfer to 3-Micron: CHIRALPAK IA-3



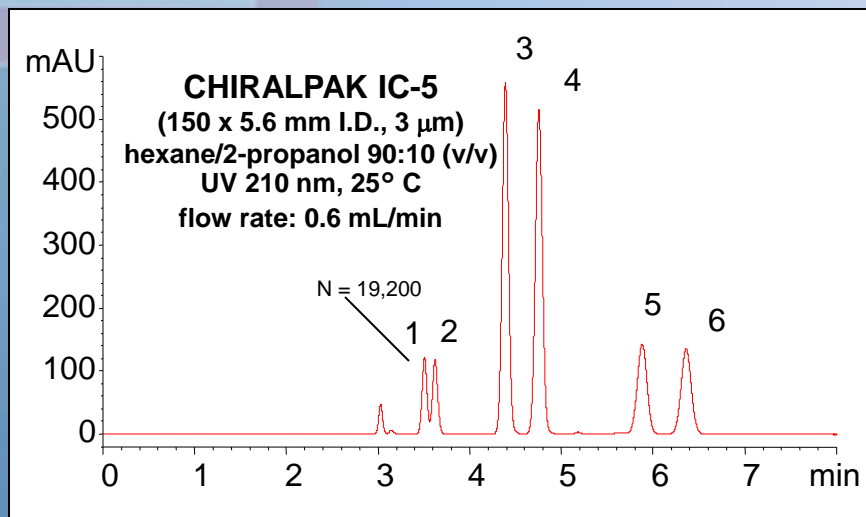
Mecoprop methyl ester: 1,2
trans-Stilbene oxide: 3,7
Benzoin ethyl ether: 4,5
Ruelene: 6,8

* ~ Equal plate numbers



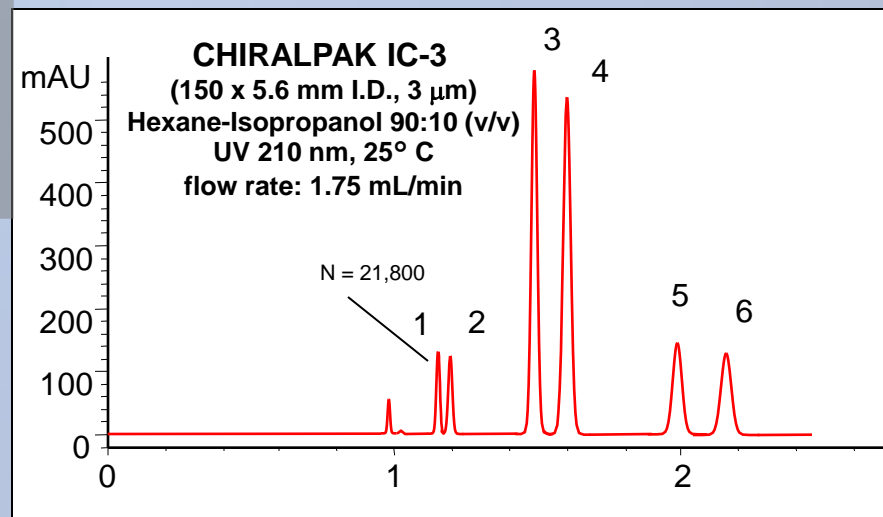
3-fold faster

Transfer to 3-Micron: CHIRALPAK IC-3



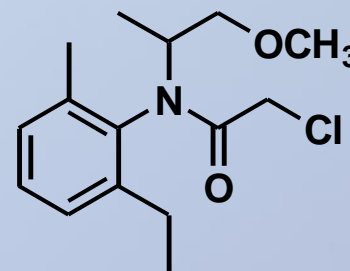
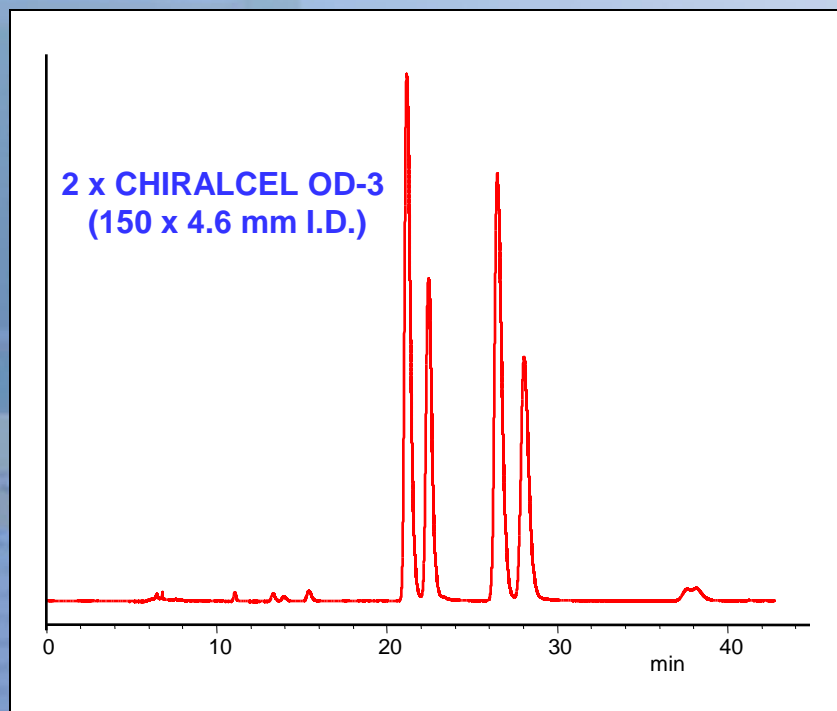
1-Phenyl-2,2,2-trifluoroethanol: 1,2
Tetrahydronaphthol: 3,4
Mecoprop methyl ester: 5,6

* ~ Equal plate numbers



3-fold faster

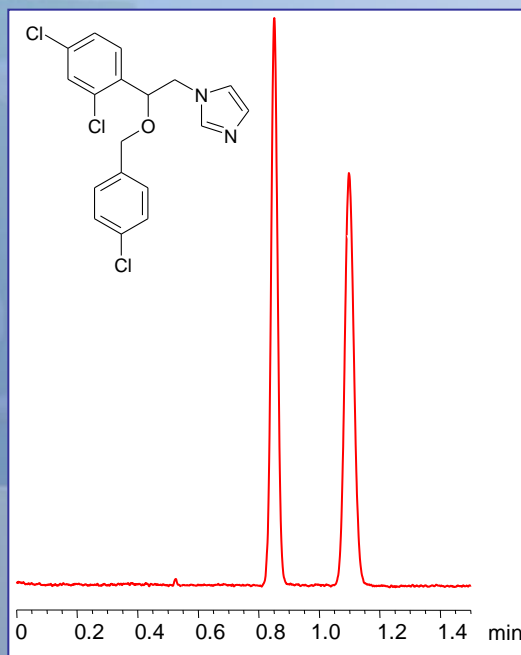
High Efficiency Separations - Metolochlor



$R_{s1,2}$	2.02
$R_{s3,4}$	1.92
N1	19098
N2	21029
N3	19006
N4	18435

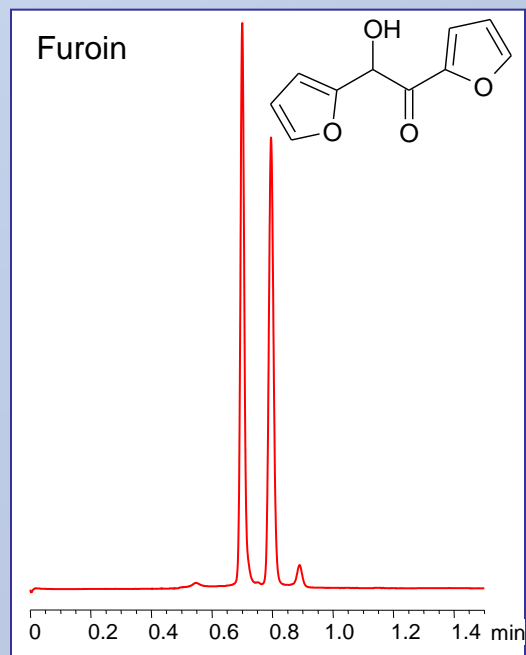
Serial coupled columns, n-hexane/2-propanol 97.5:2.5 (v/v); 0.5 mL/min; 235 nm; 15°C

High Speed Separations



MtBE-MeOH 80:20 (+0.1% Ethanolamine)
Flow rate: **3.5 ml/min**

CHIRALPAK IA-3
(4.6 x 150 mm)

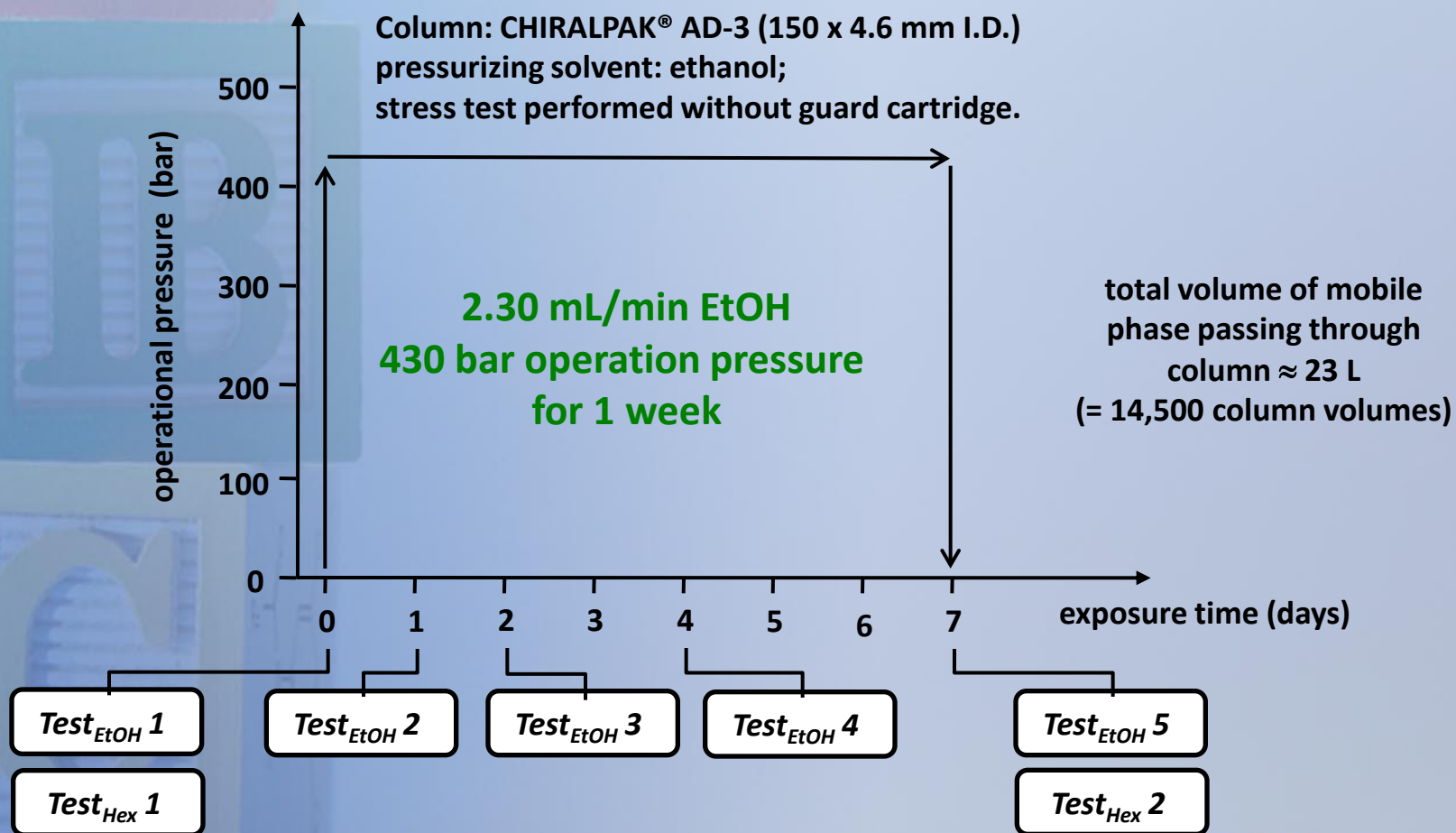


MeOH 100%
Flow rate: **3.0 ml/min**

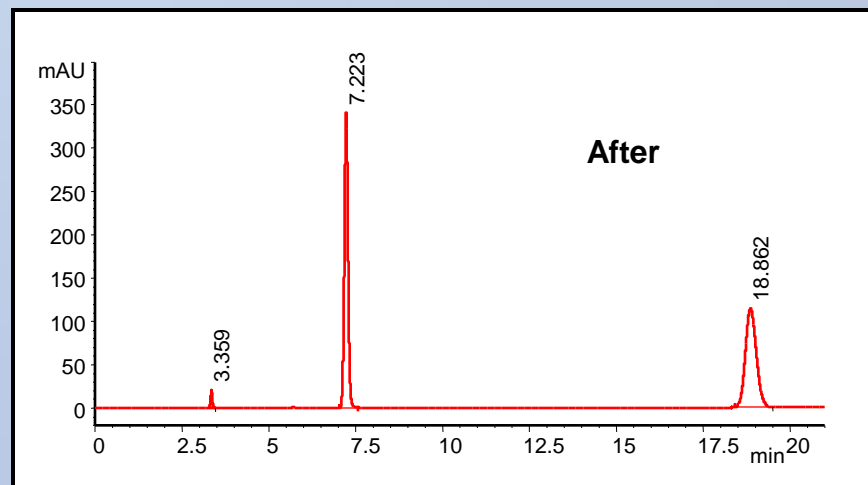
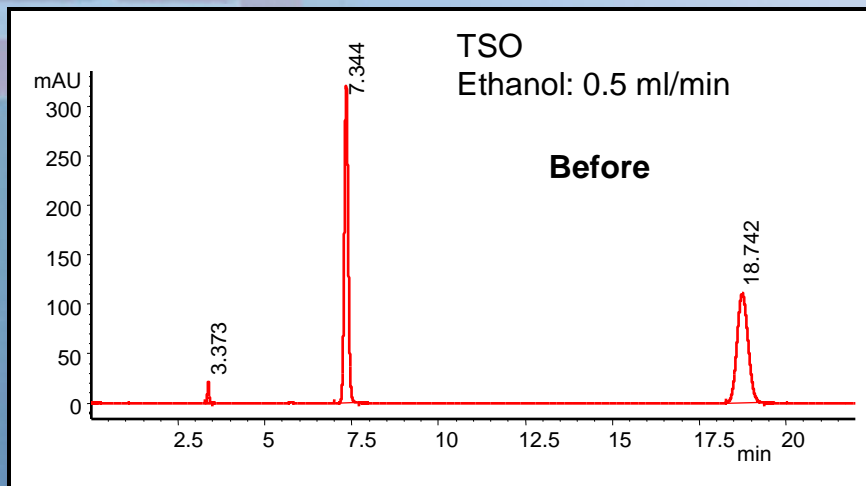
Pressure Stability

- For high speed separations, the columns must be pressure stable
- Extensive pressure testing of the 3-Micron columns shows no practical limit with conventional HPLC systems

Pressure Stability



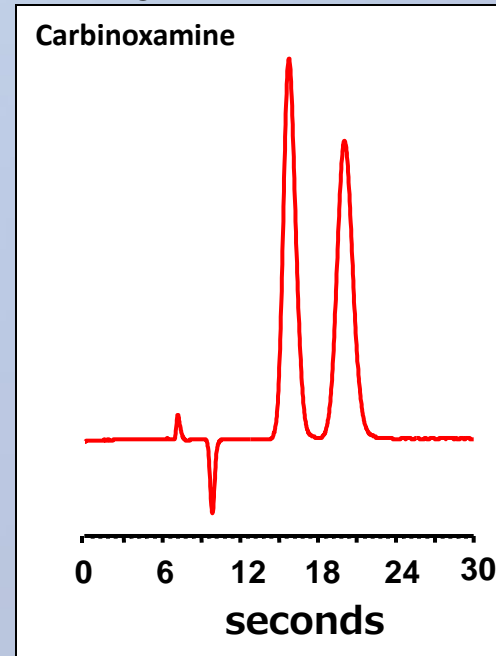
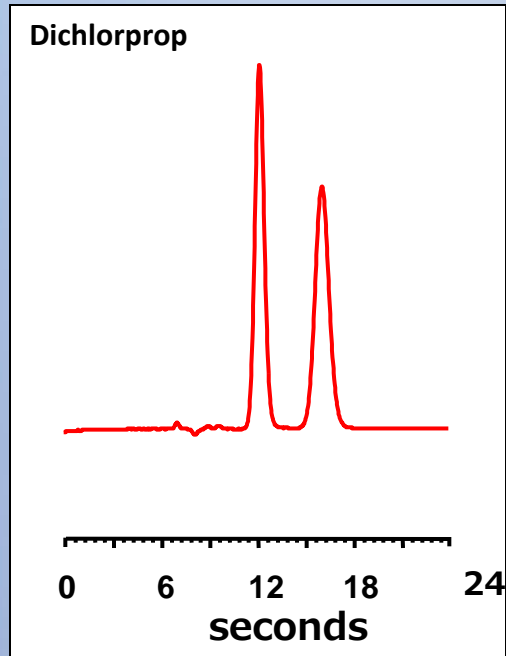
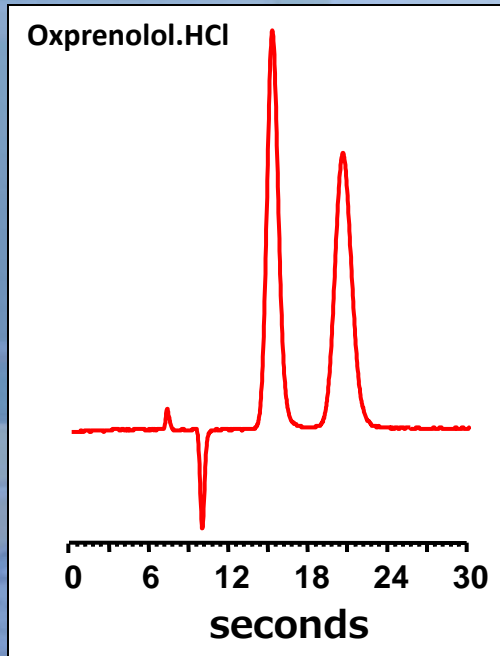
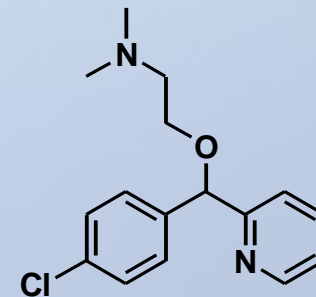
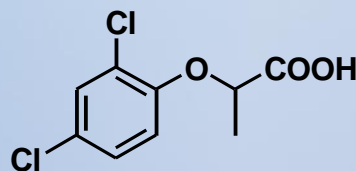
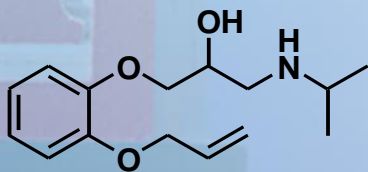
Column Tests – Pressure Stability



Column: CHIRALPAK® AD-3 (150 x 4.6 mm I.D.)

Compound	QC-Test	N unchallenged		N after stress		N Diff (%)	
		N1	N2	N1	N2	N1	N2
TSO/Ethanol	<i>Test_{EtOH}</i>	22270	17130	22430	17090	+ 0.7	- 0.2
Troeger base Hexane / IPA	<i>Test_{EtOH}</i>	18440	13940	18470	13750	+ 0.2	- 1.4
TSO Hexane/IPA	<i>Test_{Hex}</i>	21230	15530	22240	15990	+ 4.8	+ 2.9

Fast Separations

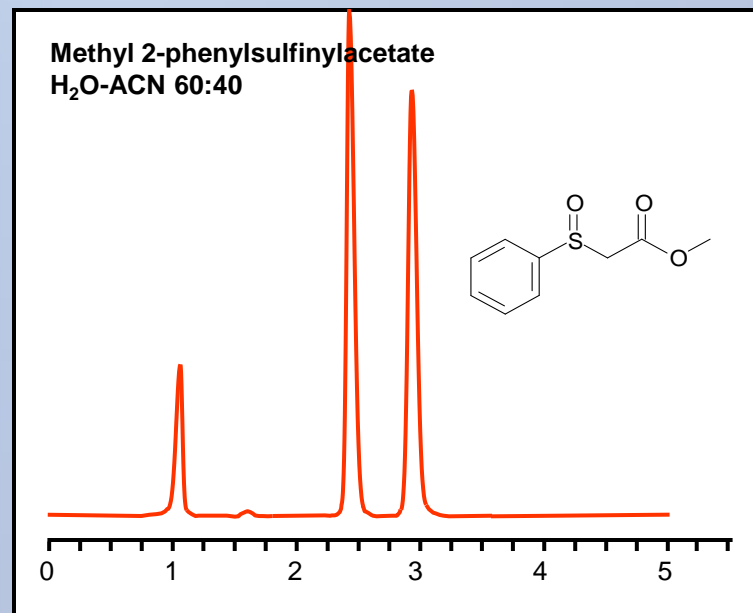
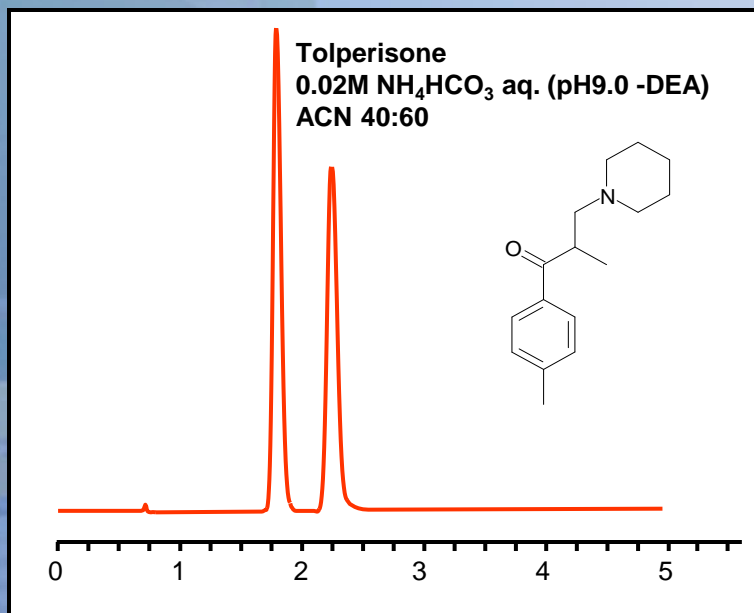


CHIRALPAK® AD-3 (50 x 4.6 mm I.D.); for oxprenolol and carbinoxamine: n-hexane/
2-propanol/diethylamine 90/10/0.1 (v/v/v); for dichlorprop: n-hexane/2-propanol/trifluoroacetic
acid 90/10/0.1 (v/v/v); flow rate: 5.0 mL/min; UV-detection: 235 nm; temperature: 25°C.

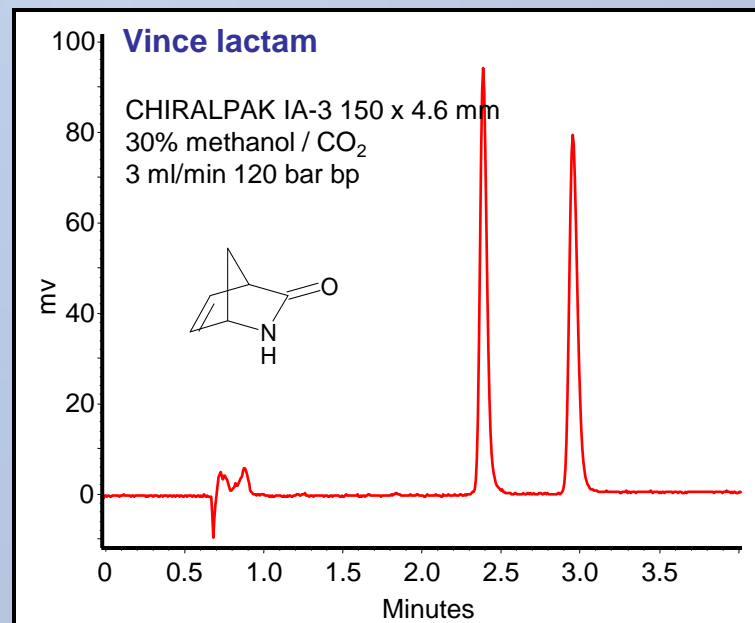
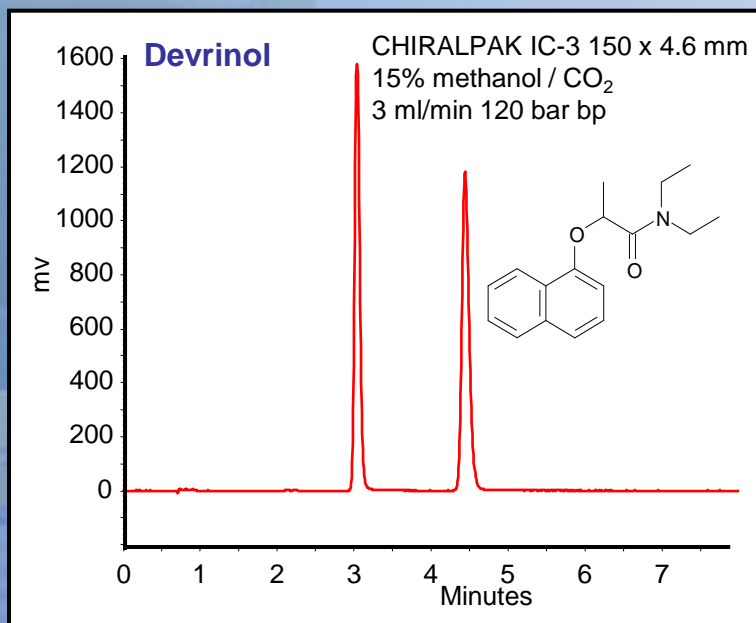
Reversed Phase

CHIRALPAK AD-3R

(4.6 x 150 mm)



SFC



3-Micron Columns

Column	Normal Phase	Reversed Phase	SFC	Fast Separations	High efficiency
CHIRALPAK IA-3	✓	✓	✓	✓	✓
CHIRALPAK IC-3	✓	✓	✓	✓	✓
CHIRALPAK AD-3	✓		✓	✓	✓
CHIRALPAK AD-3R		✓		✓	✓
CHIRALCEL OD-3	✓		✓	✓	✓
CHIRALCEL OD-3R		✓		✓	✓

Conclusions

- High efficiency at high flow rates
- Robust
 - Pressure limit > 400 bar (Determined by HPLC unit)
- Improves productivity by reduction of analysis time
- High efficiency allows difficult separations
- Can be used in conventional HPLC units