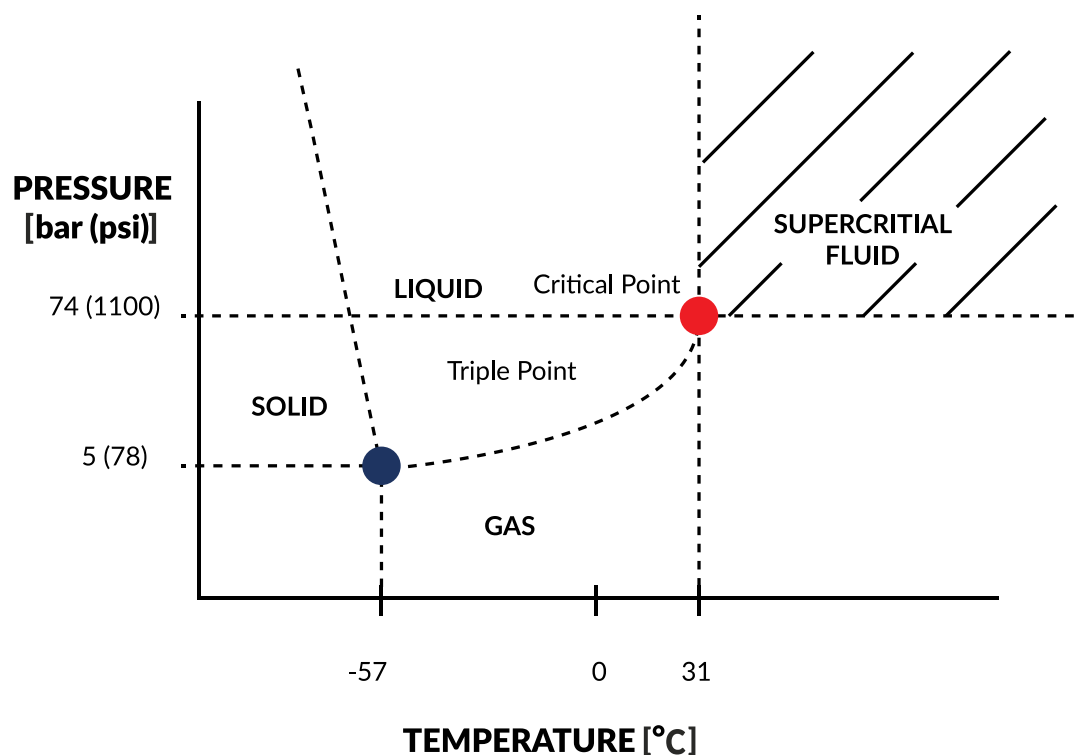


Dr. Maisch

Any Column, Any Size, Any Media



SFC COLUMNS

for Achiral, Chiral and SEC Applications

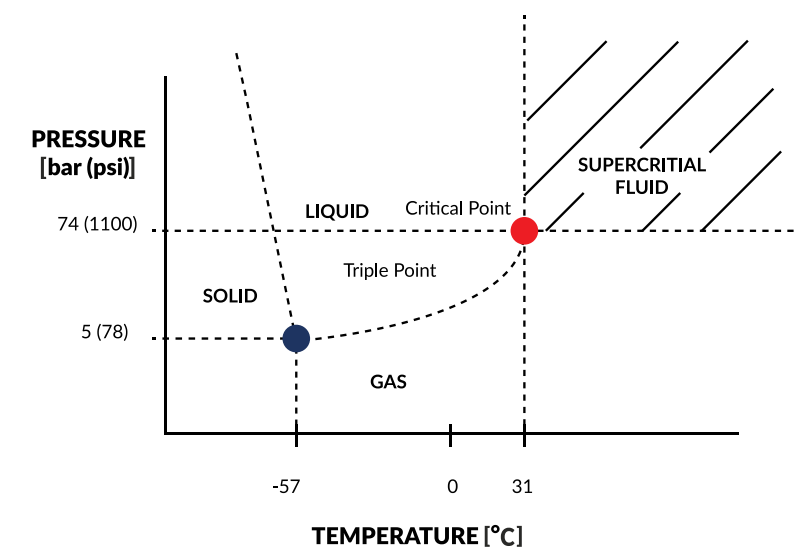
MADE BY DR. MAISCH

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SFC COLUMNS MADE BY DR. MAISCH

From one of the biggest
High-Performance Liquid Chromatography (HPLC) and
Ultra High-Performance Liquid Chromatography (UHPLC)
 Column Manufacturers in Europe.



Supercritical Fluid Chromatography (SFC) is a chromatographic technique using supercritical carbon dioxide (CO₂) as mobile phase. Supercritical CO₂ can be mixed with alcohols (despite its low polarity).

The development process for analytical SFC methods is basically the same as for analytical HPLC methods. SFC can be used to analyze any compound that is compatible with supercritical carbon dioxide and can be dissolved in an organic solvent.

The following resolution equation for HPLC is also valid for SEC:

$$R_s = \underbrace{1/4\sqrt{N}}_{\text{Efficiency}} \cdot \underbrace{\frac{\alpha-1}{\alpha}}_{\text{Selectivity}} \cdot \underbrace{\frac{k}{1+k}}_{\text{Retention}}$$

Figure 1: Resolution quotation for HPLC and SFC (Rs: Resolution, N: Efficiency, Alpha: Selectivity, k: Capacity Factor).

The Efficiency N, Selectivity Alpha, Capacity Factor k affect the Resolution R and are all independent factors depending on:

- Column Dimension.
- Mobile Phase.

Separation can be improved by increasing N and α if a minimum of retention exists.

Resolution - Optimizing Efficiency

The particle size of the silica media directly impacts the efficiency, as measured by the number of theoretical plates (N). A smaller particle size improves the efficiency of a separation.

Dr. Maisch offers a wide variety of particle sizes across its different product lines. In Table 1 you can find the standard Reprospher phases used for SFC applications.

Table 1: Available Reprospher Products for SFC Applications.

Increasing efficiency and backpressure.

Product Name	Particle Size and Part Number (PN)					
	1.7 μm	1.8 μm	2 μm	2.5 μm	3 μm	5 μm
Reprosphere 100 Si	rs117.00	rs118.00	rs12.00	rs125.00	rs13.00	rs15.00
Reprosphere 100 NH ₂ not endc.	N/A	N/A	N/A	N/A	rs13.a0	rs15.a0
Reprosphere 100 NH ₂ -DE	N/A	rs118.ade	rs12.ade	N/A	N/A	rs15.ade
Reprosphere 100 CN	N/A	rs118.c0	rs12.c0	rs125.c0	rs13.c0	rs15.c0
Reprosphere 100 CN-DE	rs117.cde	rs118.cde	N/A	N/A	N/A	rs15.cde
Reprosphere 100 Diol-DE	N/A	N/A	N/A	N/A	N/A	rs15.dde
Reprosphere 100 Diol	N/A	N/A	N/A	N/A	rs13.d0	rs15.d0

The backpressure generated by the SFC system limits the particle size that can be used. Scale-Up in SFC applications is more complex compared to HPLC conditions due to the compressibility of CO₂ causing density, pressure and temperature variations.

These variations have an impact on the mobile phase (retention, selectivity). This complicates the scale-up process from analytical to preparative methods. Most stationary phases used for SFC applications are not endcapped. A higher silica surface increases the retention. On the other side such non-end capped columns show a shorter lifetime.

Another approach to achieve higher efficiencies is to change the design of the silica particle from fully-porous to core shell particles. Core-shell particles exhibit very high efficiency relative to fully porous particles of equivalent diameter. Table 2 shows examples of ReproShell media offered by Dr. Maisch, which are based on core-shell particles.

Table 2: Available ReproShell Products.

Product Name	Particle Size and Part Number (PN)	
	2.7 μm	5 μm
ReproShell ODS-1	cs27.91	cs15.91
ReproShell ODS-3	cs27.93	cs15.93
ReproShell SI	cs27.00	cs15.00
ReproShell PFP	cs27.pfp	cs15.pfp
ReproShell Phenyl-Hexyl	cs27.ph	cs15.ph
ReproShell C8	cs27.8e	cs15.8e
ReproShell Biphenyl	cs27.bpe	cs15.bpe

Resolution - Optimizing Mobile Phase

CO₂ is not polar enough for the elution of polar compounds. The addition of a polar organic co-solvent (modifier) is necessary to allow elution and to have reasonable run times. Supercritical CO₂ is completely miscible with all commonly used organic solvents.

When mixed with an organic modifier, the critical point of CO₂ is changing, bringing the mobile phase in a state that is not necessarily supercritical anymore.

Increasing the concentration of the organic modifier in the mobile phase:

- Increases the elutropic strength.
- Decreases the retention times.

The modifier can also be adsorbed at the surface of the stationary phase, leading to a modification of this surface.

The choice of the modifier depends on:

- Eluent strength.
- Selectivity.
- Efficiency.
- Peak shapes achieved in initial test runs.

Bad peak shapes can be minimized by the addition of an organic modifier with H-bond donor capacity (MeOH, EtOH, IPA).

List of Potential Modifier:

- **Alcohols** - MeOH is by far the most commonly used alcohol in SFC applications, due to its ability to achieve higher separation efficiency and shorter analysis times in comparison to EtOH and IPA.
 - Highest elutropic strength.
 - Efficiency: MeOH > EtOH > IPA.
 - High polarity favors solubility of compounds in the mobile phase.
 - MS-detection is more sensitive (lower surface tension of MeOH gives better ionization compared to other alcohols).

- **Acetonitrile (ACN)**
 - Unique and different selectivity.
 - Aprotic solvent.
 - Poor chromatographic performance (very low efficiency, bad peak shapes).
- **Mix of Methanol and Acetonitrile**
 - Improves selectivity without altering peak shape.
- **Acidic Additives** (Formic Acid, Acetic Acid, Trifluoroacetic Acid (TFA), Citric Acid).
 - Improves the peak shapes of strong acids.
- **Basic Additives** (Isopropylamine, Diethylamine, Ethyldimethylamine, or Triethylamine).
 - Improves the peak shape of strong bases.

In the presence of both acidic and basic compounds in the sample, it is possible to include an acidic and a basic additive in the modifier.

- **Volatile Additives (Ammonium Hydroxide, Ammonium Acetate or Ammonium Formate)**
 - Improve the peak shape of acidic and basic compounds. These are compatible with **MS-detection** and easier to evaporate in the preparative scale.
 - Water is not fully soluble in CO₂ but it can be mixed in a reasonable proportion (1–5%) to a CO₂–MeOH mobile phase, in addition or replacement of traditional additives to improve the peak shape.

Most additives absorb in the UV range, leading to a baseline drift using a gradient method. Therefore, there is significant interest in stationary phases that provide symmetrical peaks without the need for additives in the mobile phase.

ANALYTICAL SFC COLUMNS
SFC COLUMNS FOR ACHIRAL APPLICATIONS

In the Reversed-Phase (RP) HPLC world a C18 modified Silica Column would typically be the starting point for the method development process. In achiral SFC applications, the use of C18 columns is theoretically possible, but in practice, the success rate is very low.

Various achiral columns used in HPLC applications can also be used for SFC applications. However, it is really difficult to predict the behaviour of a silica modification and also completely different silica modifications often provide superior separations.

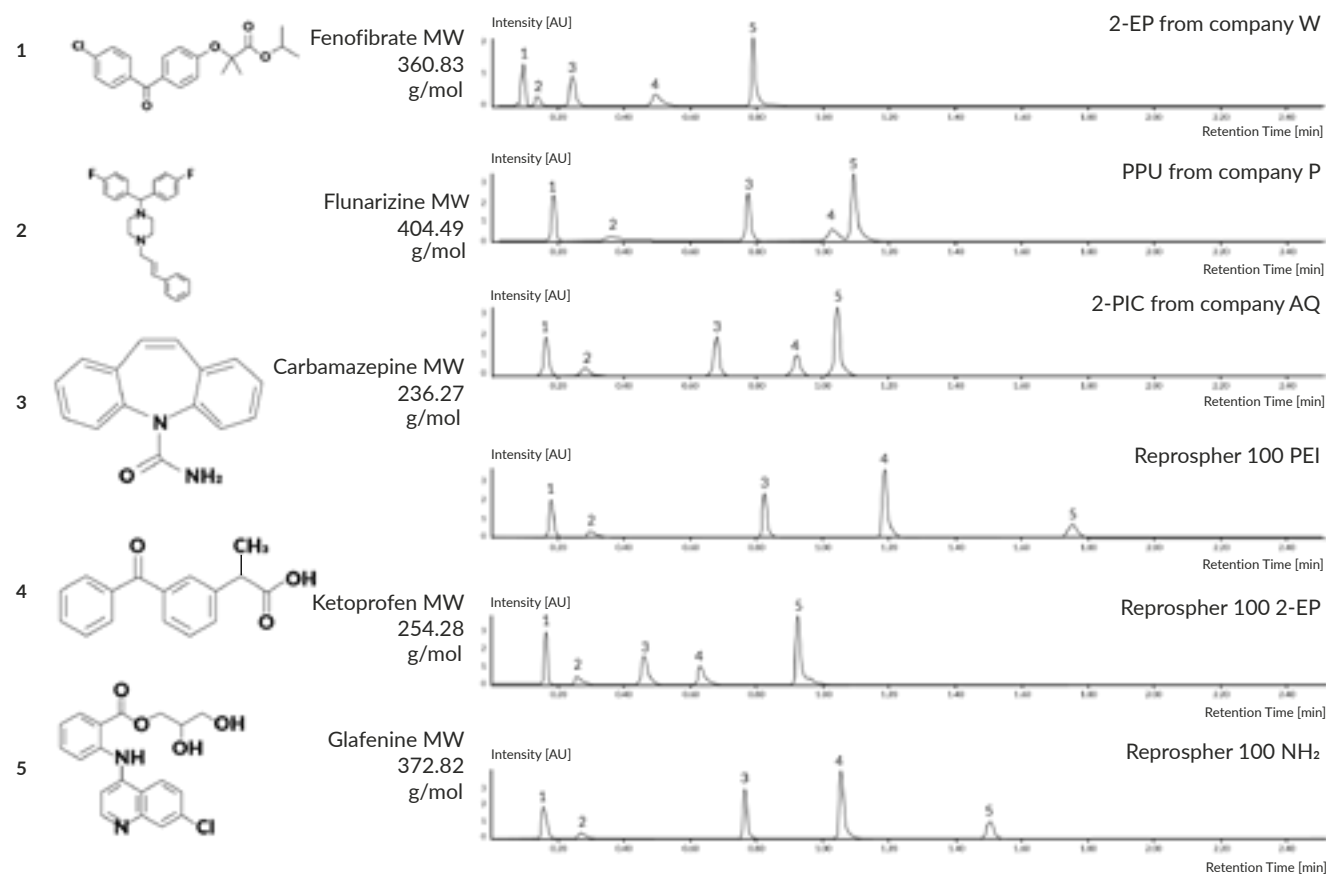


Figure 2: Testmix of 5 Compounds on 6 different SFC Columns. Application Courtesy of John Reilly, Novartis Institut of Biomedical Research NiBr AG Basel, 4002 Basel, Switzerland.

Columns: Analytical SFC Columns
Dimensions: 50 x 3 mm
Mobile Phase: A: CO₂
B: MeOH or MeOH + 0.1% basic modifier
Temperature: 35 °C

SFC COLUMNS FOR ACHIRAL APPLICATIONS
REPROSPHER PEI

Several stationary phases from Dr. Maisch exhibit excellent performance used in SFC applications. The most successful phase is Reprospher Polyethylenimine (PEI).

REPROSPHER POLYETHYLENIMINE (PEI)

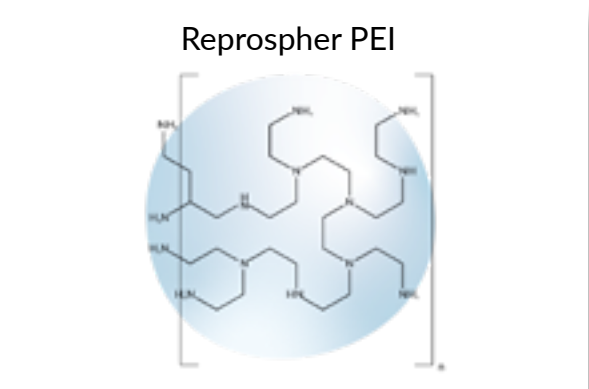


Figure 3: Scheme of Reprospher PEI.

Polyethylenimine (PEI) phase exhibits a higher density of amino groups compared to traditional Amino phases (factor 3). The polymer skeleton includes primary, secondary and tertiary amine groups.

Table 3: Available Reprospher PEI Products.

Product Name	Modification	Pore Size [Å]	Particle Size and Part Number (PN)				
			3 µm	5 µm	10 µm	30 µm	50 µm
Reprosphere 100 PEI	Polyethylenimine	100	rs13.pei	rs15.pei	rs10.pei	rs130.pei	rs150.pei
Reprosphere 300 PEI	Polyethylenimine	300	rs33.pei	rs35.pei	rs30.pei	N/A	N/A

Superior Performance of Reprospher PEI

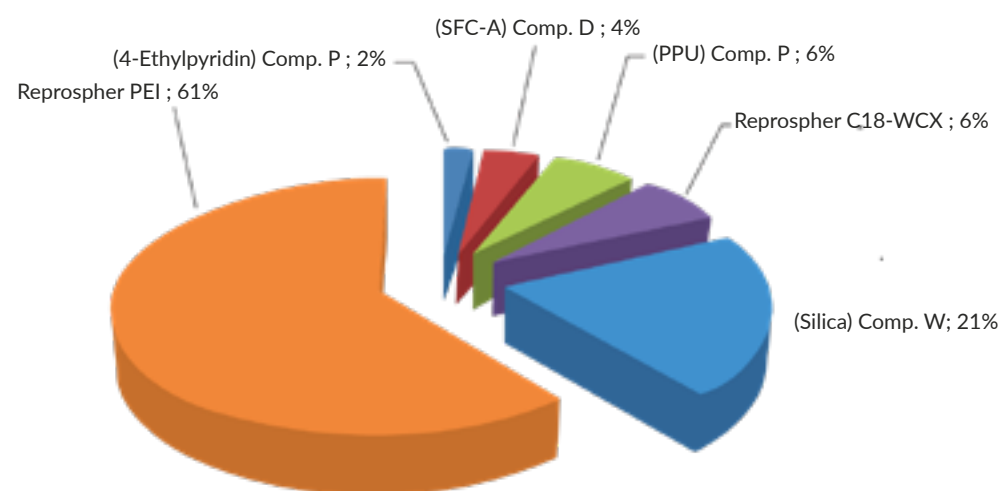


Figure 4: Superior Performance of Reprospher PEI.

Published by: Thomas Wolf, Alexander Marzlale, Eric Francotte and Trixie Wagner
Achiral SFC-MS Lab: Support of Global Discovery Chemistry Basel 2016

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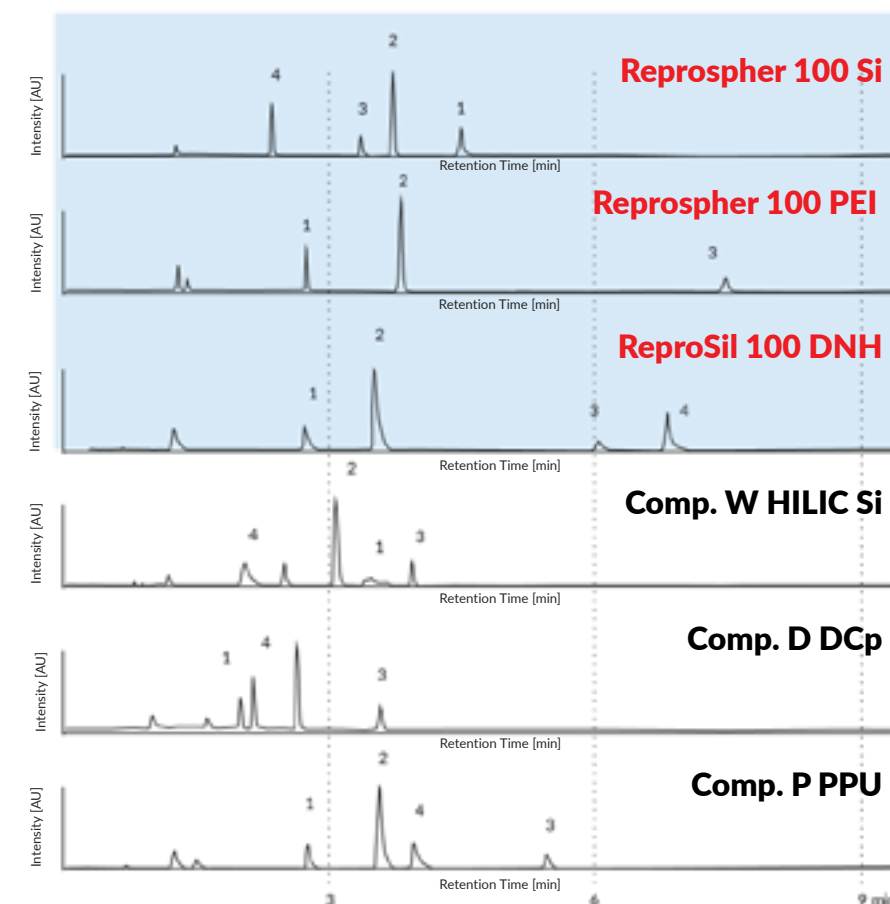


Figure 5: Testmix of 4 different Compounds on 6 different SFC Columns. Application Courtesy of Eric Francotte, Novartis AG, 8th International Conference on Packed Column SFC, Oct 2014, Basel, Switzerland.

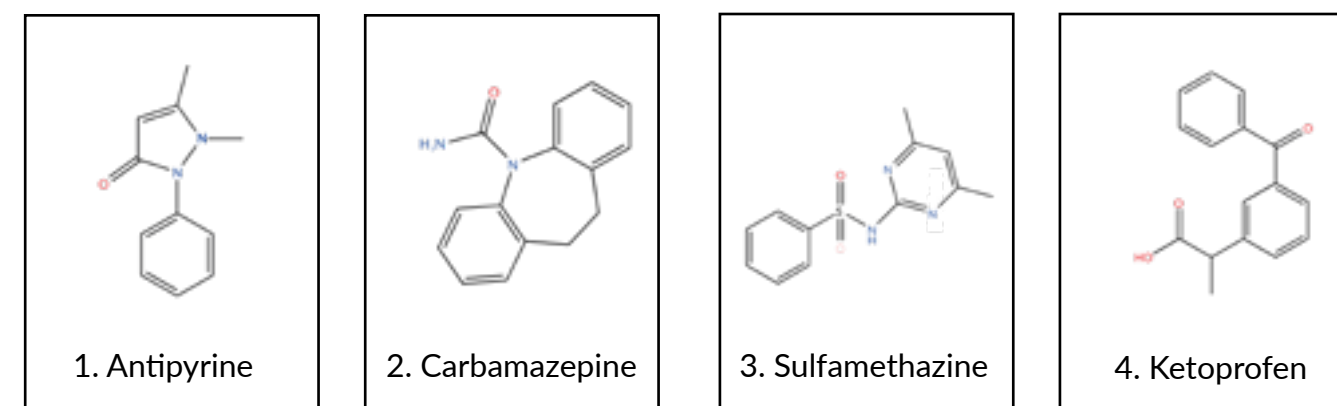


Figure 6: The 4 Compounds of the used Testmix.

Columns: Analytical SFC Columns
Dimensions: 250 x 4.6 mm
Mobile Phase: CO₂ + MeOH (5-50% in 6 min)
Flow Rate: 1.0 ml/min
Detection: UV-Detection @254 nm

Reprospher HILIC-ARG

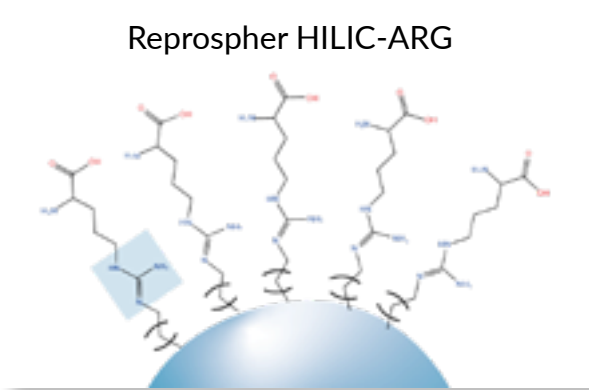


Figure 7: Scheme of Reprospher HILIC-ARG.

Table 4: Available Reprospher HILIC-ARG Products.

Product Name	Modification	Pore Size [Å]	Particle Size and Part Number (PN)	
			3 µm	5 µm
Reprospher HILIC-ARG	ARGININE	100	rs13.ARG	rs15.ARG

Reprospher HILIC-ARG is a silica phase surface modified with arginine and exhibits acidic and basic functionality. The phase has a strong affinity to hydrophilic compounds and offers a very special selectivity compared to other SFC phases.

ReproSil CBD

Special phase for cannabinoids: CBD purification.
Perfect resolution for Cannabidiol (CBD) and Cannabigerol (CBG) isolation from other cannabinoids.

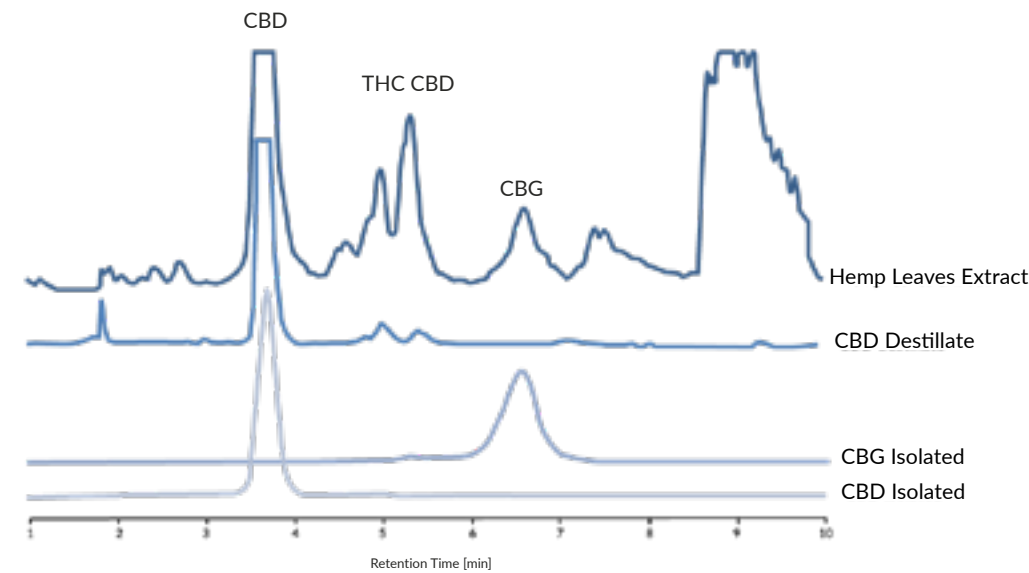


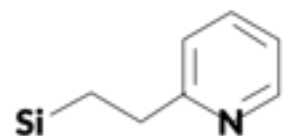
Figure 8: Hemp Leaves Extract, CBD Destillate, CBG Isolated and CBD Isolated.

Columns: ReproSil CBD
Dimensions: 250 x 4.6 mm
Mobile Phase: 4% MeOH
Detection: UV-Detection @220 nm

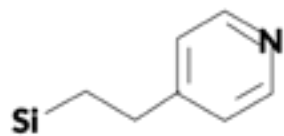
SFC COLUMNS FOR ACHIRAL APPLICATIONS

REPROSPHER 2-EP AND 4-EP

REPROSPHER 2-EP AND 4-EP



ReproSpher 2-Ethylpyridine (2-EP)



ReproSpher 4-Ethylpyridine (4-EP)

Figure 9: Scheme of Reprospher 2-EP and 4-EP.

Table 5: Available Reprospher 2-EP and 4-EP Products.

Product Name	Modification	Pore Size [Å]	Particle Size and Part Number (PN)		
			3 µm	5 µm	10 µm
ReproSpher 100 2-EP	2-Ethylpyridine	100	rs13.2ep	rs15.2ep	rs10.2ep
ReproSpher 100 4-EP	4-Ethylpyridine	100	N/A	rs15.4ep	rs10.4ep

Ethylpyridine (EP) modified silica has been the gold standard for achiral SFC analysis of basic compounds for a long time because these phases generally do not require an addition of amines to the eluent, still giving excellent peak shape and reproducibility.

The pyridine group minimizes interactions with silanol groups by steric shielding. EP-phases are also useful phase for the separation of neutral and acidic polar compounds.

The 4-EP phase offers alternative selectivity to the 2-EP phase.

Scheme of Reprospher C18-WCX Reprospher C18-WCX

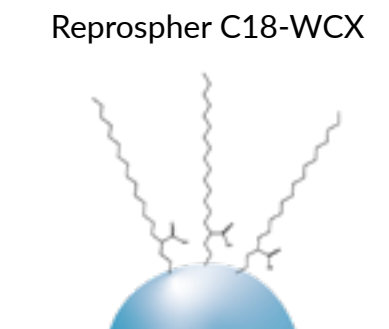


Figure 10: Scheme of Reprospher C18-WCX.

Table 6: Available Reprospher C18-WCX Products.

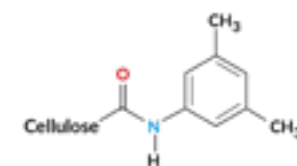
Product Name	Modification	Pore Size [Å]	Particle Size and Part Number (PN)		
			3 µm	5 µm	10 µm
ReproSpher 100 C18/WCX	C18+Carboxylic Acids	100	rs13.9ac	rs15.9ac	rs10.9ac
ReproSpher 100 4-EP	4-Ethylpyridine	100	N/A	rs15.4ep	rs10.4ep

This mixed mode phase combines a carboxylic group directly connected to a hydrophobic C18 chain. This media is non-endcapped and allows multiple interactions which result in special selectivity.

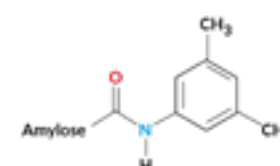
SFC COLUMNS FOR CHIRAL APPLICATIONS

REPROSIL CHIRAL

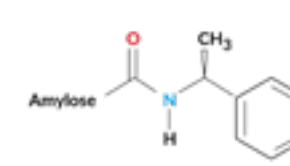
REPROSIL CHIRAL



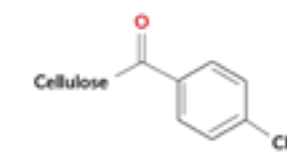
ReproSil Chiral-OM
(ChiralcelOD, Lux Cellulose-1)



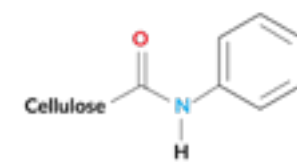
ReproSil Chiral-AM
(Chiralpak AD, Lux Amylose-1)



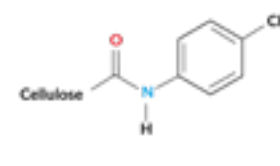
ReproSil Chiral-AMS
(Chiralpak AS)



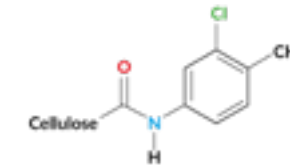
ReproSil Chiral-JM
(Chiralcel OJ, Lux Cellulose-3)



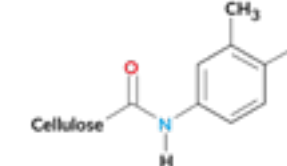
ReproSil Chiral-CM
(Chiralcel OC)



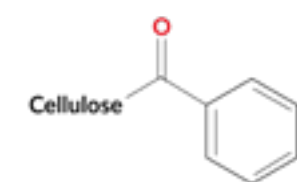
ReproSil Chiral-GM
(Chiralcel OG)



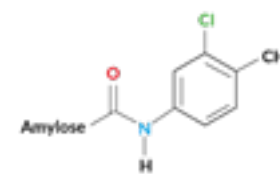
ReproSil Chiral-ZM
(Chiralcel OZ, Lux Cellulose-2)



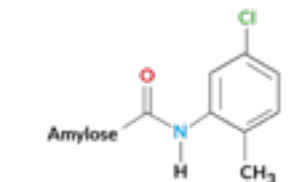
ReproSil Chiral-XM
(Chiralcel OX, Lux Cellulose-4)



ReproSil Chiral-BM
(Chiralcel OB)



ReproSil Chiral-ZA
(Chiralpak AZ)



ReproSil Chiral-YM
(Chiralpak AY, Lux Amylose-2)

Figure 11: ReproSil Chiral Phases.

ReproSil Chiral OM, CM, JM, ZM, BM, AM, AMS, ZA and YM phases are prepared by coating the silica with a polysaccharide (e.g. cellulose or amylose). Therefore, the presence of any solvent capable of dissolving polysaccharides must be strictly avoided, even at trace levels.

- Ethers incl. THF, Acetone, Chlorinated Solvents, Ethyl Acetate, DMSO, DMF, N-Methyl formamide, Toluene, Ketones, Dimethylacetamid
- IPA > 50%

Coated Dr. Maisch ChiralPhases as Alternatives to Chiral Phases from Daicel and Phenomenex

The Dr. Maisch polysaccharide phases are excellent alternatives to existing Daicel phases which was confirmed by many happy Dr. Maisch customers globally and mentioned in several scientific publications in the scientific world. One example:

EVALUATION OF REPOSIL CHIRAL OM VS. OD

Evaluation of a silica phase

modified with cellulose tris-(3,5-dimethylphenyl-carbamate)

„ReproSil Chiral-OM“

in supercritical fluid chromatography. Syame Khater and

Caroline West, University of Orleans, CNRS UMR 7311, ICOA.

All experiments were performed on a Jasco SFC system and an Acquity UPC² system. ReproSil Chiral-OM is based on silica coated with tris-(3,5-dimethylphenylcarbamate) of cellulose. Two hundred and thirty achiral compounds and one hundred and thirty chiral racemic compounds were screened on different polysaccharide-type chiral stationary phases in SFC using the following operating conditions: CO₂/MeOH 90:10, flow rate 3 ml/min, oven temperature 25 °C, outlet pressure 150 bar.

NON-SPECIFIC INTERACTIONS AND RETENTION

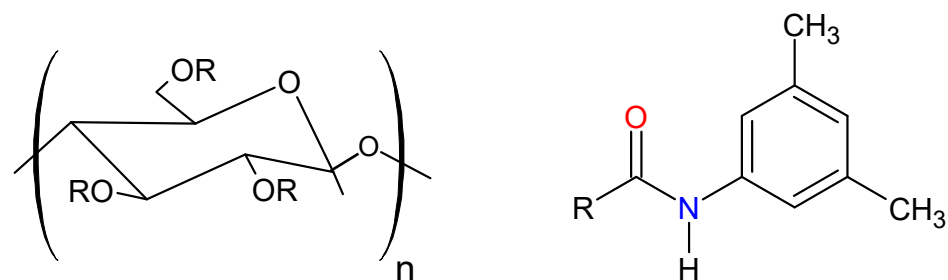


Figure 12: Scheme of cellulose tris-(3,5-dimethylphenylcarbamate).

Retention on cellulose tris-(3,5-dimethylphenylcarbamate) could be explained by non-specific interactions such as π - π interactions, hydrogen bonding and stereo-induced interactions.

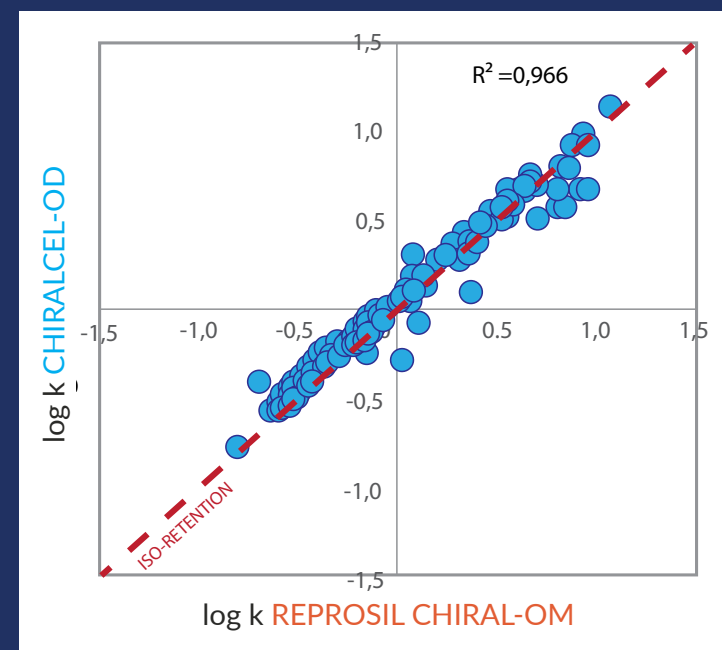


Figure 13: log k Chiralcel-OD vs. log k ReproSil Chiral-OM.

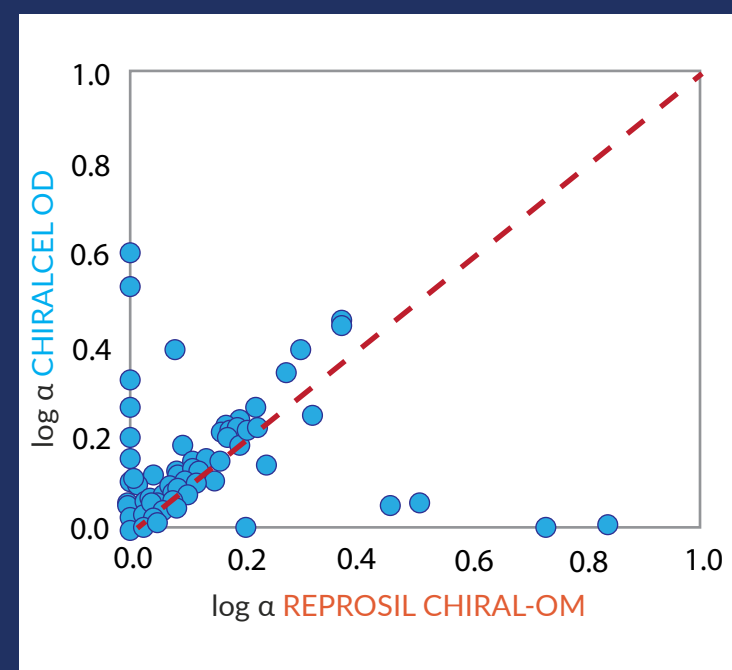


Figure 14: log α Chiralcel-OD vs. log α ReproSil Chiral-OM.

The investigation on non-specific interactions that control retention is based on the analysis of 230 achiral compounds.

The k-k plot on the left compares the logarithms of retention factors of 168 achiral species on Chiralcel OD vs. ReproSil Chiral-OM. The phases are expected to be similar since they possess the same chiral selector (R² = 0.966). They would provide similar non-specific interactions.

The α-α plot below compares the logarithm of separation factors measured for 130 racemates on ReproSil Chiral-OM vs. Chiralcel OD.

The major part of the compounds is located on the dotted line, indicating similar separation behaviour of the two columns.

Chiralcel OD provides a higher number of unique hits. Indeed, 81% of the tested chiral species are resolved on ReproSil Chiral-OM against 86% on Chiralcel OD. However, some racemates are well separated on ReproSil Chiral-OM with little or no separation on Chiralcel OD.

SFC COLUMNS FOR CHIRAL APPLICATIONS

REPOSIL CHIRAL

The following chromatograms illustrate the complementarity of the generic phases having cellulose tris-(3,5- dimethylphenyl-carbamate) as chiral selector in the course of method development: ReproSil Chiral-OM vs. Chiralcel OD. The chromatograms illustrate that the chiral (2,3-Epoxypropyl)-benzene is well resolved on ReproSil Chiral-OM (b) but there is no separation on Chiralcel OD (a).

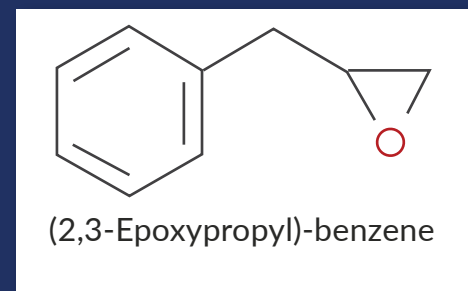
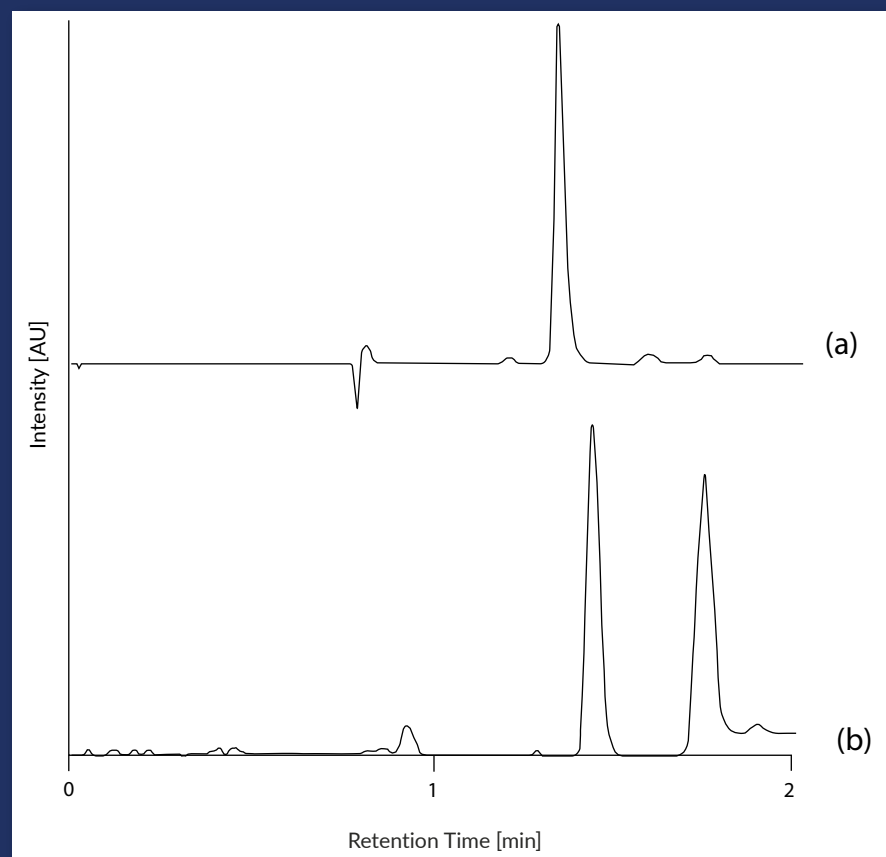


Figure 15: Separation of (2,3-Epoxypropyl)-benzene on Chiralcel OD (a) and ReproSil Chiral-OM (b).

SFC COLUMNS FOR CHIRAL APPLICATIONS

REPOSIL CHIRAL

Comparison of ReproSil Chiral-OM and Chiralcel OD

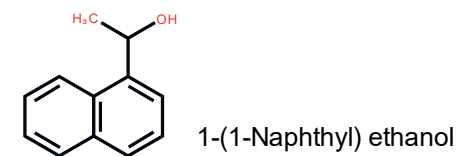
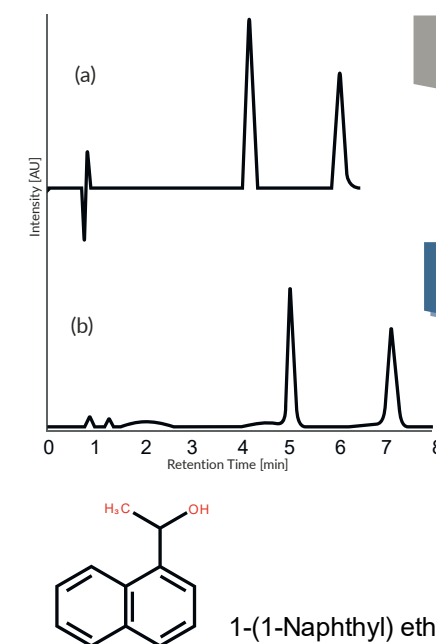


Figure 16: Separation of 1-(1-Naphthyl)ethanol on Chiralcel OD (a) and ReproSil Chiral-OM (b).

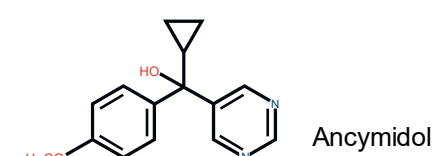
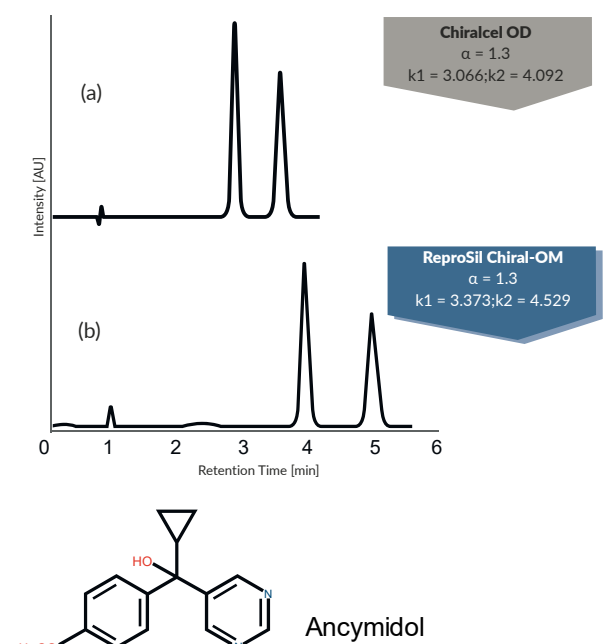


Figure 17: Separation of Ancymidol on Chiralcel OD (a) and ReproSil Chiral-OM (b).

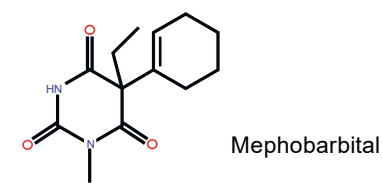
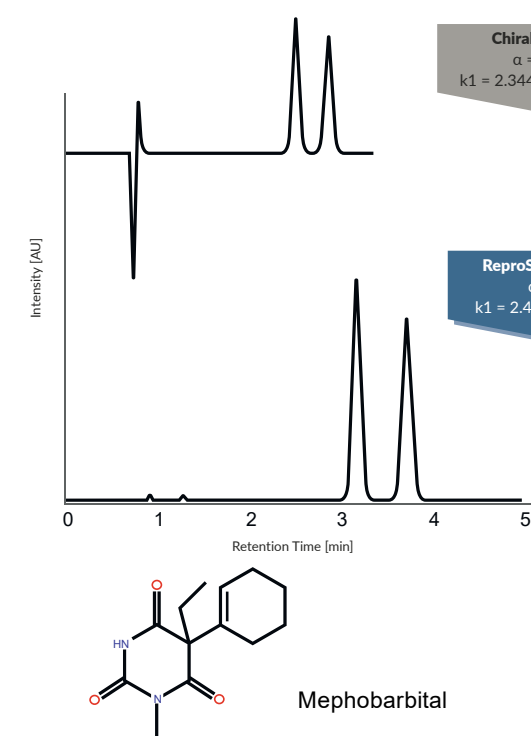


Figure 18: Separation of Mephobarbital on Chiralcel OD (a) and ReproSil Chiral-OM (b).

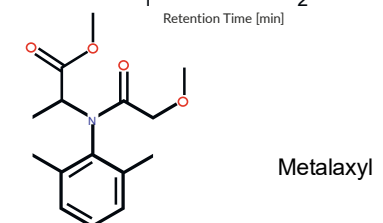
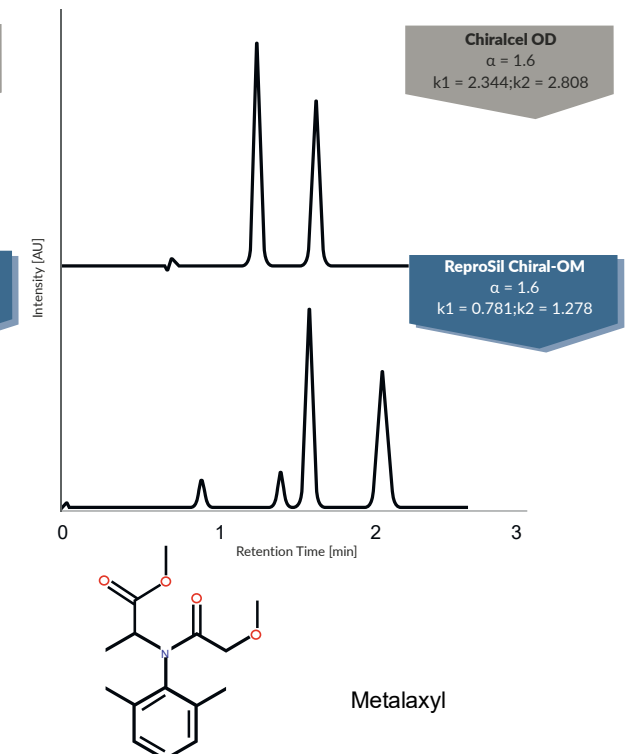


Figure 19: Separation of Metalaxyl on Chiralcel OD (a) and ReproSil Chiral-OM (b).

www.dr-maisch.com

SFC COLUMNS FOR CHIRAL APPLICATIONS

REPOSIL CHIRAL

The analysis of Fenamiphos, Gluthetimide and 5-Methyl-5-phenylhydantoin on ReproSil Chiral-OM provide a better starting point for a method development than those on RegisCell, Lux Cellulose-1 or Cellucoat, respectively.

NO SEPARATION

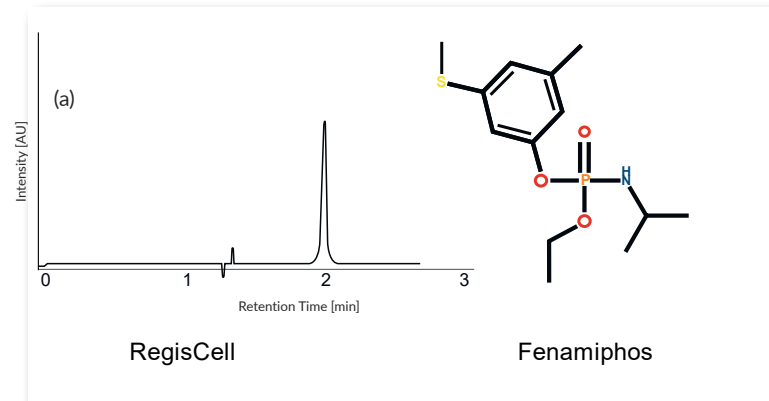


Figure 20: Separation of Fenamiphos on RegisCell (a) and ReproSil Chiral-OM (b).

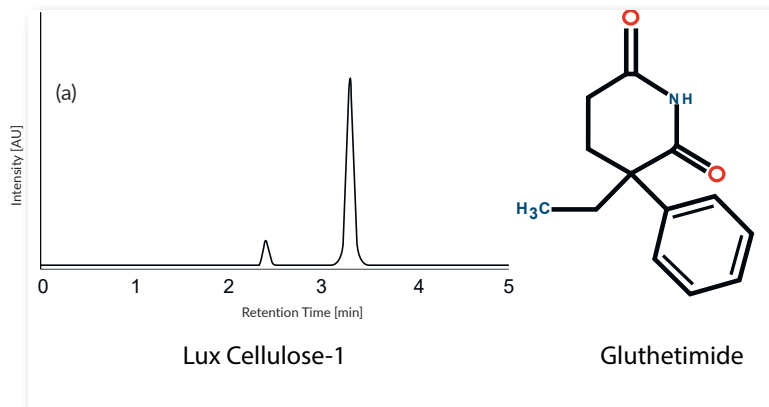


Figure 21: Separation of Gluthetimide on Lux Cellulose-1 (a) and ReproSil Chiral-OM (b).

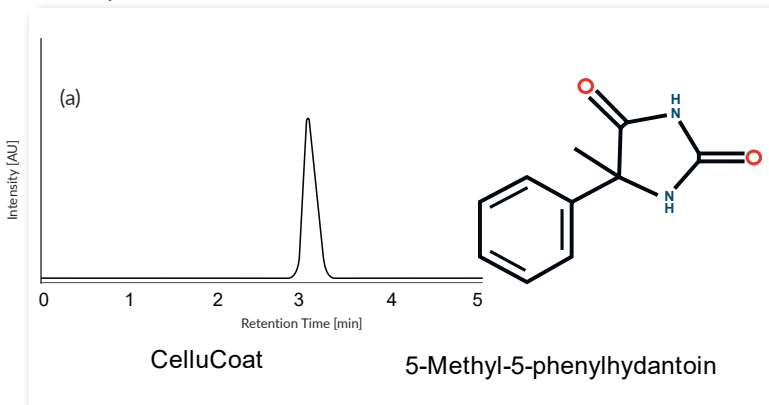
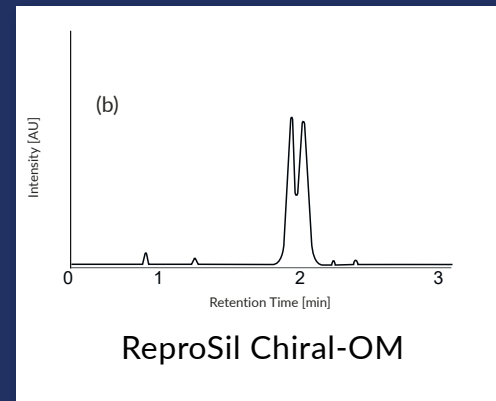


Figure 22: Separation of 5-Methyl-5-phenylhydantoin on Cellucoat (a) and ReproSil Chiral-OM (b).

SEPARATION



ReproSil Chiral OM & Chiralcel ODH

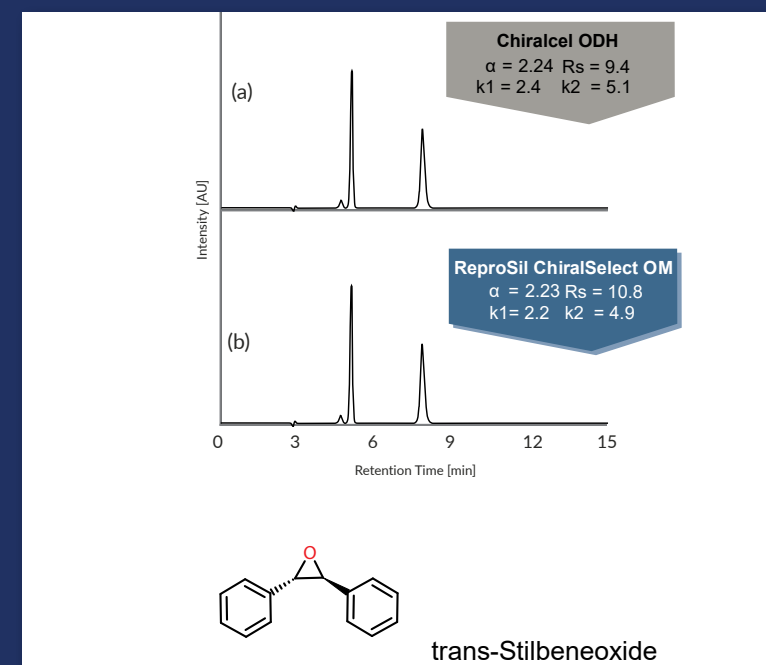


Figure 23: Separation of trans-Stilbeneoxide on Chiralcel ODH (a) and ReproSil Chiral-OM (b).

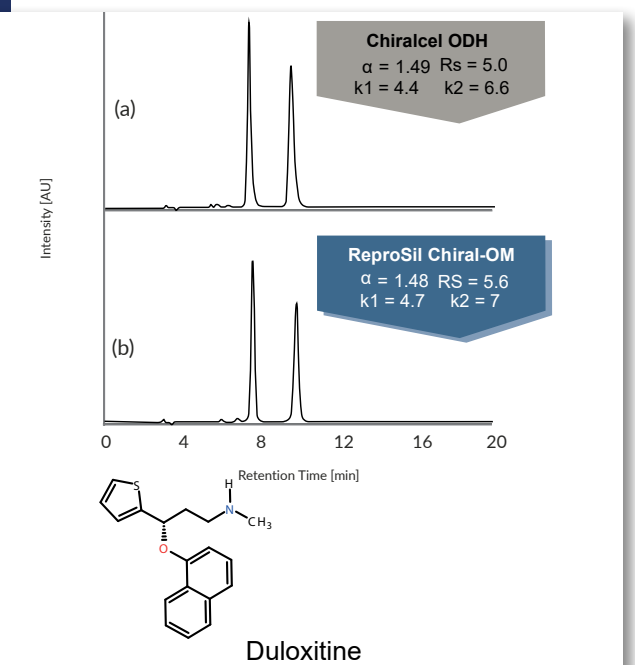


Figure 24: Separation of Duloxetine on Chiralcel ODH (a) and ReproSil Chiral-OM (b).

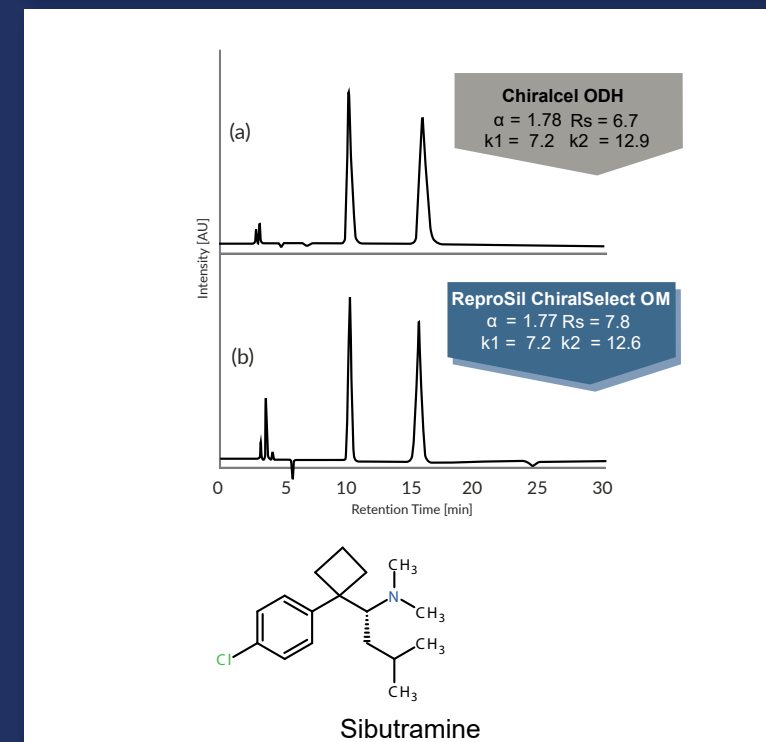


Figure 25: Separation of Sibutramine on Chiralcel ODH (a) and ReproSil Chiral-OM (b).

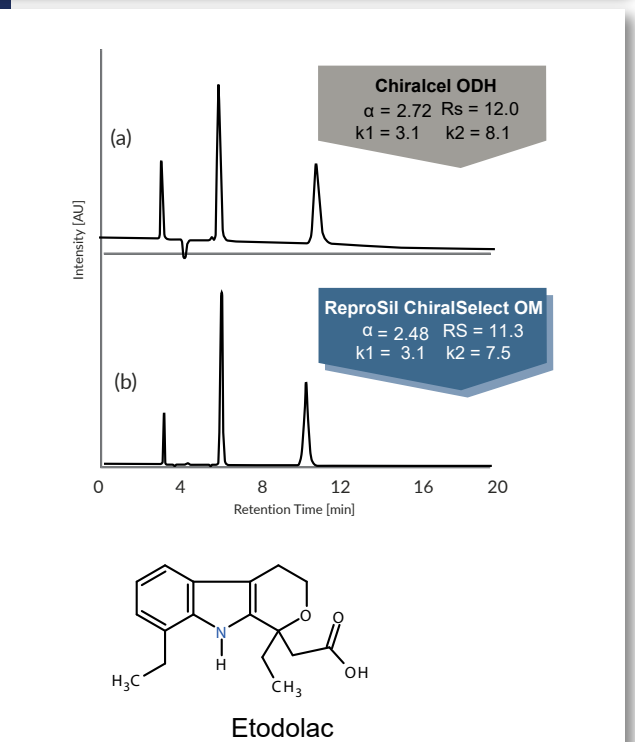


Figure 26: Separation of Etodolac on Chiralcel ODH (a) and ReproSil Chiral-OM (b).

Conclusion

ReproSil Chiral-OM is a guaranteed replacement for Chiralcel ODH columns.

Observation

01.

The selectivity is equivalent either the columns used in basic, neutral or acidic conditions.
02.

Resolution between isomer is higher for ReproSil Chiral-OM column when used in basic & neutral conditions where as in acidic condition Chiralcel ODH is showing slightly higher resolution.
03.

The peak symmetry is better for ReproSil Chiral-OM column in all three conditions (i.e. acidic, basic or neutral).
04.

With all the conditions ReproSil Chiral-OM is showing a higher number of theoretical plates.

Coated ReproSil Chiral Phases from Dr. Maisch as Alternatives to Chiral Phases from Daicel and Phenomenex

Table 7: Available Coated ReproSil Chiral Phases based on Amylose from Dr. Maisch as Alternatives to Chiral Phases from Daicel and Phenomenex.

Product Name	Chiral Selector	Particle Size and Part Number (PN)				Daicel Chiralpak	Phenomenex Lux
		3 µm	5 µm	10 µm	20 µm		
ReproSil Chiral-AMS	Amylose Tris-(S)-α-Methylbenzyl carbamate)	r63.ams	r65.ams	r60.ams	N/A	AS Chiralpak	N/A
ReproSil Chiral-AM	Amylose Tris-(3,5-dimethylphenyl carbamate)	r63.am	r65.am	r60.am	r620.am	AD Chiralpak	Amylose-1 Lux
ReproSil Chiral-YM	Amylose Tris-(5-Chlor-2-Methylphenyl carbamate)	r63.ym	r65.ym	N/A	N/A	AY Chiralpak	Amylose-2 Lux
ReproSil Chiral-ZA	Amylose Tris-(3-Chlor-4-Methylphenyl carbamate)	r63.za	r65.za	N/A	N/A	AZ Chiralpak	N/A

Table 8: Available Coated ReproSil Chiral Phases based on Cellulose from Dr. Maisch as Alternatives to Chiral Phases from Daicel and Phenomenex.

Product Name	Chiral Selector	Particle Size and Part Number (PN)				Daicel Chiralpak	Phenomenex Lux
		3 µm	5 µm	10 µm	20 µm		
ReproSil Chiral-BM	Cellulose (Tris-Benzoyl)	N/A	r65.bm	N/A	N/A	OB Chiralpak	N/A
ReproSil Chiral-JM	Cellulose Tris-(4-Methylbenzoyl)	r63.jm	r65.jm	r60.jm	r620.jm	OJ Chiralpak	Cellulose-3 Lux
ReproSil Chiral-GM	Cellulose Tris-(4-Methyl-Phenyl carbamate)	N/A	r65.gm	N/A	N/A	OG Chiralpak	N/A
ReproSil Chiral-OM	Cellulose Tris-(3,5-Dimethylphenyl carbamate)	r63.om	r65.om	r60.om	r620.om	OD Chiralpak	Cellulose-1 Lux
ReproSil Chiral-ZM	Cellulose Tris-(3-Chlor-4-Methylphenyl carbamate)	r63.zm	r65.zm	N/A	N/A	OZ Chiralpak	Cellulose-2 Lux
ReproSil Chiral-XM	Cellulose Tris-(4-Chlor-3-Methylphenyl carbamate)	r63.xm	r65.xm	N/A	N/A	OX Chiralpak	Cellulose-4 Lux
ReproSil Chiral-CM	Cellulose Tris-(Phenylcarbamate)	r63.cm	r65.cm	r60.cm	N/A	OC Chiralpak	N/A

Immobilized ReproSil Chiral Phases

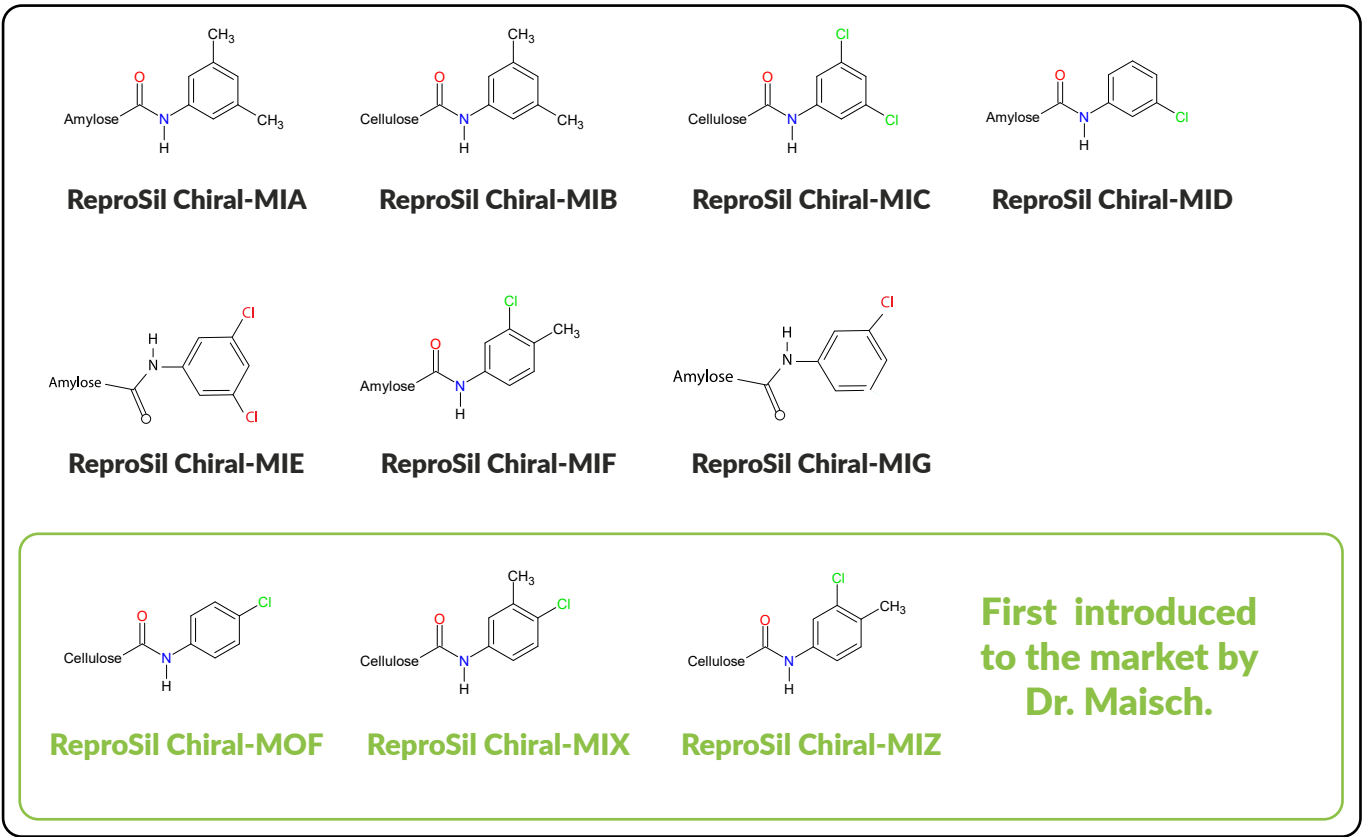


Figure 27: Immobilized ReproSil Chiral Phases from Dr. Maisch.

The immobilized stationary phases ReproSil Chiral-MIA, MIF, MID, MIB, MIC, MIG MIX, MIZ and MOF with greatly increased column robustness tolerate strong organic solvents such as DMSO, DCM, Ethyl Acetate, MtBE and THF to be injected onto the column both as an injection solvent or part of the eluent.

Immobilized ReproSil Chiral Phases from Dr. Maisch as Alternatives to Chiral Phases from Daicel and Phenomenex

Table 9: Available Immobilized ReproSil Chiral Phases based on Amylose from Dr. Maisch as Alternatives to Chiral Phases from Daicel and Phenomenex.

Product Name	Chiral Selector	Particle Size and Part Number (PN)				Daicel Chiralpak	Phenomenex Lux
		3 µm	5 µm	10 µm	20 µm		
ReproSil Chiral-MIA	Amylose Tris-(3,5-Dimethylphenyl carbamate)	N/A	r65.mia	N/A	r620.mia	IA Chiralpak	i-Amylose-1 Lux
ReproSil Chiral-MID	Amylose Tris-(3-Chlorophenyl carbamate)	N/A	r65.mid	N/A	N/A	IA Chiralpak	N/A
ReproSil Chiral-MIE	Amylose Tris-(3,5-Dichlorophenyl carbamate)	N/A	r65.mie	N/A	N/A	IE Chiralpak	N/A
ReproSil Chiral-MIF	Amylose Tris-(3-Chloro-4-Methylphenyl carbamate)	N/A	r65.mif	N/A	N/A	IF Chiralpak	N/A
ReproSil Chiral-MIG	Amylose Tris-(3-Chloro-5-Methylphenyl carbamate)	N/A	r65.mig	N/A	N/A	N/A	N/A

Table 10: Available Immobilized ReproSil Chiral Phases based on Cellulose from Dr. Maisch as Alternatives to Chiral Phases from Daicel and Phenomenex.

Product Name	Chiral Selector	Particle Size and Part Number (PN)				Daicel Chiralpak	Phenomenex Lux
		3 µm	5 µm	10 µm	20 µm		
ReproSil Chiral-MIB	Cellulose Tris-(3,5-Dimethylphenyl carbamate)	N/A	r65.mib	N/A	N/A	IB Chiralpak	N/A
ReproSil Chiral-MIC	Cellulose Tris-(3,5-Dichlorophenyl carbamate)	r63.mic	r65.mic	N/A	N/A	IC Chiralpak	i-Cellulose-5 Lux
ReproSil Chiral-MIX	Cellulose Tris-(4-Chlor-3-Methylphenyl carbamate)	N/A	r65.mix	N/A	N/A	N/A	N/A
ReproSil Chiral-MIZ	Cellulose Tris-(3-Chlor-4-Methylphenyl carbamate)	r63.miz	r65.miz	N/A	N/A	N/A	N/A
ReproSil Chiral-MOF	Cellulose Tris-(4-Chlorophenyl carbamate)	N/A	r65.mof	N/A	N/A	N/A	N/A

Example: Part Number (PN) for ReproSil Chiral-MOF, 5 µm, 250 x 4.6 mm: r65.mof.s2546

NOTE: Other particle sizes are available on request.

SFC COLUMNS FOR CHIRAL APPLICATIONS

REPOSIL CHIRAL

Comparison of ReproSil Chiral-OM and Lux Cellulose-4

ReproSil Chiral-MIX

5 µm, 100 x 3.0 mm

Sample: Customer Sample

Mobile Phase: CO₂ / 0-20% MeOH (0.1% DEA) in 2 min.

Lux Cellulose-4

3 µm, 100 x 4.6 mm

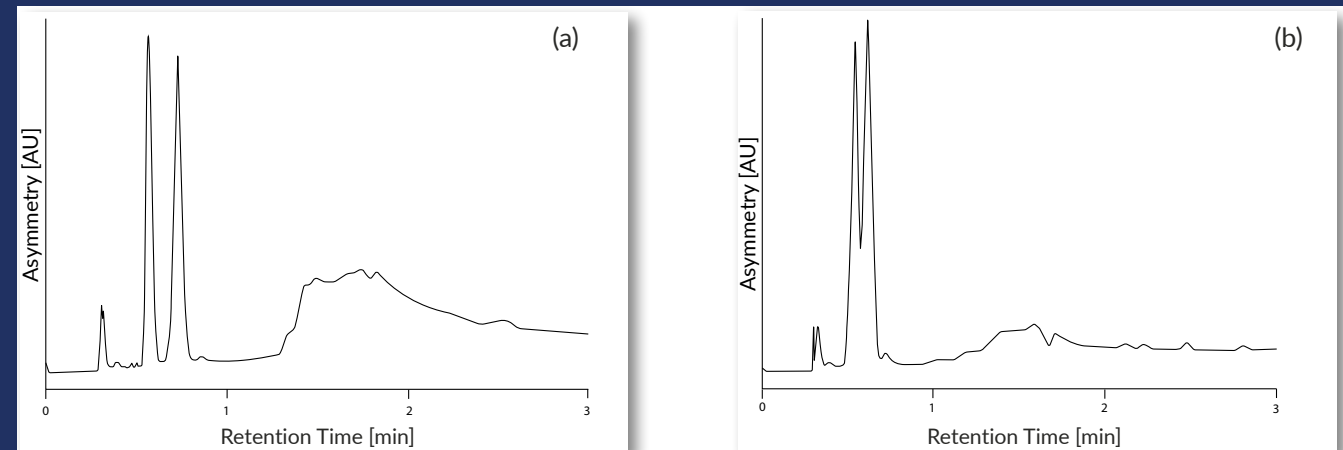


Figure 28: Separation of a Customer Sample on ReproSil Chiral-OM (a) and Lux Cellulose-4 (b).

No.	RT [min]	Area	%Area	Resolutions	Symmetry
1	0.564	220320	39.72	N/A	1.20
2	0.726	334417	60.28	2.26	1.04

No.	RT [min]	Area	%Area	Resolutions	Symmetry
1	0.547	647055	44.58	N/A	N/A
2	0.626	804384	55.42	0.97	N/A

ReproSil Chiral-MIX

5 µm, 100 x 3.0 mm

Sample: Tetrahydro-2H-1,3-thiazine-2-one (TSO)

Mobile Phase: CO₂/10% MeOH (0.1% DEA).

Lux Cellulose-4

3 µm, 100 x 4.6 mm

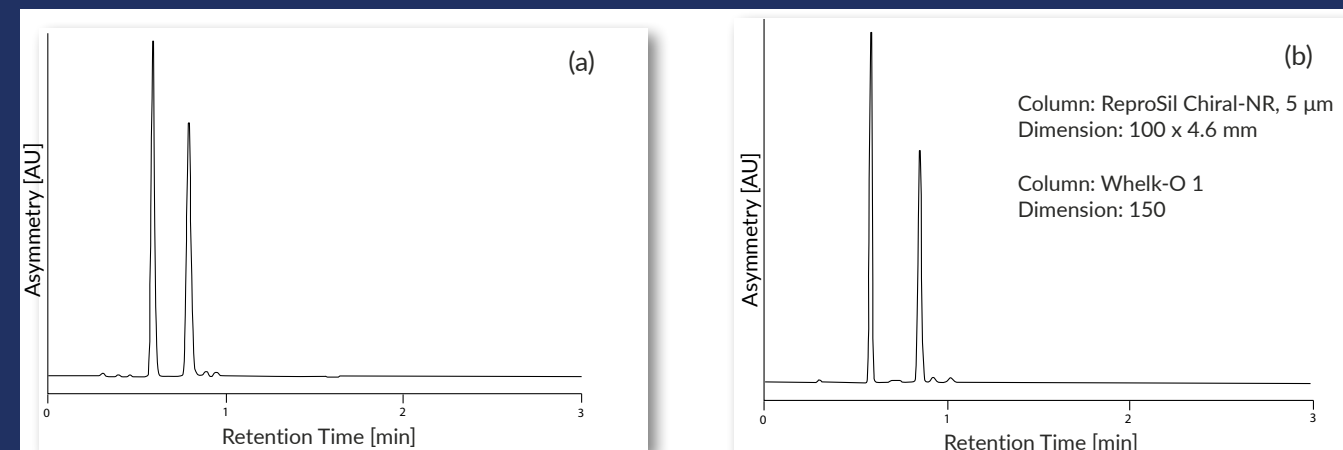


Figure 29: Separation of TSO on ReproSil Chiral-MIX (a) and Lux Cellulose-4 (b).

No.	RT [min]	Area	%Area	Resolutions	Symmetry
1	0.588	1970619	49.64	N/A	1.13
2	0.789	1999432	50.36	4.97	1.11

No.	RT [min]	Area	%Area	Resolutions	Symmetry
1	0.583	1038369	49.91	N/A	1.05
2	0.851	1041945	50.09	8.89	1.04

SFC COLUMNS FOR CHIRAL APPLICATIONS

REPOSIL CHIRAL

Comparison of ReproSil Chiral-OM and Lux Cellulose-2

ReproSil Chiral-MIZ

3 µm, 100 x 3.0 mm

Sample: Customer Sample

Mobile Phase: CO₂/ 10-50% MeOH (0.1% DEA) in 2 min, hold until 5 min.

Lux Cellulose-2

3 µm, 50 x 4.6 mm

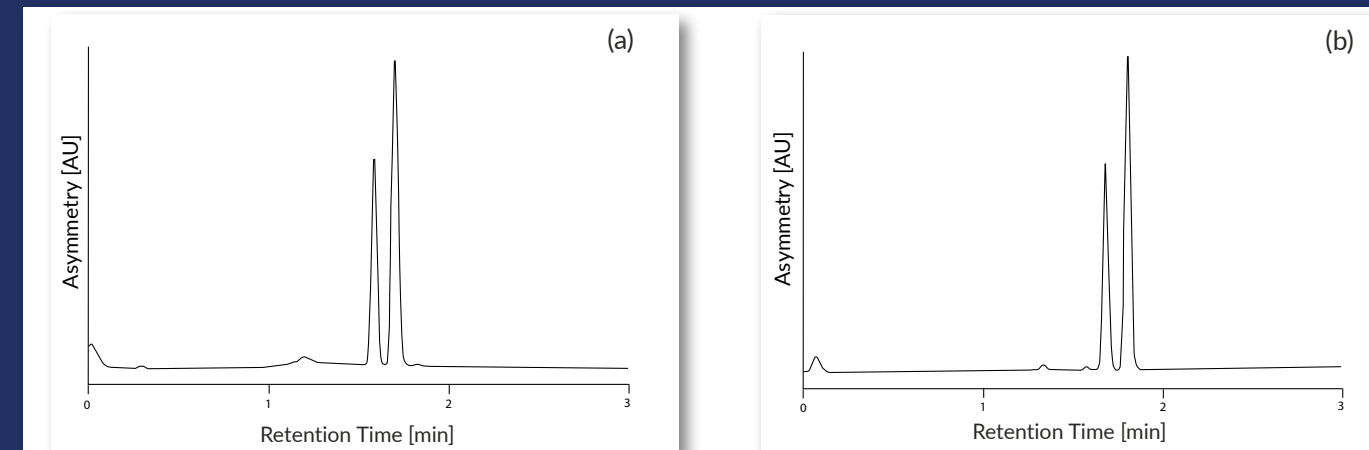


Figure 30: Separation of a Customer Sample on ReproSil Chiral-MIZ (a) and Lux Cellulose-2 (b).

No.	RT [min]	Area	%Area	Resolutions	Symmetry
1	1.585	1872263	36.75	N/A	1.06
2	1.699	3221889	36.25	1.77	1.09

No.	RT [min]	Area	%Area	Resolutions	Symmetry
1	1,678	1757077	36.89	N/A	1.05
2	1,801	3005764	63.11	2,00	1.06

Immobilized Brush-Type Phase

Immobilised Brush-Type Phase with electron acceptor and donor functionality. Particularly useful for aromatic compounds with O or N near the chiral centre.

This phase shows a very broad versatility and complementary selectivity to ReproSil Chiral Polysaccharide Phases. The Phase is compatible with all commonly used mobile phases, including aqueous systems.

Both antipodes of the chiral selector are available – allowing to reverse the elution order of the enantiomers of a given racemate.

SFC COLUMNS FOR CHIRAL APPLICATIONS

REPOSIL CHIRAL-NR

ReproSil Chiral-NR

ReproSil Chiral-NR showed excellent hit rates in many chiral purification departments of global pharmaceutical companies.

Preparative Chiral Separations Using HPLC – Hoffmann-La Roche, Basel, 2014

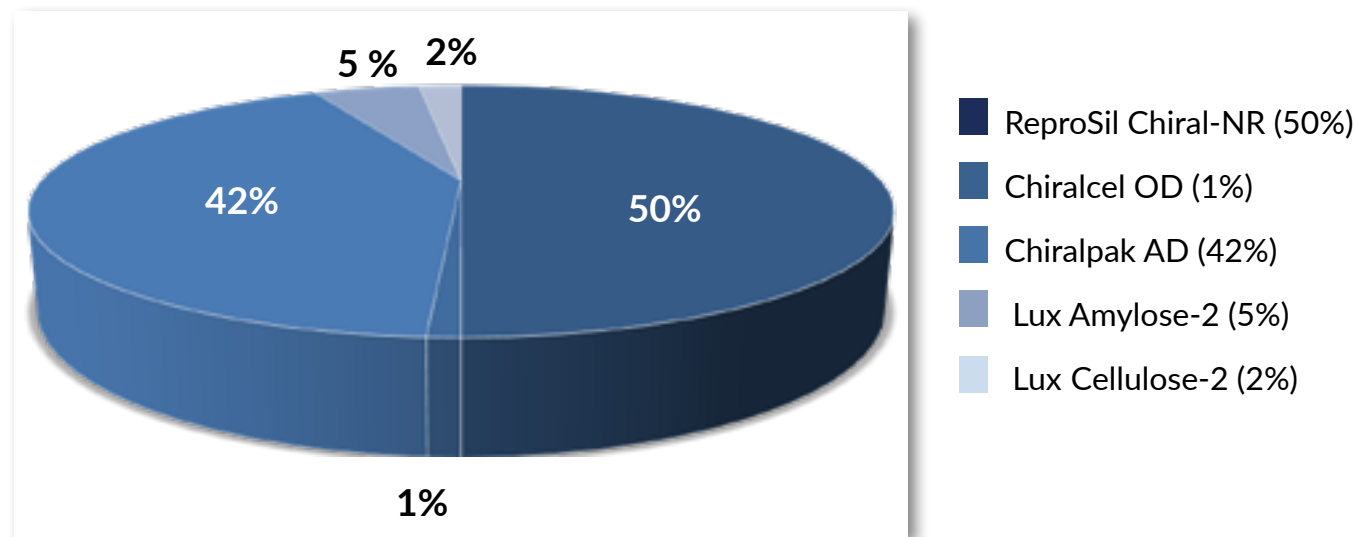


Figure 31: Statistical Evaluation of Chiral SFC Screening of Pharmaceutical Compounds- Hoffmann-La Roche, Basel, 2014.

ReproSil Chiral-NR is available in different particle sizes.

Table 11: Available Immobilized ReproSil Chiral-NR and ReproSil Chiral-NR-R Products.

Product Name	Chiral Selector	Particle Size and Part Number (PN)			
		3 µm	5 µm	8 µm	12 µm
ReproSil Chiral-NR	Immobilized Brush-Type, π-Electron Acceptor / π-Electron Donor Phase	r13.nr	r15.nr	r18.nr	r112.nr
ReproSil Chiral-NR-R ¹⁾	Immobilized Brush-Type, π-Electron Donor Phase	r13.nrr	r15.nrr	r18.nrr	r112.nrr

1) Inverse Elution Order in comparison to ReproSil Chiral-NR

Example:
Part Number (PN) for ReproSil Chiral-NR, 5 µm, 250 x 4.6 mm: r15.nr.s2546.

NOTE:
Other particle sizes are available on request.

SFC COLUMNS FOR CHIRAL APPLICATIONS

REPOSIL CHIRAL-NR

Comparison of ReproSil Chiral-NR and Whelk-O 1.

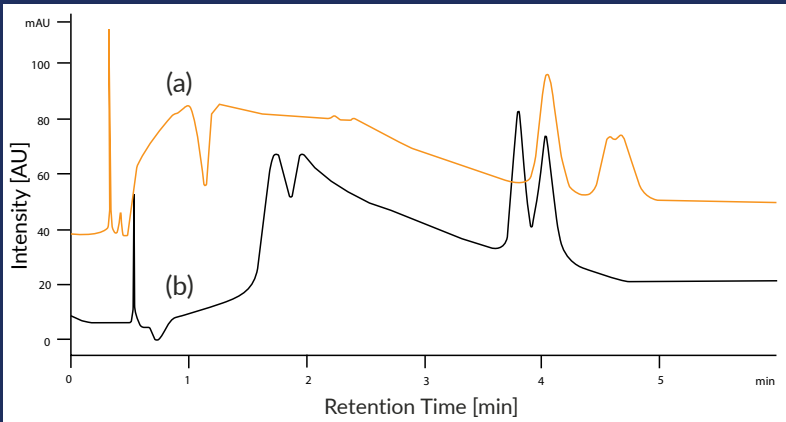


Figure 32: Separation of a chiral Customer Sample on ReproSil Chiral-NR, 8 µm, 100 x 4.6 mm (a) and (R,R)-Whelk-O 1, 5 µm, 150 x 4.6 mm (b).

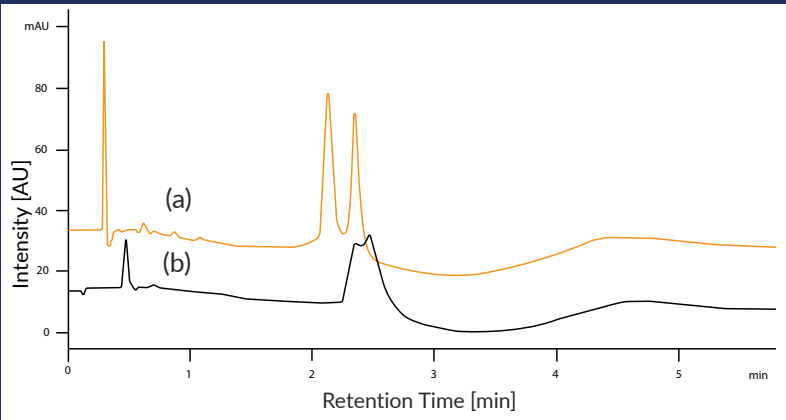


Figure 33: Separation of a chiral Customer Sample on ReproSil Chiral-NR, 8 µm, 100 x 4.6 mm (a) and (R,R)-Whelk-O 1, 5 µm, 150 x 4.6 mm (b).

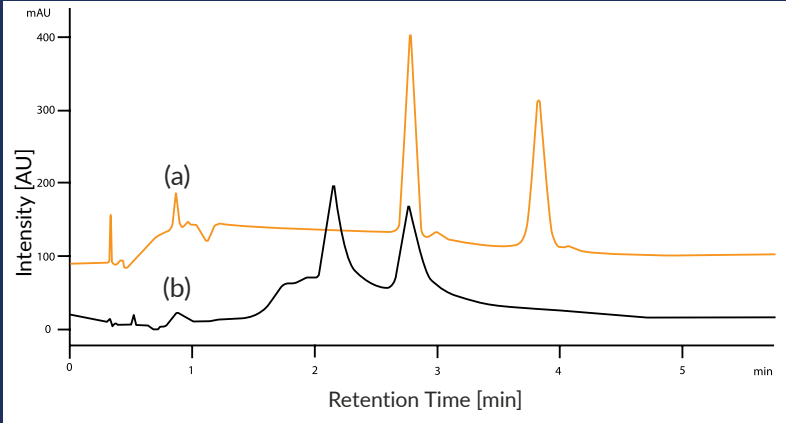


Figure 34: Separation of a chiral Customer Sample on ReproSil Chiral-NR, 8 µm, 100 x 4.6 mm (a) and (R,R)-Whelk-O 1, 5 µm, 150 x 4.6 mm (b).

Column: ReproSil Chiral-NR, 5 µm
Dimension: 100 x 4.6 mm

Column: Whelk-O 1, 5 µm
Dimension: 150 x 4.6 mm

Mobile Phase: MeOH + 0.1% DEA
Gradient: 10% - 50% in 2 min
hold 1.0 min at 50%

Flow Rate: 4 ml/min
Temperature: 35 °C
Backpressure: 103 bar
Detection: UV-Detection @220 nm

SFC Columns for SEC Applications

Polymer analysis can be performed using three modes:

- 1. Size Exclusion Chromatography (SEC).
- 2. Liquid Adsorption Chromatography (LAC).
- 3. Liquid Adsorption Chromatography at Critical Conditions (LACCC).

All three modes can be operated under SFC conditions and offer an excellent approach for PEG analysis on both analytical and preparative scales. Further details can be found in Dr. Maisch's Technical Notification 0007.



Table 12: Available ReproSil SEC Products.

Product Name	Pore Size [Å]	MG-Range [Da]	Surface Modification	Particle Size and Part Number (PN)			
				1.9 µm	3 µm	5 µm	10 µm
ReproSil 50 SEC	50	500 - 10 000	N/A	N/A	N/A	r05.sec	N/A
ReproSil 125 SEC	125	5000 - 100 000	N/A	N/A	r13.sec	r15.sec	r10.sec
ReproSil 200 SEC	200	10 000 - 500 000	PEG	r219.sec	N/A	r25.sec	N/A
ReproSil 200 SEC-2	200	10 000 - 500 000	DIOL	r219.sec2	r23.sec2	r25.sec2	r20.sec2
ReproSil 300 SEC	300	10 000 - 1 000 000	N/A	N/A	r33.sec	r35.sec	N/A
ReproSil 4000 SEC	600	20 000 - 500 000	N/A	N/A	N/A	r45.sec	N/A
ReproSil 5000 SEC	800	150 000 - 1 250 000	N/A	N/A	N/A	r55.sec	N/A

PREPARATIVE SFC COLUMNS

SFC is particularly attractive on a preparative scale, as the CO₂ in the mobile phase can be easily removed during depressurization and potentially recycled. Only a small amount of co-solvent is left. The time savings represent a significant advantage over normal-phase or reversed-phase preparative purifications.

Dr. Maisch offers all Dr. Maisch media in prep-column dimensions.

The superior hardware type for prep columns is the LONGLIFE Hardware.

Benefits of the LONGLIFE Hardware:

- Packed by piston.
- Flexible Bed Length.
- Static Axial Compression (SAC) Mechanism.
- Packing and Repacking Service.
- Available ID: 25, 30, 40, 50, 70 mm.
- Scalability to > 150 mm ID - Using MODcol columns in combination with the MODcol Multipacker.

The LONGLIFE Hardware even allows to pack 3 µm particles in prep dimension which results in an extremely high efficiency.

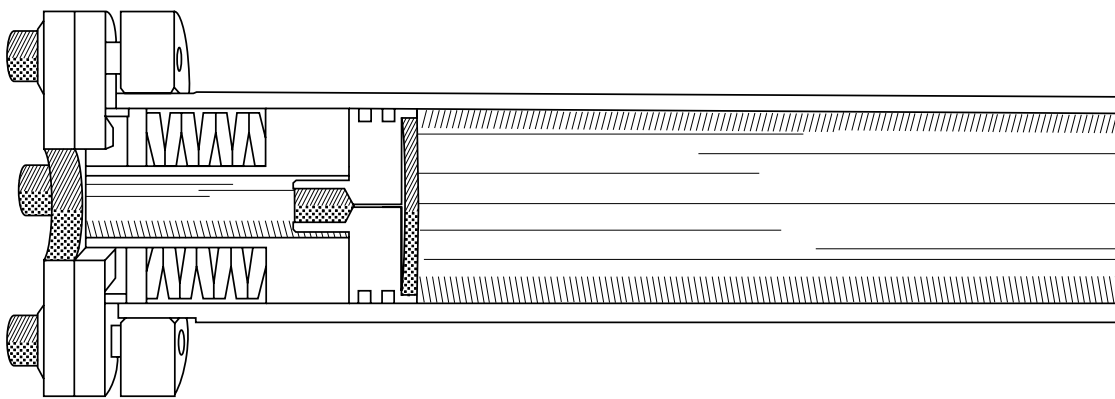
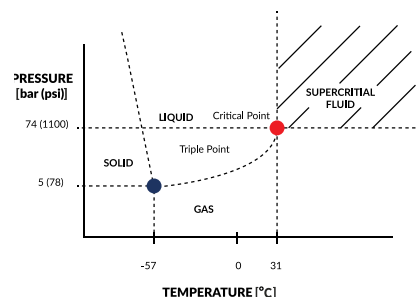


Figure 34: Longlife Hardware.

Dr. Maisch

Any Column, Any Size, Any Media

Distributor:



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