



## TCI Chiral HPLC Column

~ *Helical Polymer New Chiral Stationary Phase* ~

**Tokyo Chemical Industry Co.,Ltd.**

# Features of TCI Chiral

A unique new stationary phase

- Polymaleimide helical polymer bearing chiral side groups coated on silica gel.

Suitable for separation of carbonyls and others

- Ex. Ketones, Esters, Carboxylic acids, N-Protected Amino acid, Alcohols and others.

Applicable to both normal and reversed phase modes.

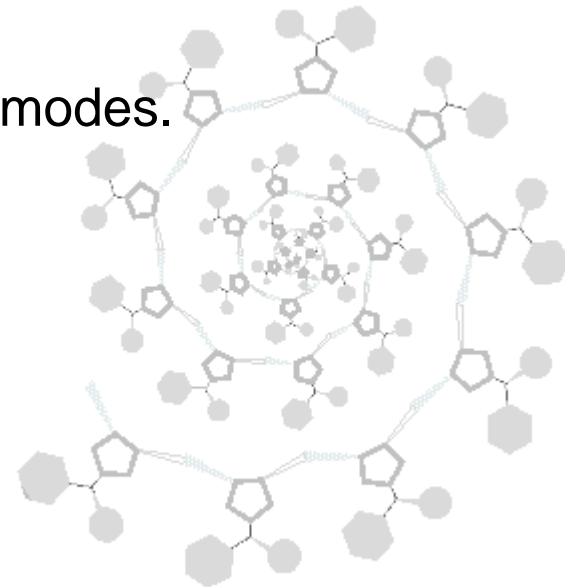
High column load capacity

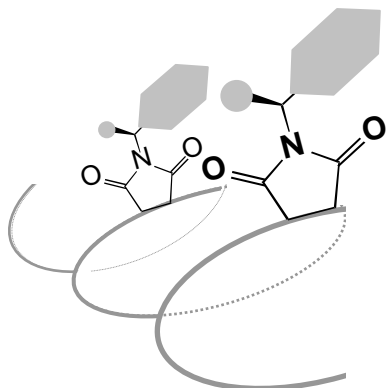
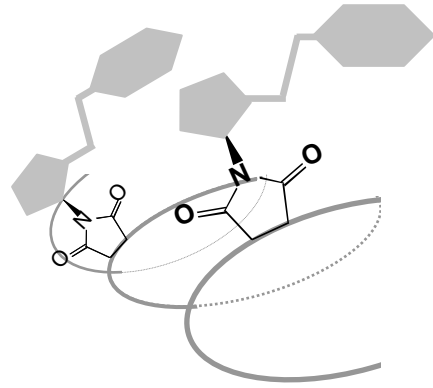
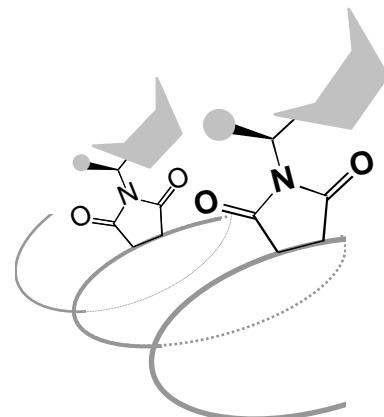
Superior column longevity

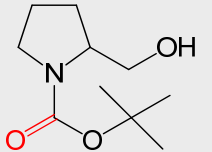
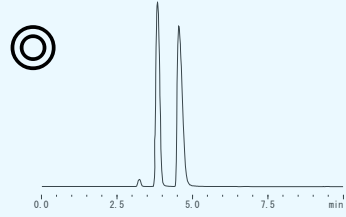
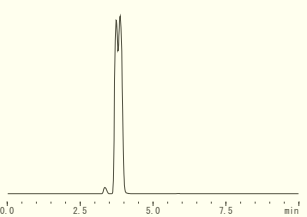
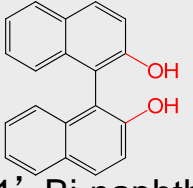
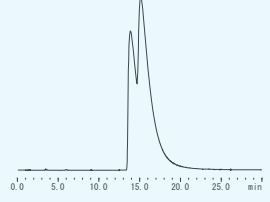
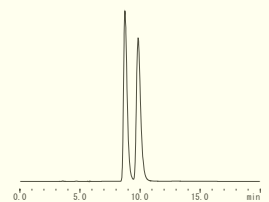
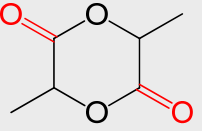
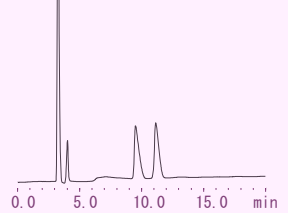
- Maximum pressure: 2900 psi (20 MPa)

High throughput analysis

Affordable price



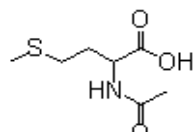
Column	TCI Chiral MB-S	TCI Chiral BP-S	TCI Chiral CH-S
Ligand			
Retention Power (Normal Phase)	High	Medium	Weak
Analyte	Low polar	Medium polar	High polar
	Carbonyls (Ketones, Esters, Carboxylic acids, N-Protected amino acids), Alcohols, Diols, Epoxides, Heterocycles, Sulfoxides, Others		

Column	TCI Chiral MB-S	TCI Chiral BP-S	TCI Chiral CH-S
Separation % of 81 compounds ★	95%	76%	71%
Applications			
 N-Boc-prolinol			No Separation
 1,1'-Bi-naphthol			No Separation
 DL-Lactide	No Separation	No Separation	

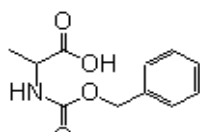
★Please see next and after the next pages as examples. All chromatograms are on our web site.

# Separation Compounds 1

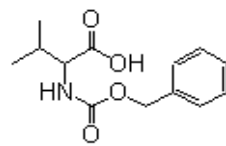
## N-Protected amino acids



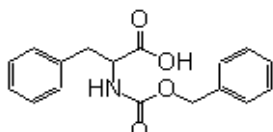
N-Acetylmethionine



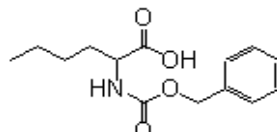
N-Cbz-alanine



N-Cbz-valine

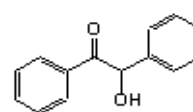


N-Cbz-phenylalanine

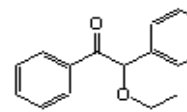


N-Cbz-norleucine

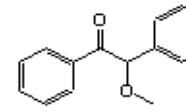
## Ketones



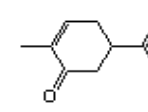
Benzoin



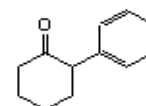
Benzoin Ethyl Ether



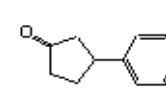
Benzoin Methyl Ether



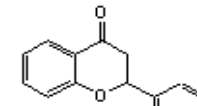
Carvone



2-Phenylcyclohexanone

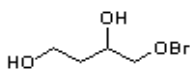


3-Phenylcyclopentanone

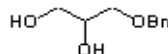


Flavanone

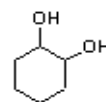
## Alcohols & Phenols



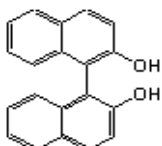
4-Benzyloxy-1,3-butanediol



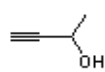
3-Benzyloxy-1,2-propanediol



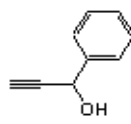
1,2-Cyclohexanediol



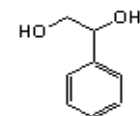
1,1'-Bi-2-naphthol



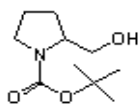
3-Butyn-2-ol



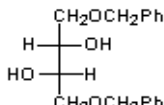
1-Phenyl-2-propyn-1-ol



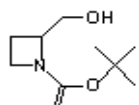
Phenylethylene Glycol



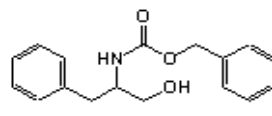
N-Boc-prolinol



1,4-Di-O-benzylthreitol

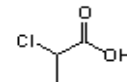


1-Boc-2-azetidinmethanol

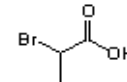


N-Cbz-phenylalaninol

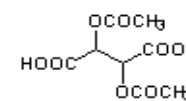
## Carboxylic acids



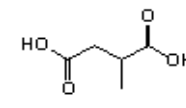
2-Chloropropionic Acid



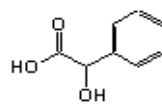
2-Bromopropionic Acid



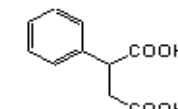
Diacetyltartaric Acid



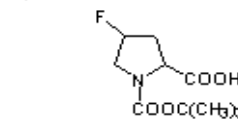
Methylsuccinic Acid



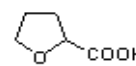
Mandelic Acid



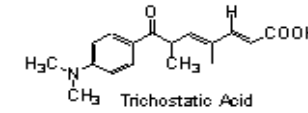
Phenylsuccinic Acid



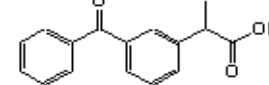
1-Boc-4-fluoro-2-pyrrolidinecarboxylic Acid



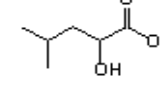
Tetrahydrofuran-2-carboxylic Acid



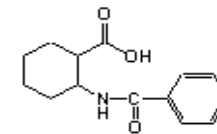
Trichostatic Acid



Ketoprofen



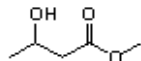
Leucic Acid



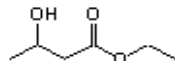
cis-2-Benzamidocyclohexanecarboxylic Acid

# Separation Compounds 2

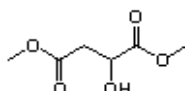
## Esters & Lactones



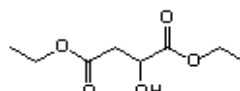
Methyl 3-Hydroxybutyrate



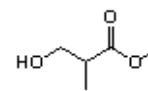
3-Hydroxybutyric Acid Ethyl Ester



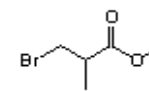
Dimethyl Malate



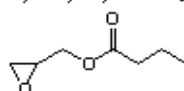
Diethyl Malate



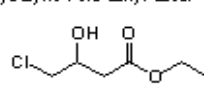
Methyl 3-Hydroxyisobutyrate



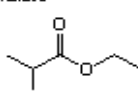
Methyl 3-Bromo-2-methylpropionate



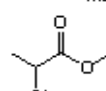
Glycidyl Butyrate



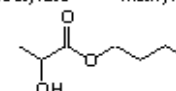
Ethyl 4-Chloro-3-hydroxybutyrate



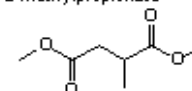
2-Chloropropionic Acid Ethyl Ester



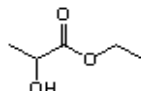
2-Chloropropionic Acid Methyl Ester



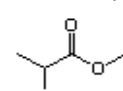
Butyl Lactate



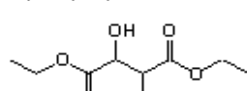
Dimethyl Methylsuccinate



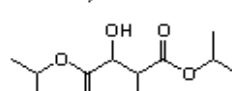
Ethyl Lactate



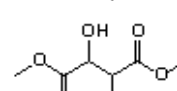
Methyl Lactate



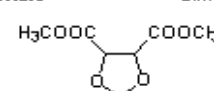
Diethyl Tartrate



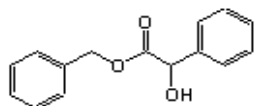
Diisopropyl Tartrate



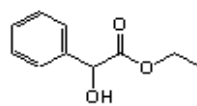
Dimethyl Tartrate



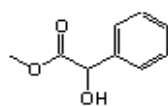
Dimethyl 2,3-O-Isopropylidene tartrate



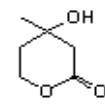
Benzyl Mandelate



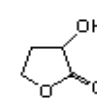
Ethyl Mandelate



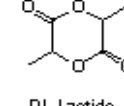
Methyl Mandelate



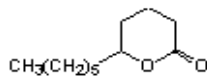
Mevalonolactone



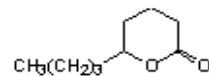
alpha-Hydroxy-gamma-butyrolactone



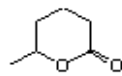
DL-Lactide



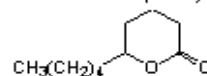
delta-Undecanolactone



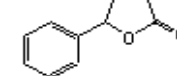
delta-Nonanolactone



delta-Hexanolactone

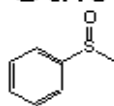


delta-Decanolactone

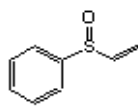


gamma-Phenyl-gamma-butyrolactone

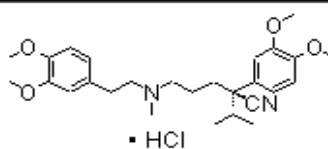
## Others



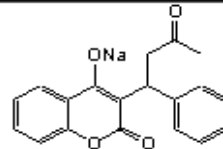
Methyl Phenyl Sulfoxide



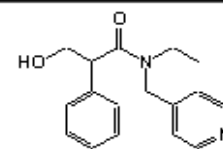
Phenyl Vinyl Sulfoxide



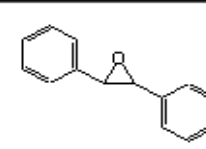
Verapamil Hydrochloride



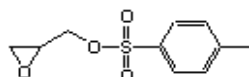
Warfarin Sodium



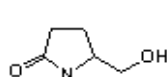
Tropicamide



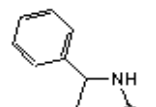
trans-Stilbene oxide



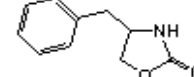
Glycidyl p-Toluenesulfonate



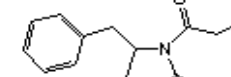
5-(Hydroxymethyl)-2-pyrrolidinone



4-Phenyl-2-oxazolidinone



4-Benzyl-2-oxazolidinone



4-Benzyl-3-propionyl-2-oxazolidinone

## Normal Phase

n-Hexane / IPA = 90/10 (initial condition)

- Elution time is long → increase IPA ratio (ex.30%)
- Elution time is short → decrease IPA ratio (ex.1%)
- Acidic compound → add 0.1% of Trifluoroacetic acid
- Basic compound → add 0.1% of Diethylamine

## Reversed Phase

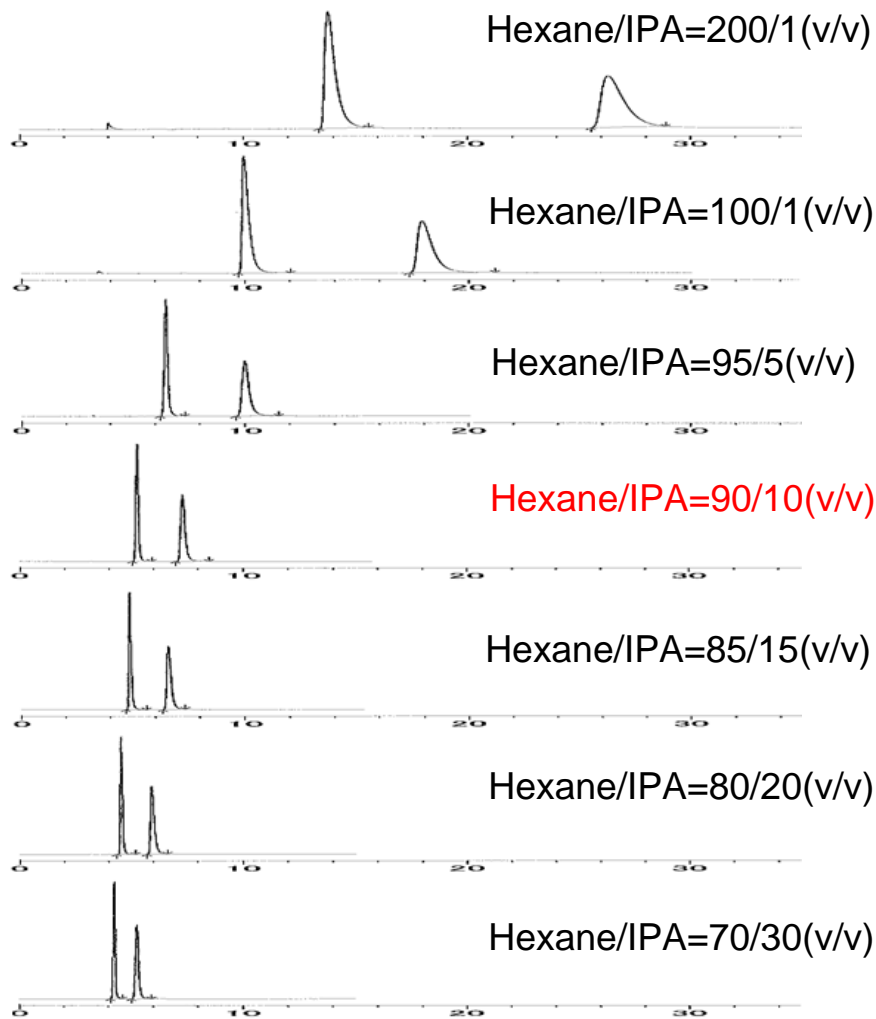
Acetonitrile / Water = 20/80 (initial condition)

- Elution time is long → increase acetonitrile ratio (ex.40%)
- Elution time is short → decrease acetonitrile ratio (ex.10%)
- Acidic compound → add 0.1% of Trifluoroacetic acid
- Basic compound → choice buffer solution

## ✘ Unusable solvents

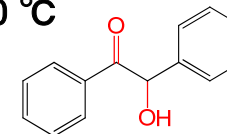
- THF, Toluene, Halogenated solvents (Chloroform, etc.)

# Change ratio of solvents → Change retention power



Column : TCI Chiral MB-S ( $3\ \mu\text{m}$ )  
 Column Size : 4.6 mm I.D.  $\times$  250 mm  
 Mobile Phase : Hexane/IPA  
 Detection : UV 254 nm  
 Flow Rate : 1.0 mL/min  
 Temperature : 40 °C

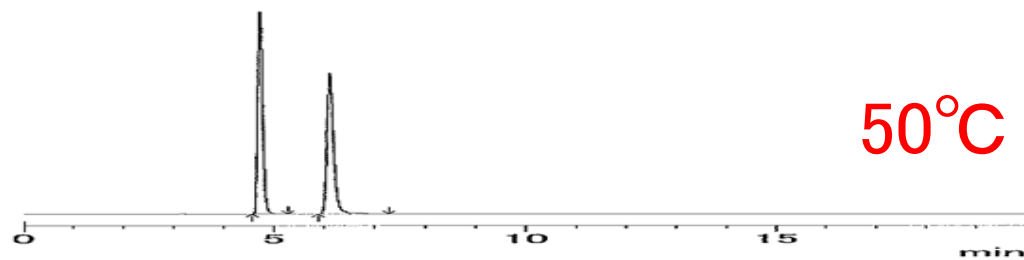
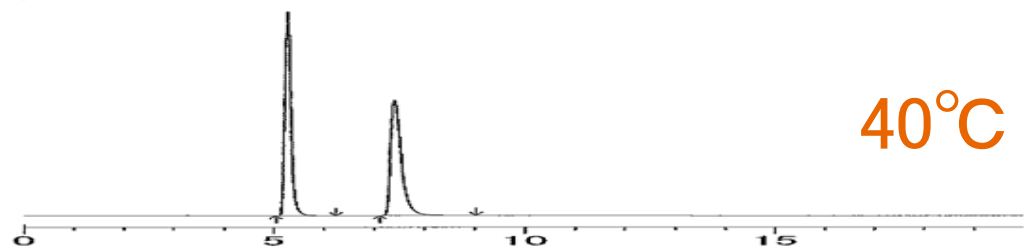
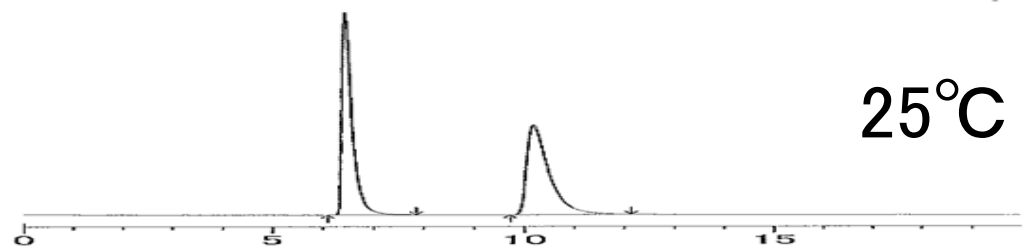
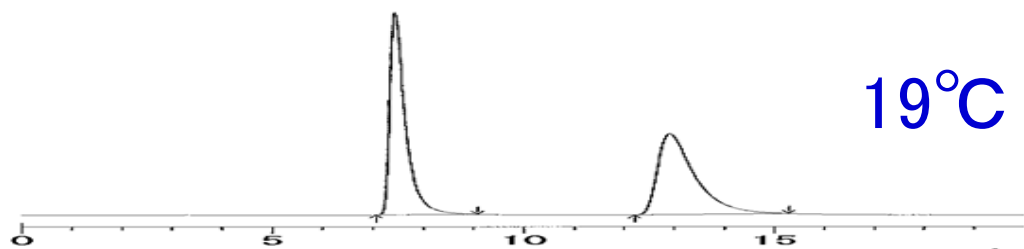
Sample :



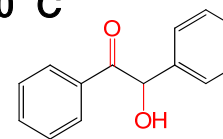
Benzoin



# Temperature effect



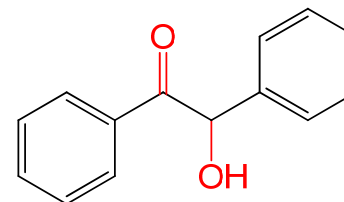
Column : TCI Chiral MB-S (3  $\mu$  m)  
 Column Size : 4.6 mm I.D.  $\times$  250 mm  
 Mobile Phase : Hexane/IPA = 90/10 (v/v)  
 Detection : UV 254 nm  
 Flow Rate : 1.0 mL/min  
 Temperature : 40 °C  
 Sample :



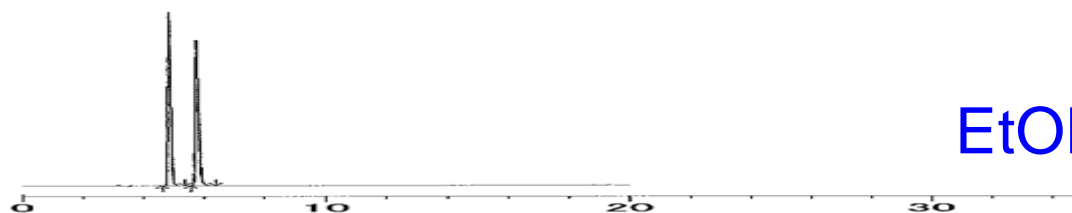
Benzoin

# Modifier effect

Column : TCI Chiral MB-S ( $3\ \mu\text{m}$ )  
 Column Size : 4.6 mm I.D.  $\times$  250 mm  
 Mobile Phase : Hexane / Polar Solvent = 90/10  
 Detection : UV 254 nm  
 Flow Rate : 1.0 mL/min  
 Temperature : 40 °C  
 Sample : Benzoin

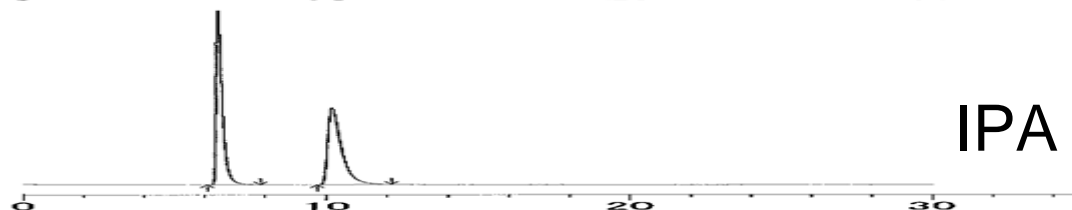


Benzoin



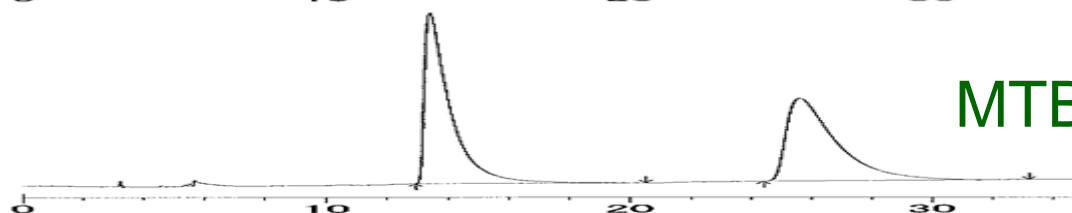
EtOH

Pressure: 5.6MPa



IPA

Pressure: 5.7MPa



MTBE

Pressure: 5.3MPa

※MTBE : Methyl tert-butyl ether

# Stability test

Column : TCI Chiral BP-S  
 Column Size : 4.6mmID × 50mm  
 Mobile Phase : Hexane/IPA = 90/10  
 Detection : UV 254 nm  
 Flow Rate : 0.7 mL/min  
 Temperature : 40°C  
 Sample : Benzoin

injection	$\alpha$	R <sub>s</sub>
1	2.13	2.41
400	2.14	2.35
600	2.13	2.32
800	2.12	2.30
1000	2.12	2.29

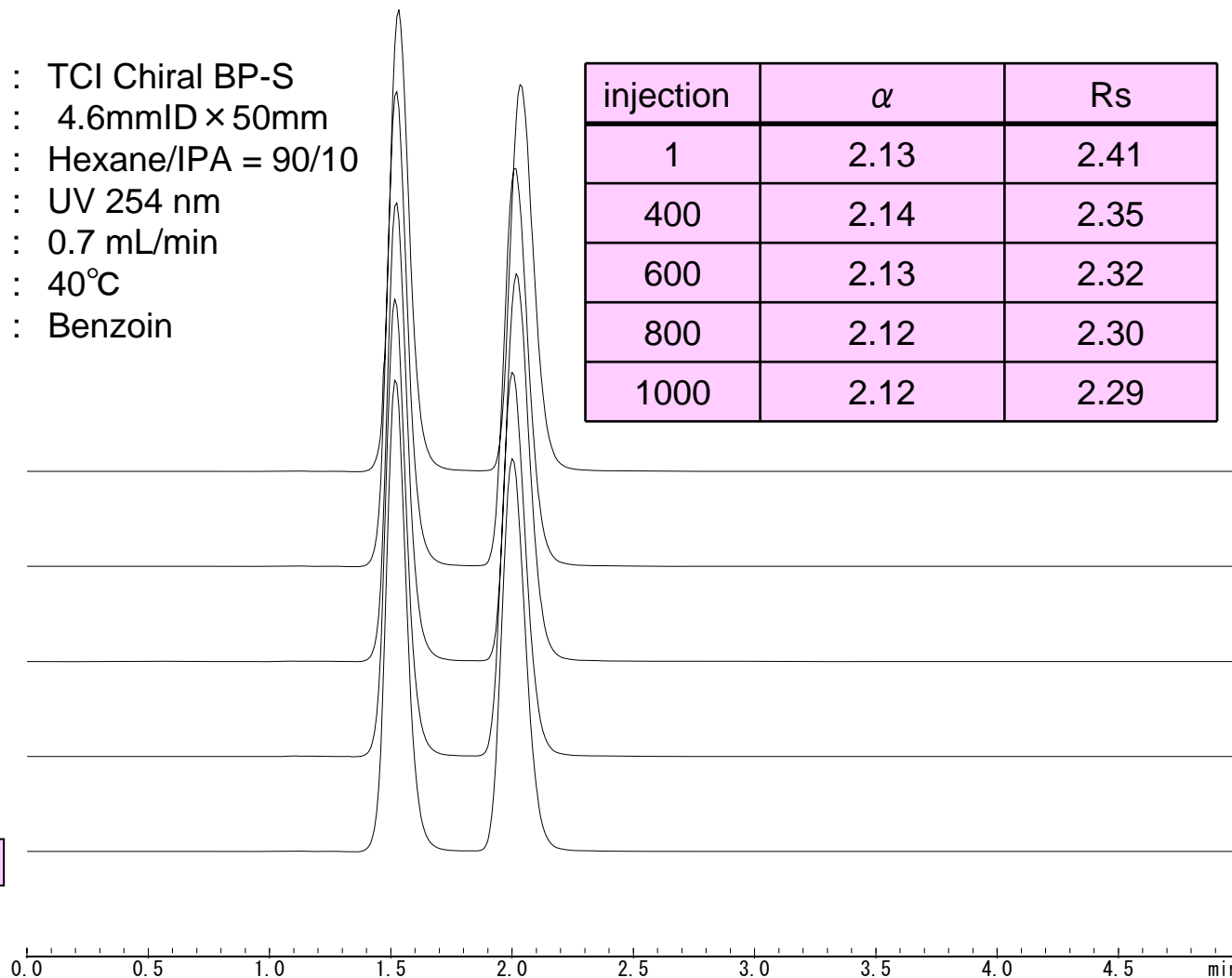
Injection:1

Injection:400

Injection:600

Injection:800

Injection:1000



# Batch to batch reproducibility

alpha

2.5

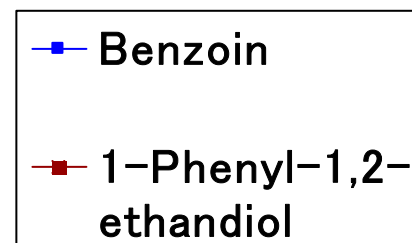
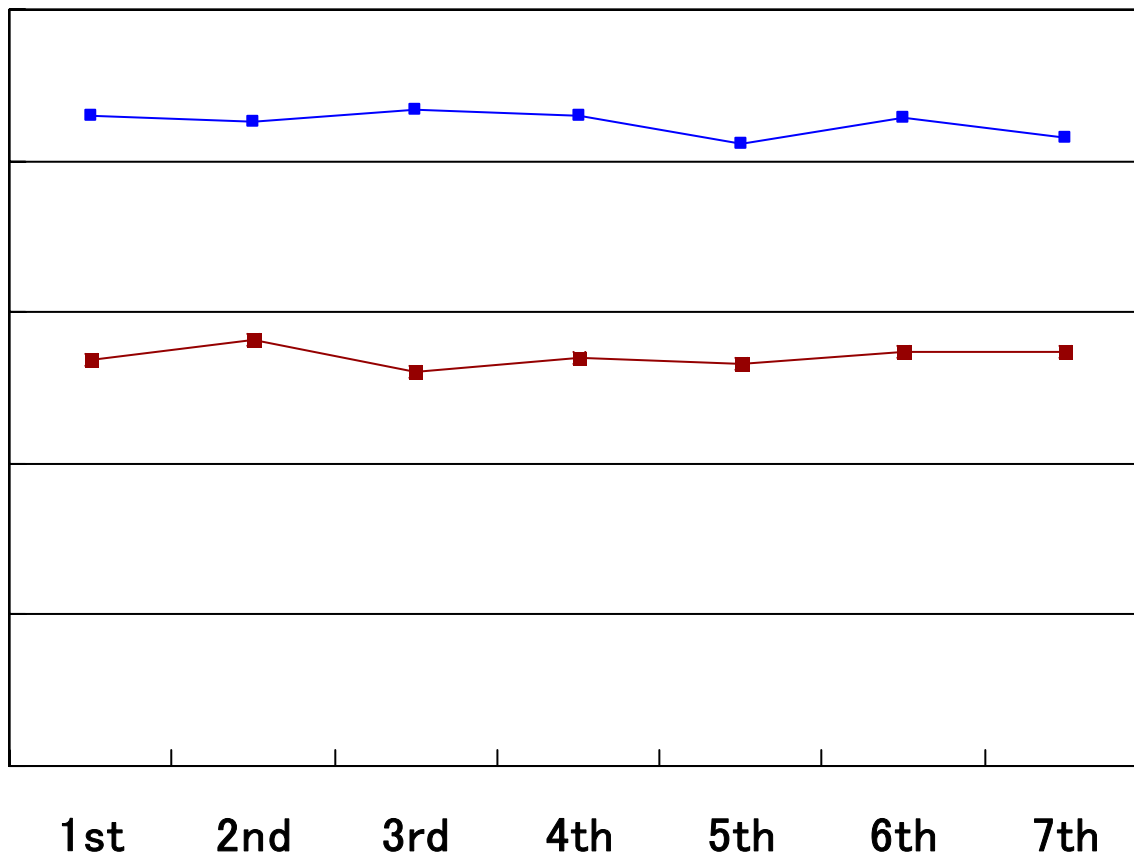
2

1.5

1

0.5

0

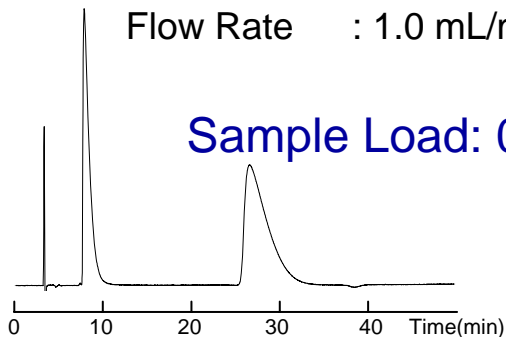


TCI Chiral MB-S ( $3\ \mu\text{m}$ )

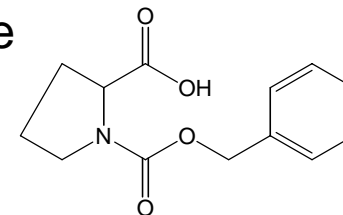
# Column load capacity test

## Analysis

Column Size : 4.6mm I.D. × 250mm  
Flow Rate : 1.0 mL/min



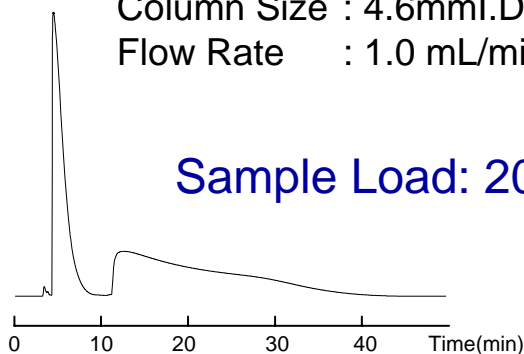
## N-Cbz-proline



Column : TCI Chiral MB-S (5 $\mu$ m)  
Mobile Phase : n-Hexane/2-Propanol/TFA  
=90/10/0.1  
Temperature : 40°C  
Detection : UV254nm

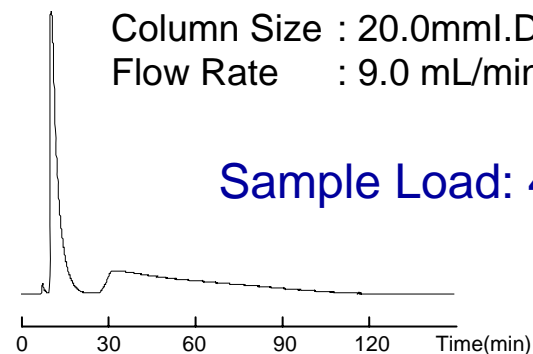
## Loading test by analysis column

Column Size : 4.6mm I.D. × 250mm  
Flow Rate : 1.0 mL/min



## Loading test by prep column

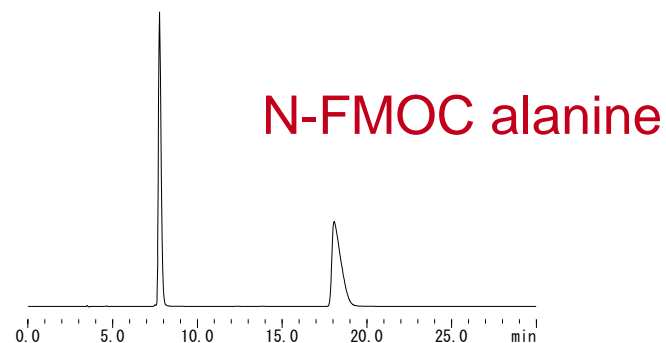
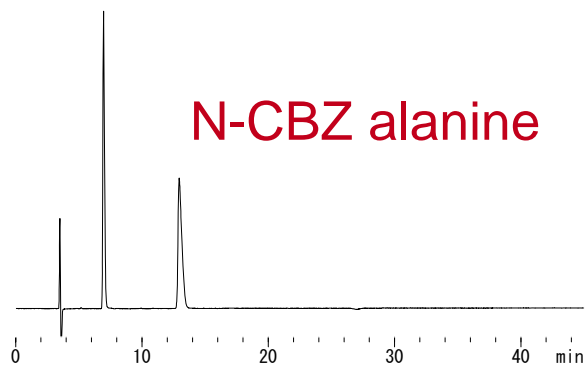
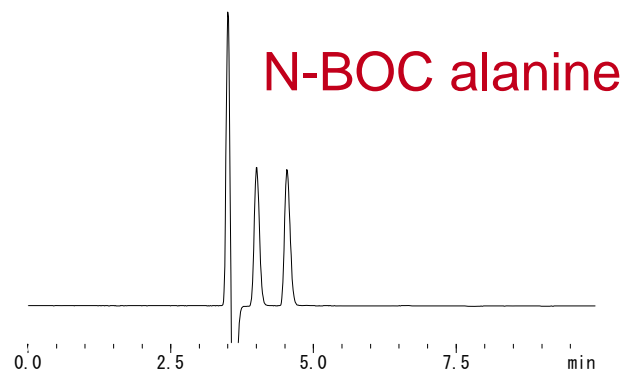
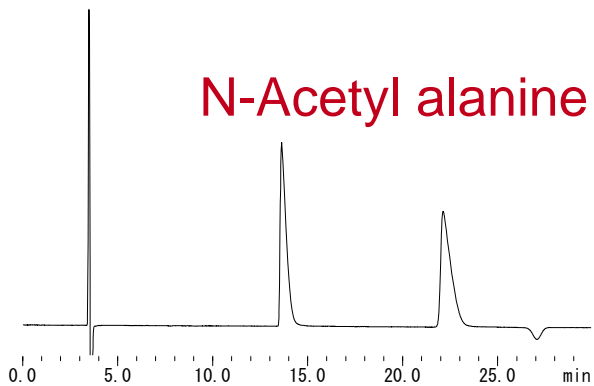
Column Size : 20.0mm I.D. × 250mm  
Flow Rate : 9.0 mL/min



# N-Protected alanine applications

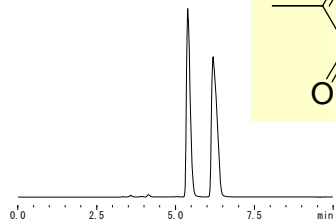
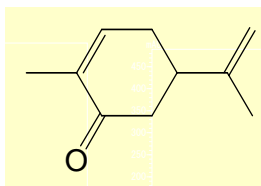
	N-Acetyl	N-BOC	N-CBZ	N-FMOC
Alpha	1.9	1.7	2.6	3.3
Rs	8.9	2.4	11.5	13.0

Column : TCI Chiral BP-S (5  $\mu$  m)  
 Column Size : 4.6mmID  $\times$  250mm  
 Mobile Phase : Hexane/IPA/TFA=95/5/0.1  
 Detection : UV210nm (N-Acetyl, N-BOC)  
 UV254nm (N-CBZ, N-FMOC)  
 Flow Rate : 1.0mL/min  
 Temperature : 40°C

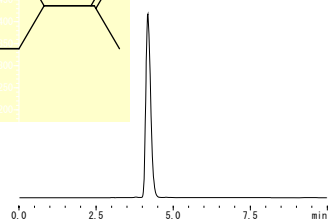


# Comparison with Polysaccharide types

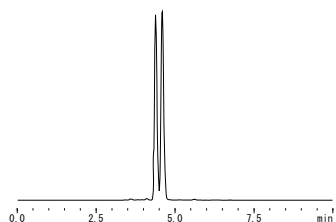
## Carvone



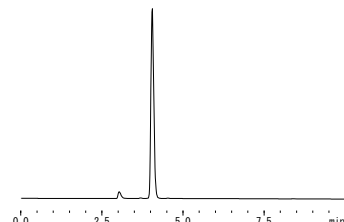
TCI Chiral MB-S



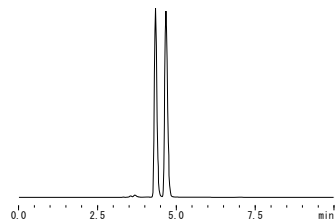
Amylose type 1



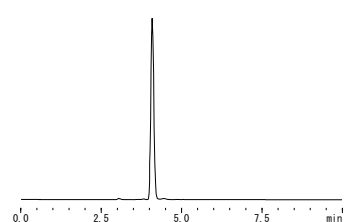
TCI Chiral BP-S



Amylose type 2

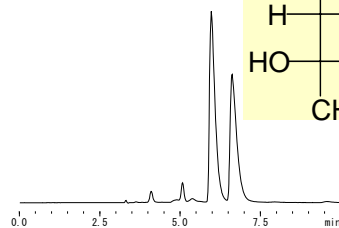
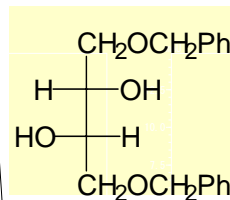


TCI Chiral CH-S

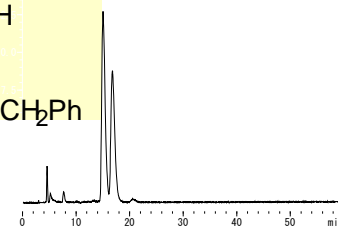


Cellulose type

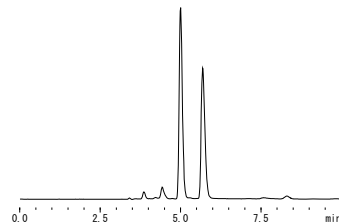
## 1,4-Di-O-benzylthreitol



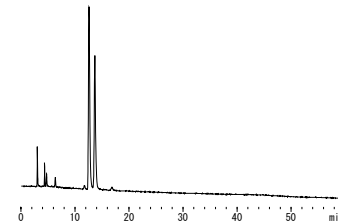
TCI Chiral MB-S



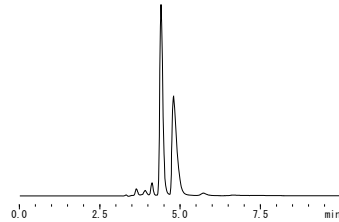
Amylose type 1



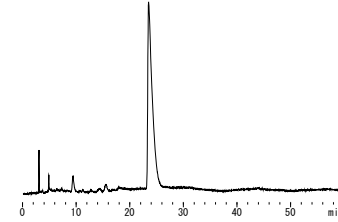
TCI Chiral BP-S



Amylose type 2



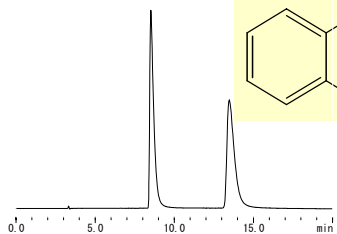
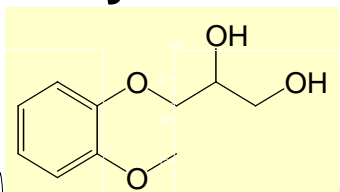
TCI Chiral CH-S



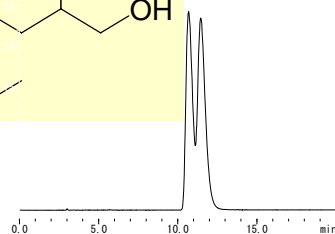
Cellulose type

# Comparison with Polysaccharide types

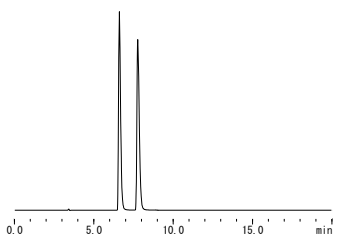
## Guaiacol Glycerol Ether



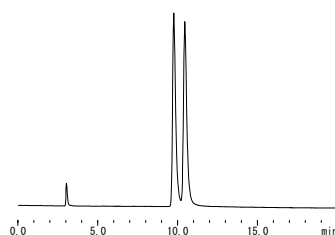
TCI Chiral MB-S



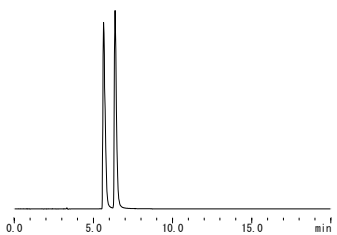
Amylose type 1



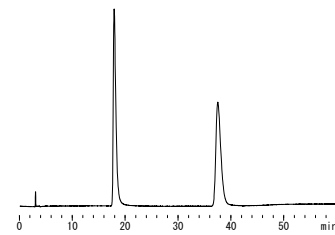
TCI Chiral BP-S



Amylose type 2

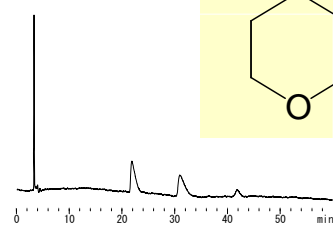
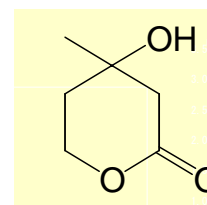


TCI Chiral CH-S

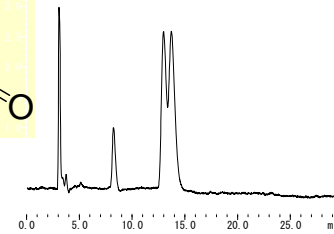


Cellulose type

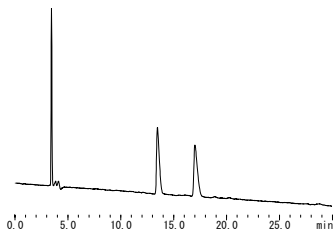
## Mevalonolactone



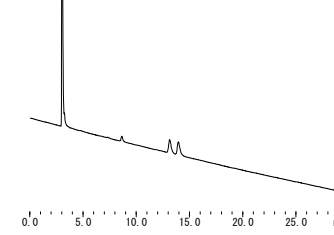
TCI Chiral MB-S



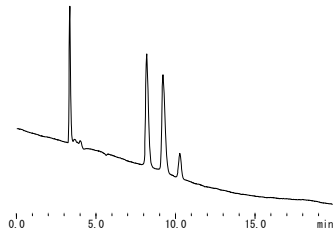
Amylose type 1



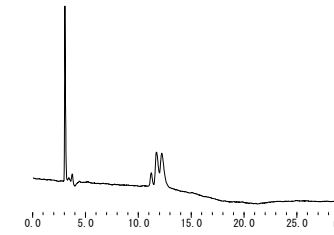
TCI Chiral BP-S



Amylose type 2



TCI Chiral CH-S

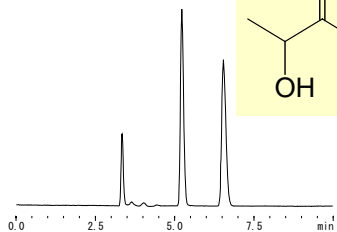
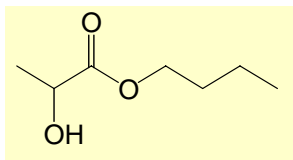


Cellulose type

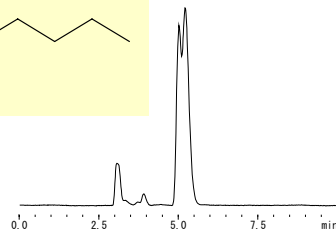


# Comparison with Polysaccharide types

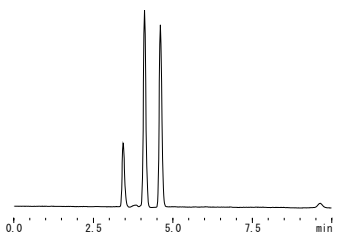
## Butyl Lactate



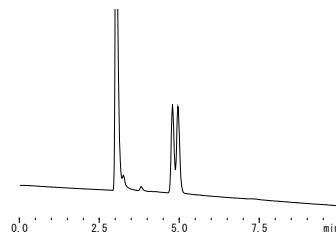
TCI Chiral MB-S



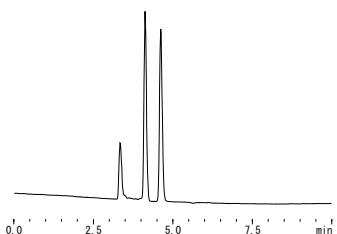
Amylose type 1



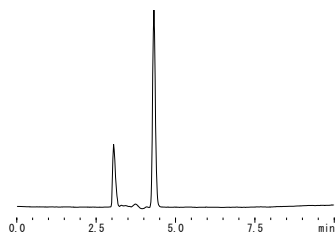
TCI Chiral BP-S



Amylose type 2

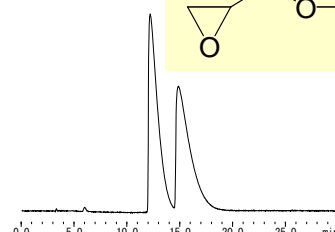
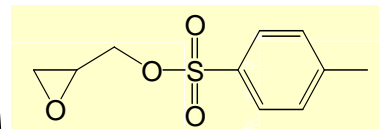


TCI Chiral CH-S

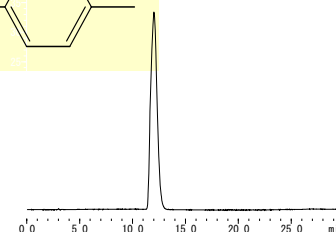


Cellulose type

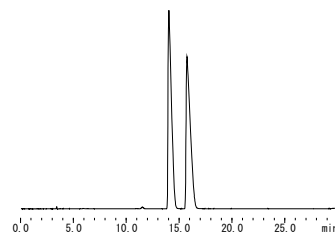
## Glycidyl p-Toluenesulfonate



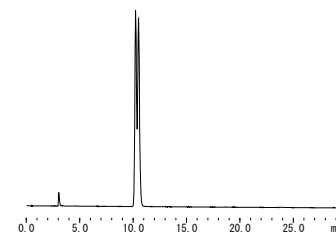
TCI Chiral MB-S



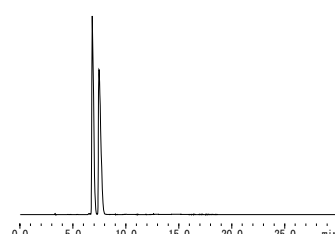
Amylose type 1



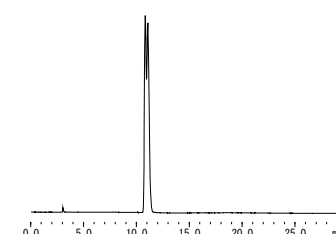
TCI Chiral BP-S



Amylose type 2



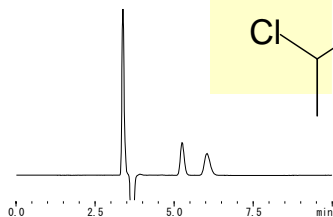
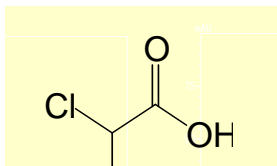
TCI Chiral CH-S



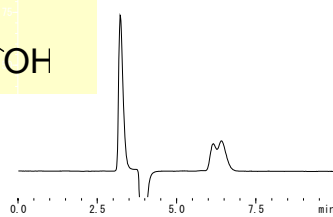
Cellulose type

# Comparison with Polysaccharide types

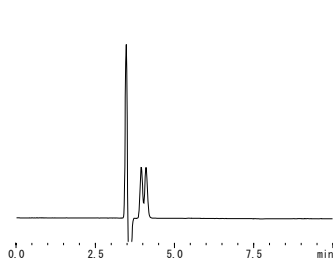
## 2-Chloropropionic Acid



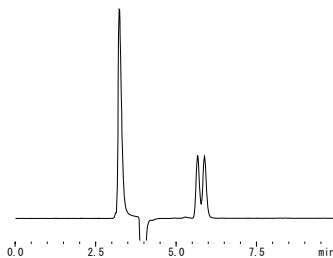
TCI Chiral MB-S



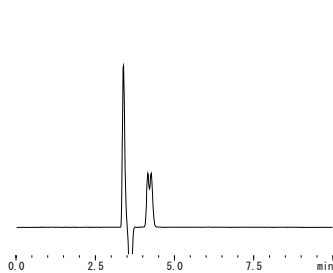
Amylose type 1



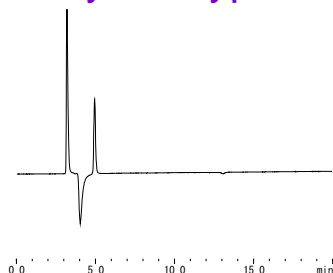
TCI Chiral BP-S



Amylose type 2

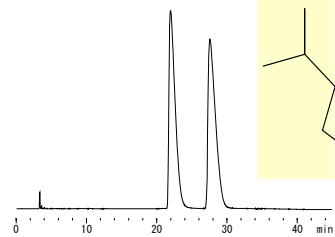
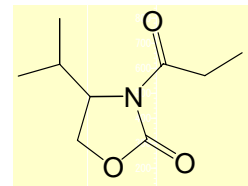


TCI Chiral CH-S

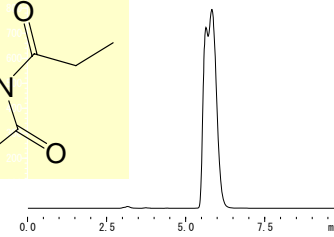


Cellulose type

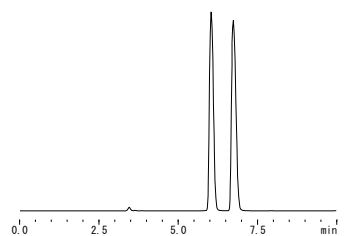
## 4-Isopropyl-3-propionyl-2-oxazolidinone



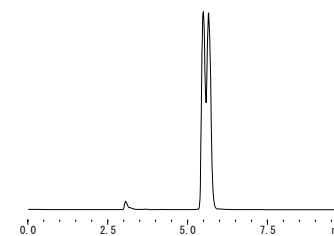
TCI Chiral MB-S



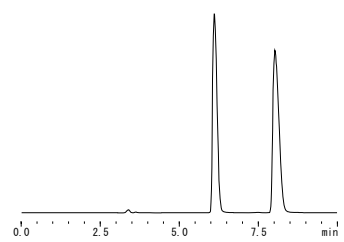
Amylose type 1



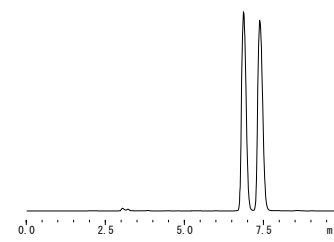
TCI Chiral BP-S



Amylose type 2

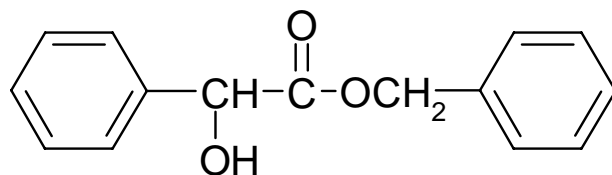


TCI Chiral CH-S

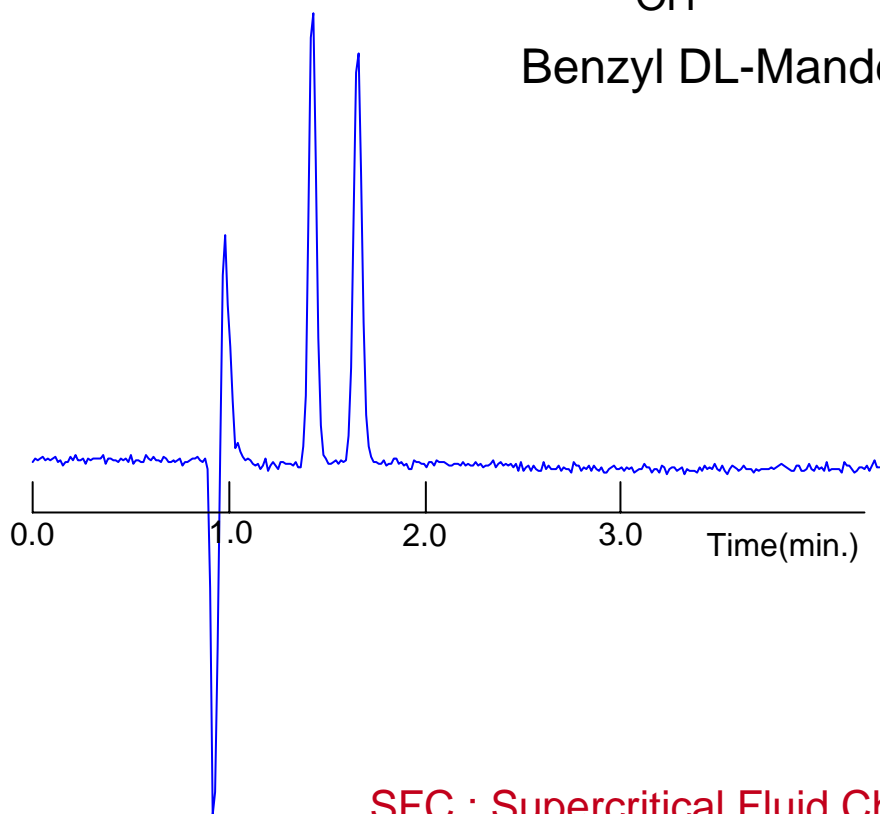


Cellulose type

# SFC application



Benzyl DL-Mandelate



Column	:	TCI Chiral MB-S (3 $\mu$ m)
Column Size	:	4.6mmID $\times$ 150mm
Temperature	:	40 $^{\circ}$ C
Pressure	:	20MPa
Mobile Phase	:	CO <sub>2</sub> /IPA=90/10
Detection	:	UV254nm
Flow Rate	:	2.0mL/min
Sample	:	Benzyl DL-Mandelate 0.99mg/mL(IPA)
Injection Vol.	:	5 $\mu$ L
Column Pressure	:	2.4MPa

SFC : Supercritical Fluid Chromatography



# Complete TCI Chiral product line

Column Type	TCI Chiral MB-S		TCI Chiral BP-S		TCI Chiral CH-S	
Particle Size	3 $\mu$ m	5 $\mu$ m	3 $\mu$ m	5 $\mu$ m	3 $\mu$ m	5 $\mu$ m
4.6mm $\times$ 50mm	S3815	S3845	S3825	S3855	S3835	S3865
4.6mm $\times$ 150mm	S3810	S3840	S3820	S3850	S3830	S3860
4.6mm $\times$ 250mm	S3811	S3841	S3821	S3851	S3831	S3861
Cartridge type guard for 4.6mm column (3.0mm $\times$ 15mm)*	S3849(1/Pack)		S3859(1/Pack)		S3869(1/Pack)	
2.0mm $\times$ 50mm	S3816	S3846	S3826	S3856	S3836	S3866
2.0mm $\times$ 150mm	S3812	S3842	S3822	S3852	S3832	S3862
2.0mm $\times$ 250mm	S3813	S3843	S3823	S3853	S3833	S3663
Guard for 2.0 (or 4.6mm ) Column (1.0mm $\times$ 15mm )	S3819(3/Pack)		S3829(3/Pack)		S3839(3/Pack)	
10.0mm $\times$ 250mm	-	S3870	-	S3880	-	S3890
20.0mm $\times$ 250mm	-	S3871	-	S3881	-	S3891

\*3.0mm  $\times$  15mm guard column is a cartridge type column and needs a holder. Holder:S1450