YMC EUROPE GMBH
The Selectivity Company

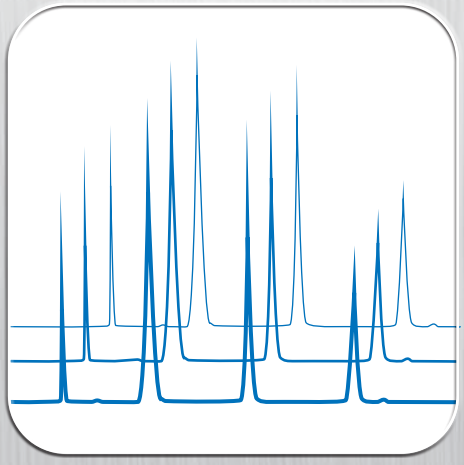
Preparative columns for HPLC and SFC

YMC-ACTUS

Throughput

Yield

Long Lasting



www.ymc.eu

Fast (semi-)preparative chromatography

Semi-preparative chromatography is the link between analytical HPLC and preparative LC. Even though the chromatographic systems used for (semi-)preparative LC are not as large as preparative LC systems, the objectives remain the same

- **Purification and isolation of maximum sample quantity**
- **Savings in time and costs.**

With YMC-Actus columns, packed with YMC's innovative resins,

- **Yield**
- **Throughput**
- **Long column lifetime**

are easily achieved!

With YMC-Actus, time is on your side!

Contents

"YMC-Actus Triart columns are highly reliable tools"

"Analytical YMC-Triart and preparative YMC-Actus Triart columns are highly reliable tools for small molecule scale-up and purification."

Cyril Henry, Novalix (FR)

Specifications

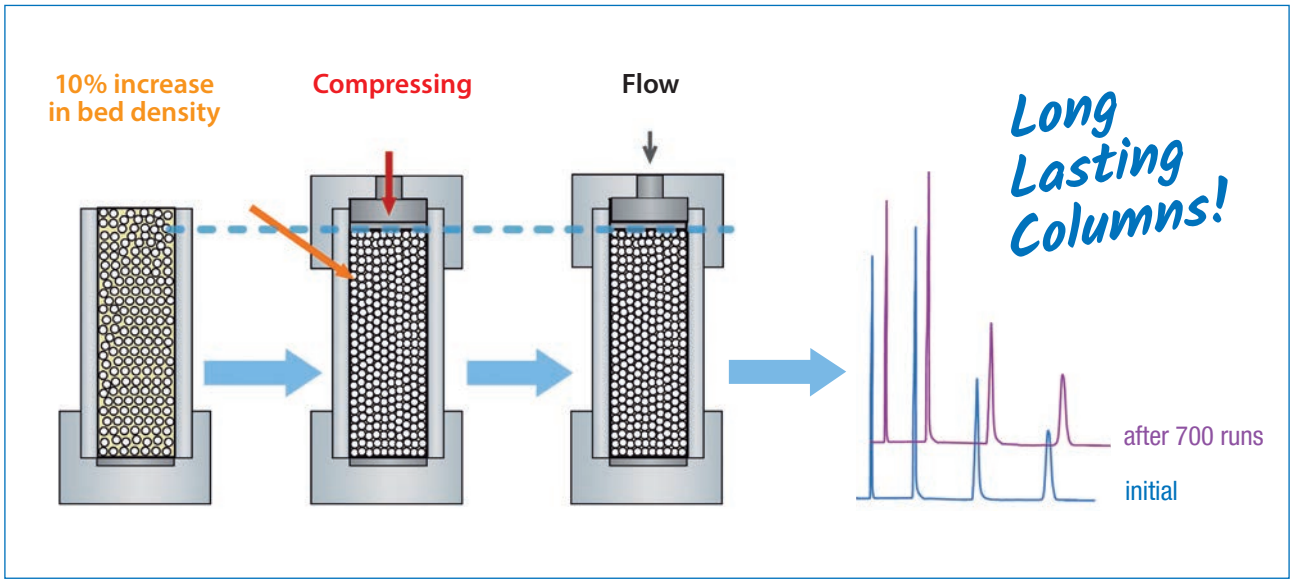
	YMC-Actus
Stationary phases	YMC-Triart / YMC-Triart Prep RP Classics CHIRAL ART
Particle size / µm	5, 7*, 10*, 15*, 20*
Internal diameter / mm	20, 30, 50
Length / mm	50, 75, 100, 150, 250
Pressure limit (for 5 µm)	20–30 mm ID: 30 MPa (4,350 psi) 50 mm ID: 20 MPa (2,900 psi)

*not all combinations of stationary phase and particle size are available

High performance purifications with YMC-Actus (semi-)preparative columns

How to obtain long lasting columns!

YMC-Actus series columns are semi-preparative HPLC columns that have excellent column stability and efficiency as a result of applying axial compression technology.
YMC-Actus series columns show high stability under high flow rate or steep gradient conditions which are desirable for milligram scale preparative HPLC of various compounds.



Uniformly high density packing is necessary for highly efficient and stable HPLC columns.
DAC (Dynamic Axial Compression) columns are widely used for preparative separation in pilot or production scale. This allows uniformly high density packing and prevents formation of voids.

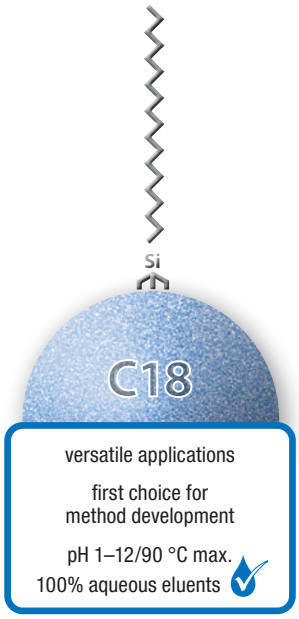
YMC-Actus series columns have been developed by applying this Axial Compression Technology to semiprep column production. The column bed is compressed appropriately when attaching the inlet end assembly of the newly designed YMC-Actus hardware. It provides increased bed density (10 % higher than conventional columns) and bed uniformity.

YMC-Triart and Actus Technology: A perfect match!

YMC-Triart is a versatile material with exceptional narrow particle and pore size distributions. YMC-Triart allows challenging pH and high temperature conditions in work day-to-day in laboratories. Most importantly, due to its unique particle composition, a balanced hydrophobicity and silanol activity are achieved which makes YMC-Triart a "First Choice" column in method development.

Phase overview

YMC-Triart C18



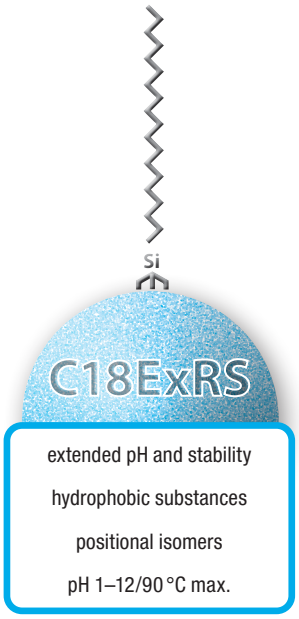
versatile applications

first choice for method development

pH 1–12/90 °C max.

100% aqueous eluents

YMC-Triart C18 ExRS



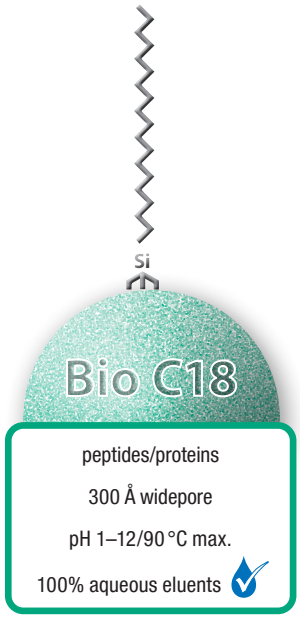
extended pH and stability

hydrophobic substances

positional isomers

pH 1–12/90 °C max.

YMC-Triart Bio C18



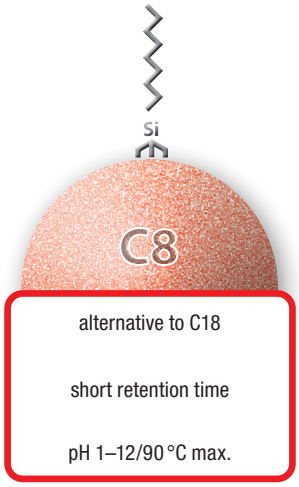
peptides/proteins

300 Å widepore

pH 1–12/90 °C max.

100% aqueous eluents

YMC-Triart C8

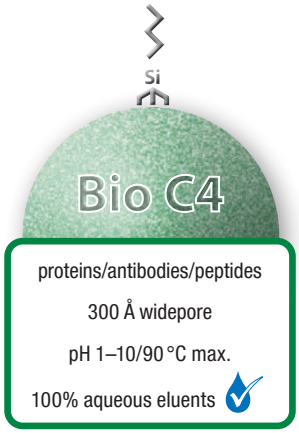


alternative to C18

short retention time

pH 1–12/90 °C max.

YMC-Triart Bio C4



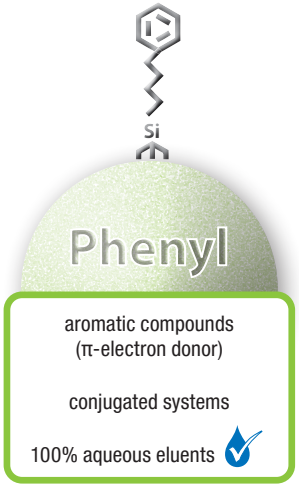
proteins/antibodies/peptides

300 Å widepore

pH 1–10/90 °C max.

100% aqueous eluents

YMC-Triart Phenyl

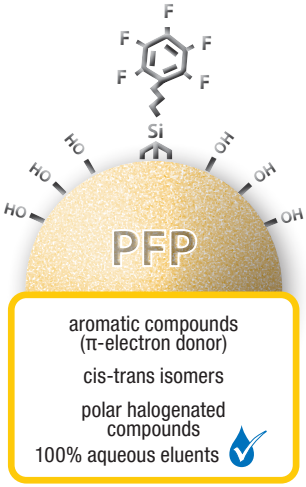


aromatic compounds (π-electron donor)

conjugated systems

100% aqueous eluents

YMC-Triart PFP



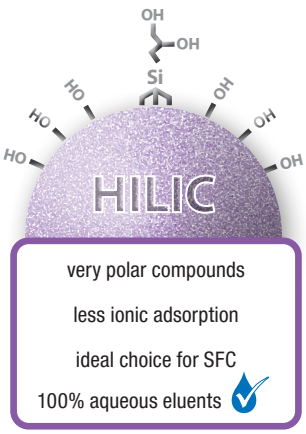
aromatic compounds (π-electron donor)

cis-trans isomers

polar halogenated compounds

100% aqueous eluents

YMC-Triart Diol-HILIC



very polar compounds

less ionic adsorption

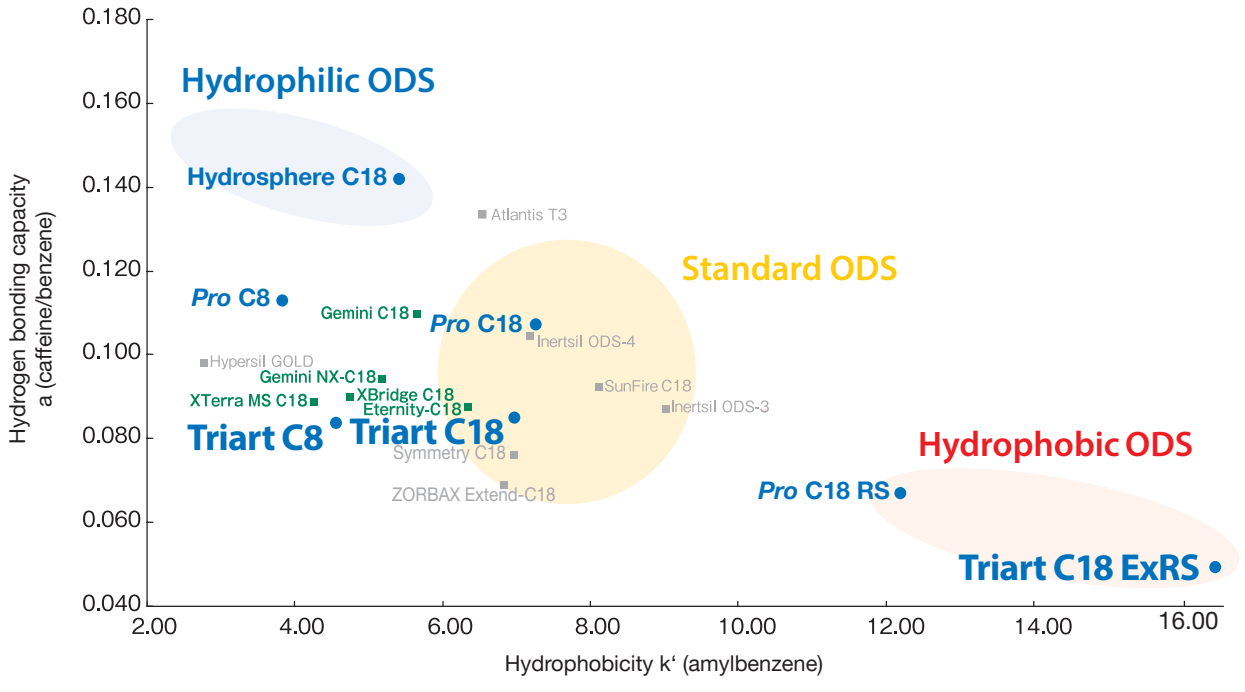
ideal choice for SFC

100% aqueous eluents

Specification YMC-Triart

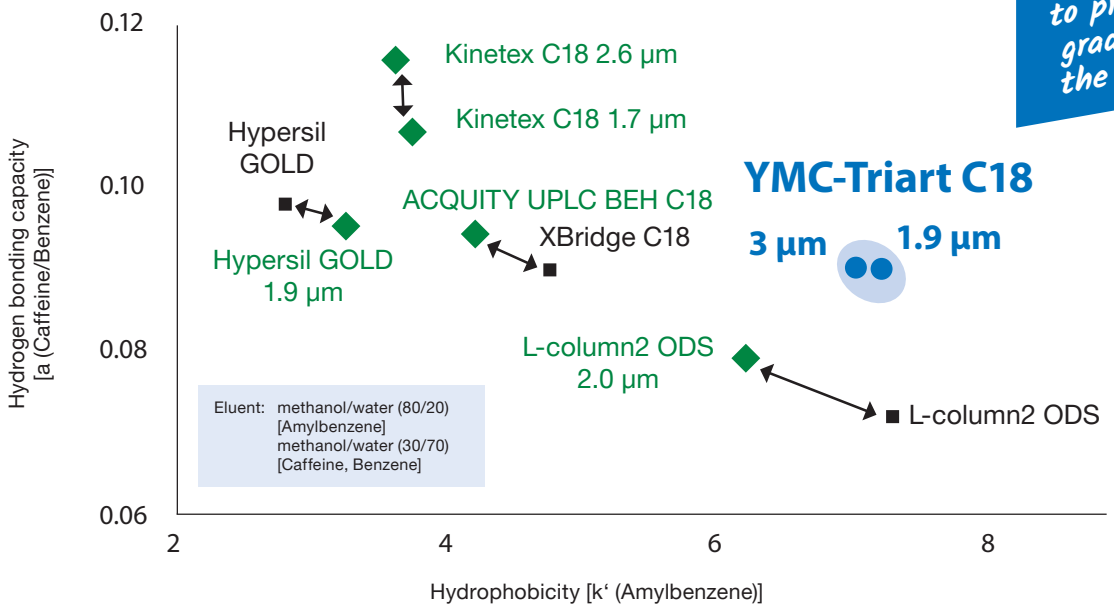
	C18	C18 ExRS	Bio C18	C8	Bio C4	Phenyl	PFP	Diol-HILIC
Base	organic/inorganic hybrid silica							
Stationary phase	C18 (USP L1)	C18 (USP L1)	C18 (USP L1)	C8 (USP L7)	C4 (USP L26)	Phenyl (USP L11)	Penta-fluorophenyl (USP L43)	Diol (USP L20)
Particle size	5 µm (1.9 and 3 µm)							
Pore size	12 nm	8 nm	30 nm	12 nm	30 nm	12 nm	12 nm	12 nm
Specific surface	360 m^2/g	430 m^2/g	—	360 m^2/g	—	360 m^2/g	360 m^2/g	360 m^2/g
Carbon content	20 %	25 %	—	17 %	—	17 %	15 %	—
Bonding	trifunctional							
Endcapping	multi-stage	multi-stage	multi-stage	multi-stage	multi-stage	multi-stage	none	none
pH range	1 ~ 12	1 ~ 12	1 ~ 12	1 ~ 12	1 ~ 10	1 ~ 10	1 ~ 8	2 ~ 10
Temperature range	pH < 7: 90 °C pH > 7: 50 °C	pH < 7: 90 °C pH > 7: 50 °C	pH < 7: 90 °C pH > 7: 50 °C	pH < 7: 90 °C pH > 7: 50 °C	pH < 7: 90 °C pH > 7: 50 °C	50 °C	50 °C	50 °C
Pressure limit	20–30 mm ID: 30 MPa (4,350 psi) 50 mm ID: 20 MPa (2,900 psi)							
100% aqueous eluents	✓	✘	✓	✘	✓	✓	✓	✓

"First choice" column for method development



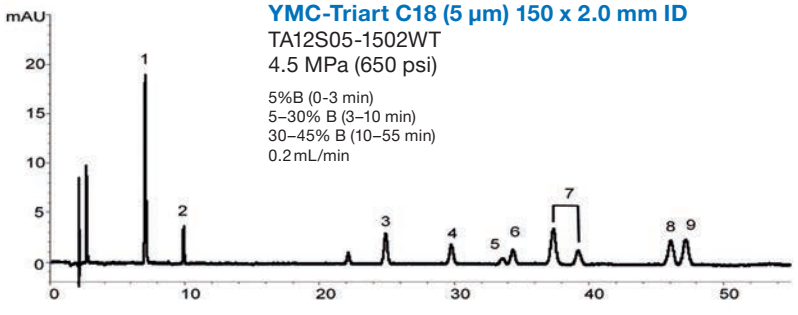
Evaluation of method transfer performance

YMC-Triart is the only UHPLC to preparative grade gel on the market!



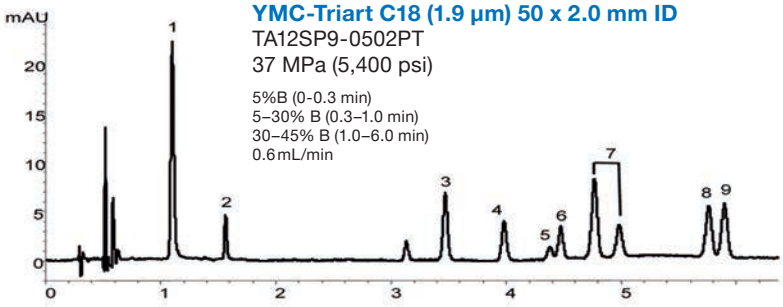
With the introduction of UHPLC, sub-2-µm particles became neccessary. Therefore smaller particles have been added to existing column lines. Consequently, sub-2-µm particles may exhibit differences in chromatographic performance. By introducing YMC-Triart, YMC provides matching chromatographic behaviour for all particles sizes!

Method transfer HPLC ↔ UHPLC



1. Oxine-copper (Copper 8-quinolinolate)
2. Asulam
3. Thiram
4. Triclopyr
5. Mecoprop
6. Flazasulfuron
7. Siduron
8. Halosulfuron-methyl
9. Azoxystrobin

55 min



6 min

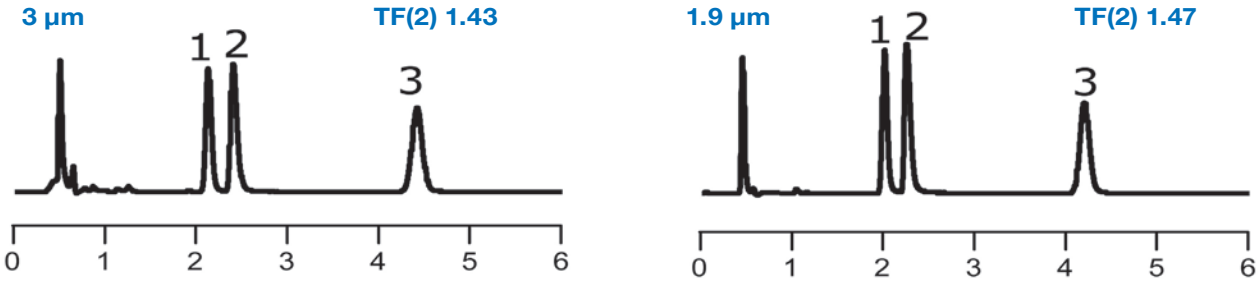
Eluent:	A) water+ 0.1% formic acid B) acetonitrile+ 0.1% formic acid
Temperature:	40 °C
Detection:	UV at 240 nm
Injection:	1 µL (5 µg/mL)

When transferring the 55 min HPLC method to UHPLC scale, the resolution remains the same although the separation time is reduced to only 6 min.

Secure your method transfer!

Differences in selectivity, retention time, and also peak shapes between different particle sizes of commercially available C18 phases in the same brand (or an alternative as recommended by its manufacturer) have been observed.

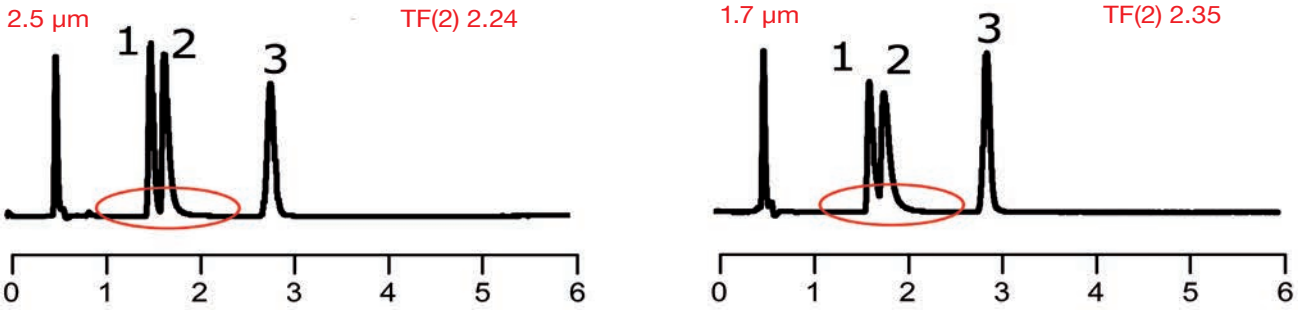
YMC-Triart C18



YMC has addressed this issue of method transfer. YMC-Triart columns show identical selectivity and excellent peak shapes for basic compounds for all 3.0 µm to 1.9 µm particle sizes. It allows predictable scale up from UHPLC to conventional HPLC and even to semi-preparative LC, and vice versa.

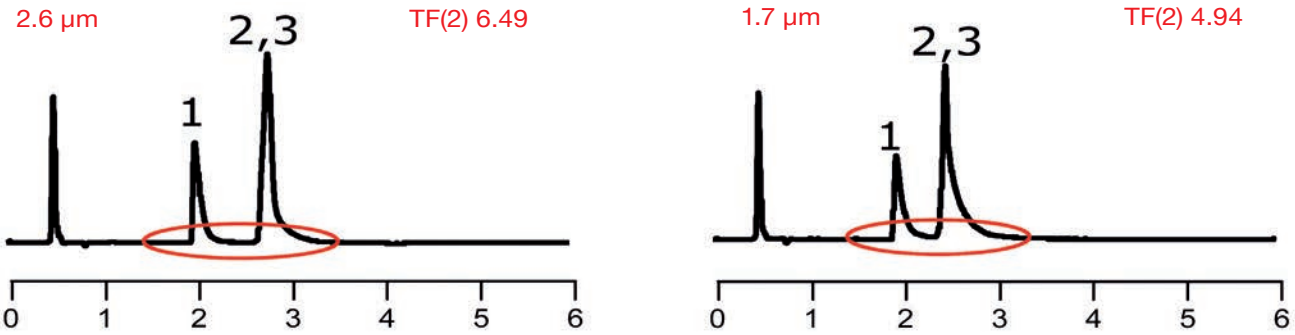
Case Studies

X-Bridge BEH C18 and Acquity UPLC BEH C18



These observations might not be representative for all applications.

Kinetex™ C18

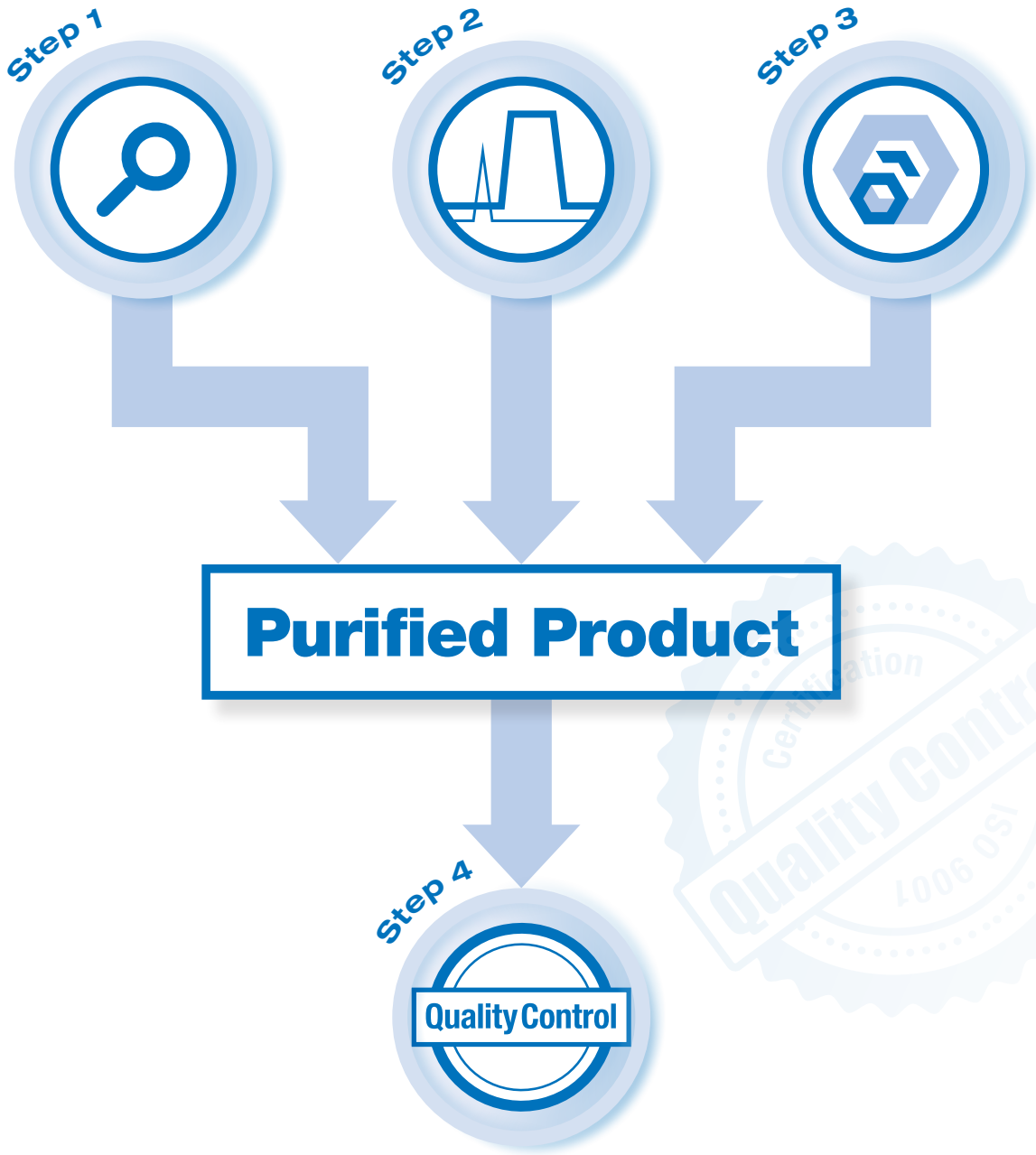


KinetexTM C18 columns show significant peak tailing and have limited scalability due to lack of larger particle sizes.

Column:	50 x 2.0 mm ID or 2.1 mm ID
Eluent:	20 mM KH_2PO_4-K_2HPO_4 (pH 6.9) / acetonitrile (65/35)
Temperature:	40 °C
Flow rate:	0.2 mL/min
Detection:	UV at 235 nm

1. Chlorpheniramine (basic)
2. Dextromethorphan (basic)
3. Propyl paraben (internal standard)

Effective purification method development!



Step 1 Developing a well optimised separation on an analytical scale

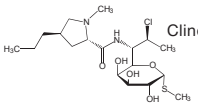
Step 2 Loading study on an analytical scale

Step 3 Scale-up to semi-preparative column dimensions

Step 4 Quality control/proof of concept

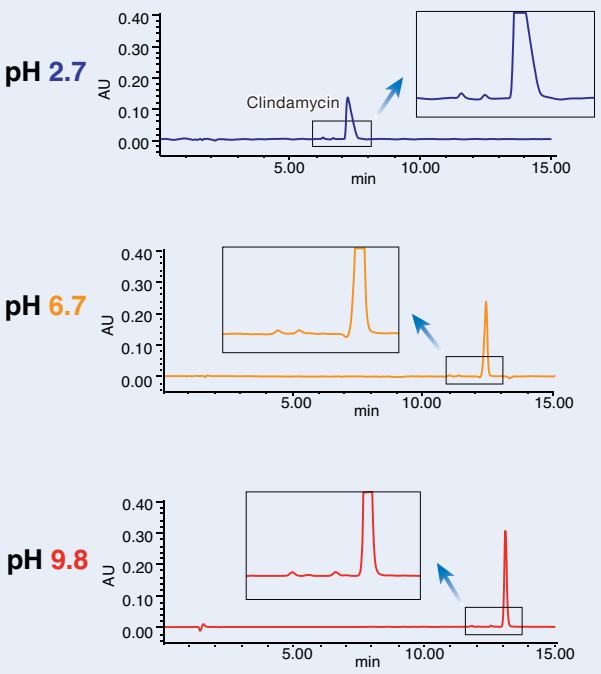
Development of the analytical method

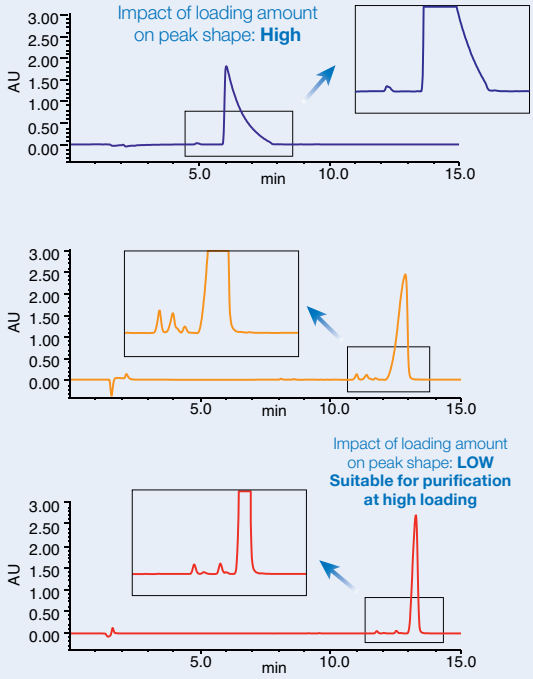
YMC-Triart C18 (5 µm) 150 x 4.6 mm ID



0.01 mg Loading
10 µl injection, 1.0 mg/mL in water

0.5 mg Loading
10 µl injection, 50 mg/mL in water



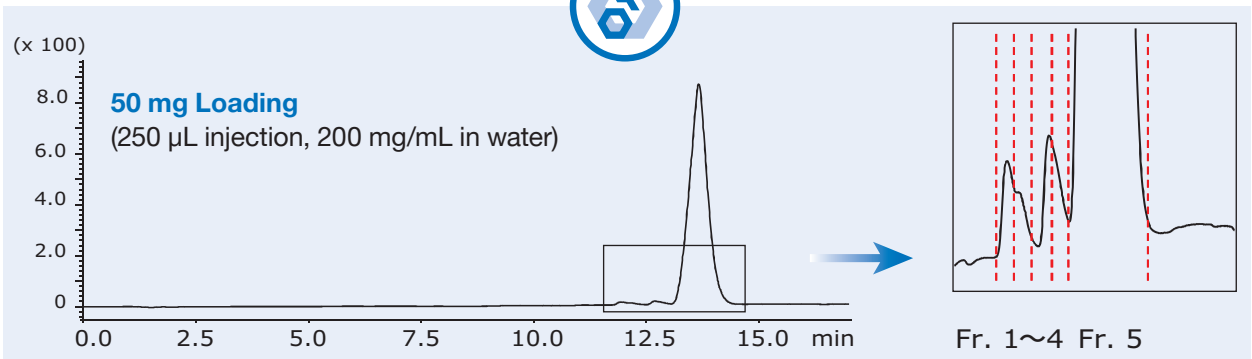


Part No.: TA12S05-1546PTH
Eluent: A) 20 mM HCOOH for pH 2.7
20 mM $HCOONH_4$ for pH 6.7
20 mM $HCOONH_4$-NH_3 for pH 9.8
B) acetonitrile

Gradient: 10–75%B (0–15 min)
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV at 210 nm
Pressure: 7.0 MPa

Quality control/proof of concept

YMC-Actus Triart C18 (5 µm) 150 x 20 mm ID



Part No.: TA12S05-1520WX
Eluent: A) 20 mM $HCOONH_4$-NH_3 (pH 9.8)
B) acetonitrile
Gradient: 10–75%B (0–15 min)
Flow rate: 18.9 mL/min

Temperature: ambient
Detection: UV at 210 nm
Pressure: 8.4 MPa

In order to develop a successful semi-preparative method it is beneficial to carry out the following steps:

Step 1 Developing a well optimised separation on an analytical scale

Determine separation conditions by using analytical columns packed with different stationary phases and various conditions.

Step 2 Loading study on an analytical scale

Select the particle size of the packing material and the inner diameter of column appropriate for the sample volume. Optimise the separation conditions and perform loadability studies using analytical columns with inner diameter of 4.6 mm or 6.0 mm packed with the packing material selected for the preparative separation (scout column). If the particle size of the packing material is the same as in step 1, this process can be omitted. If the preparative column is more than 100 mm ID, it is advisable to insert another step with a scout column of 20 mm ID in order to more accurately predict loadability and calculations of the running costs.

Step 3 Scale-up to semi-preparative column dimensions

Proceed with the preparative separation by scaling up the chromatographic parameters such as flow rate, column ID and sample load by the required factor. Of all the steps in this process, the most demanding step will be the scale-up of the chromatographic parameters in order to meet the preparative demands.

There are a number of scalable parameters which must be included: flow rate, column ID, sample load, tubing ID, sample injection concentration, volume of sample loop, consumption of solvent, dead volume, fraction mass, size of the detector cell.

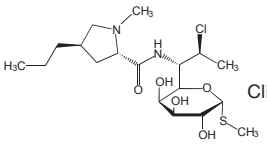
Step4 Quality control/proof of concept

Analyse the fractions from your purification.

Example: Separation of Clindamycin as basic drug

Step 1 Development of the analytical method

YMC-Triart C18 (5 µm) 150 x 4.6 mm ID

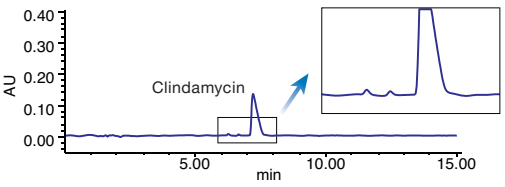


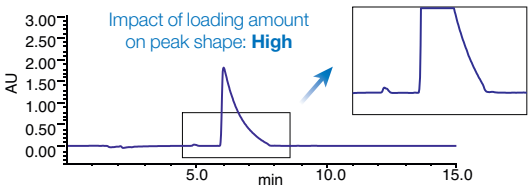
Clindamycin (pKa=7.6)

0.01 mg Loading
10 µl injection, 1.0 mg/mL in water

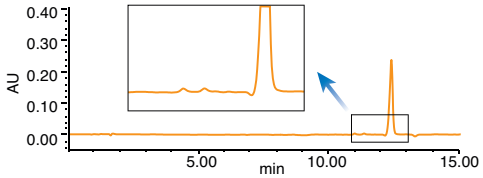
0.5 mg Loading
10 µl injection, 50 mg/mL in water

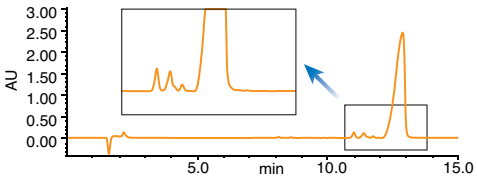
pH 2.7



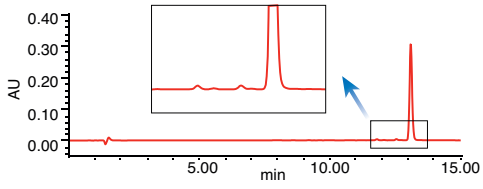


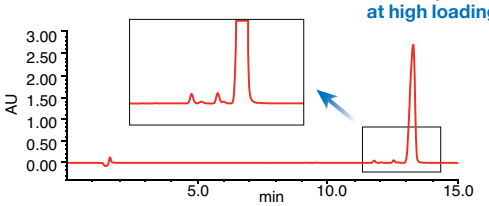
pH 6.7





pH 9.8

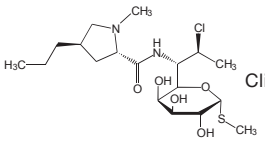




Part No.:	TA12S05-1546PTH
Eluent:	A) 20 mM HCOOH for pH 2.7 20 mM $HCOONH_4$ for pH 6.7 20 mM $HCOONH_4$-NH_3 for pH 9.8 B) acetonitrile
Gradient:	10–75%B (0-15 min)
Flow rate:	1.0 mL/min
Temperature:	25 °C
Detection:	UV at 210 nm
Pressure:	7.0 MPa

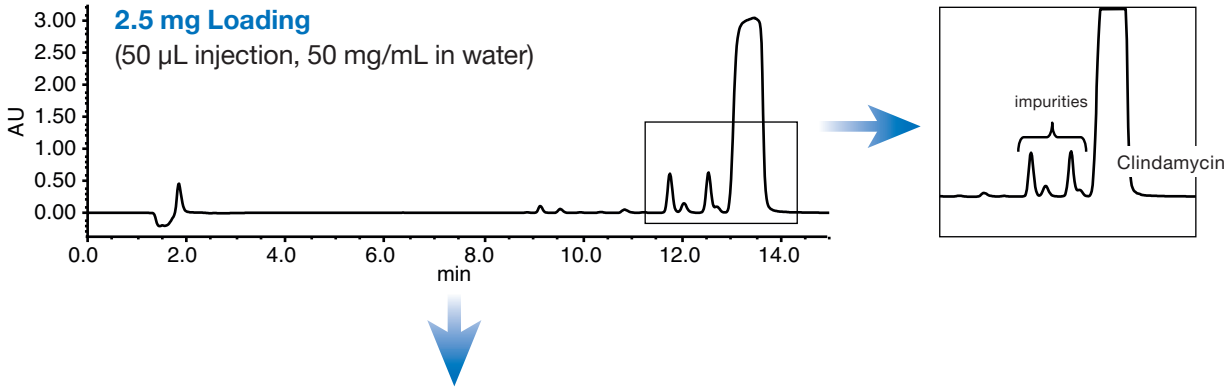
Step 2 Loading study on an analytical scale

YMC-Triart C18 (5 µm) 150 x 4.6 mm ID



Clindamycin (pKa=7.6)

pH 9.8

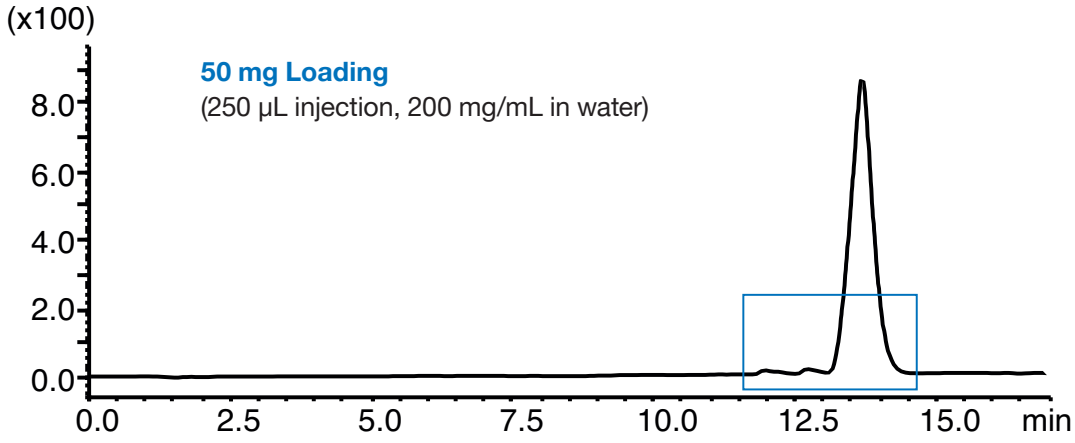


Scale-up to semi-preparative scale

Part No.: TA12S05-1546PTH
Eluent: A) 20 mM $HCOONH_4$-NH_3 for pH 9.8
B) acetonitrile
Gradient: 10–75%B (0-15 min)
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV at 210 nm
Pressure: 7.0 MPa

Step 3 Scale-up

YMC-Triart C18 (5 µm) 150 x 20 mm ID

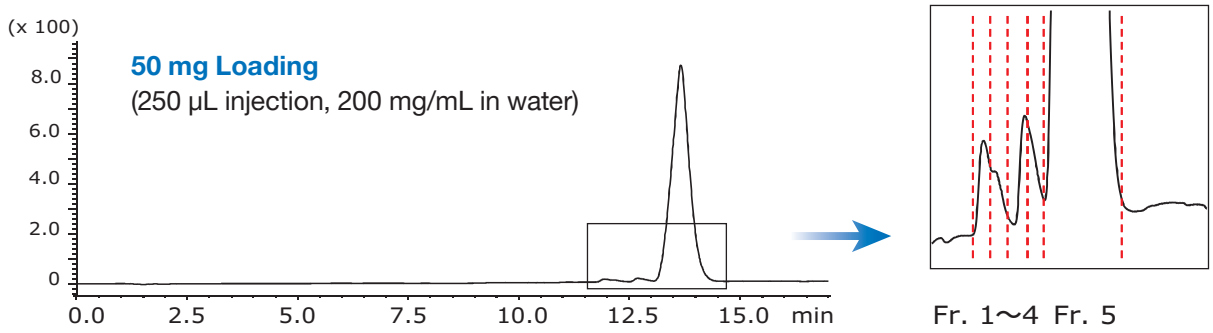


Part No.: TA12S05-1520WX
Eluent: A) 20 mM $HCOONH_4$-NH_3 (pH 9.8)
B) acetonitrile
Gradient: 10–75%B (0-15 min)
Flow rate: 18.9 mL/min
Temperature: ambient
Detection: UV at 210 nm
Pressure: 8.4 MPa

Step 4 Quality control/proof of concept

Quality Control

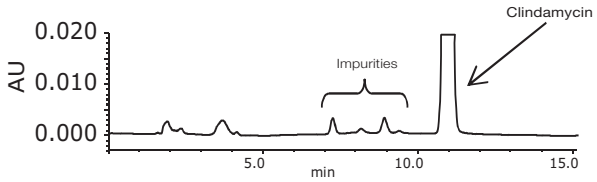
YMC-Actus Triart C18 (5 µm) 150 x 20 mm ID



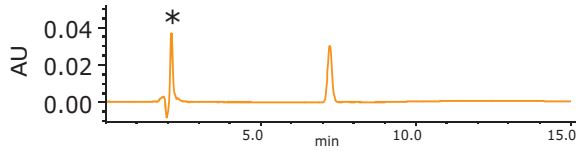
Part No.: TA12S05-1520WX
Eluent: A) 20 mM $HCOONH_4$-NH_3 (pH 9.8)
B) acetonitrile
Gradient: 10–75%B (0–15 min)
Flow rate: 18.9 mL/min
Temperature: ambient
Detection: UV at 210 nm
Pressure: 8.4 MPa

Analysis of fractions

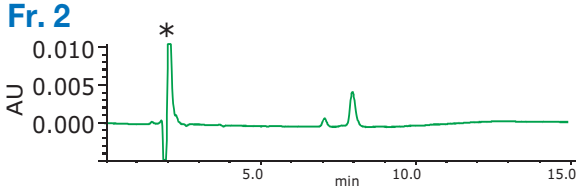
Crude



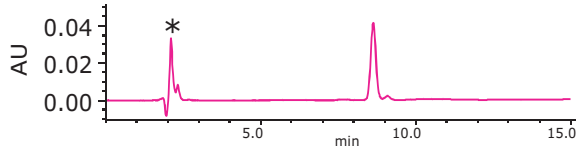
Fr. 1



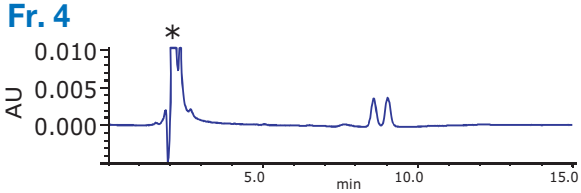
Fr. 2



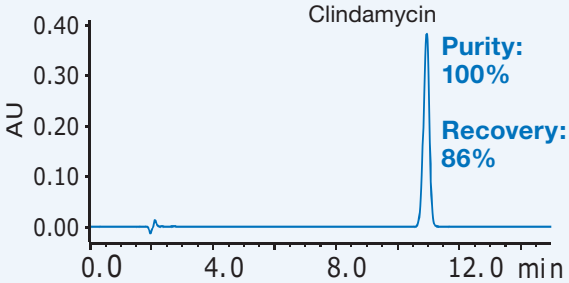
Fr. 3



Fr. 4



Fr. 5



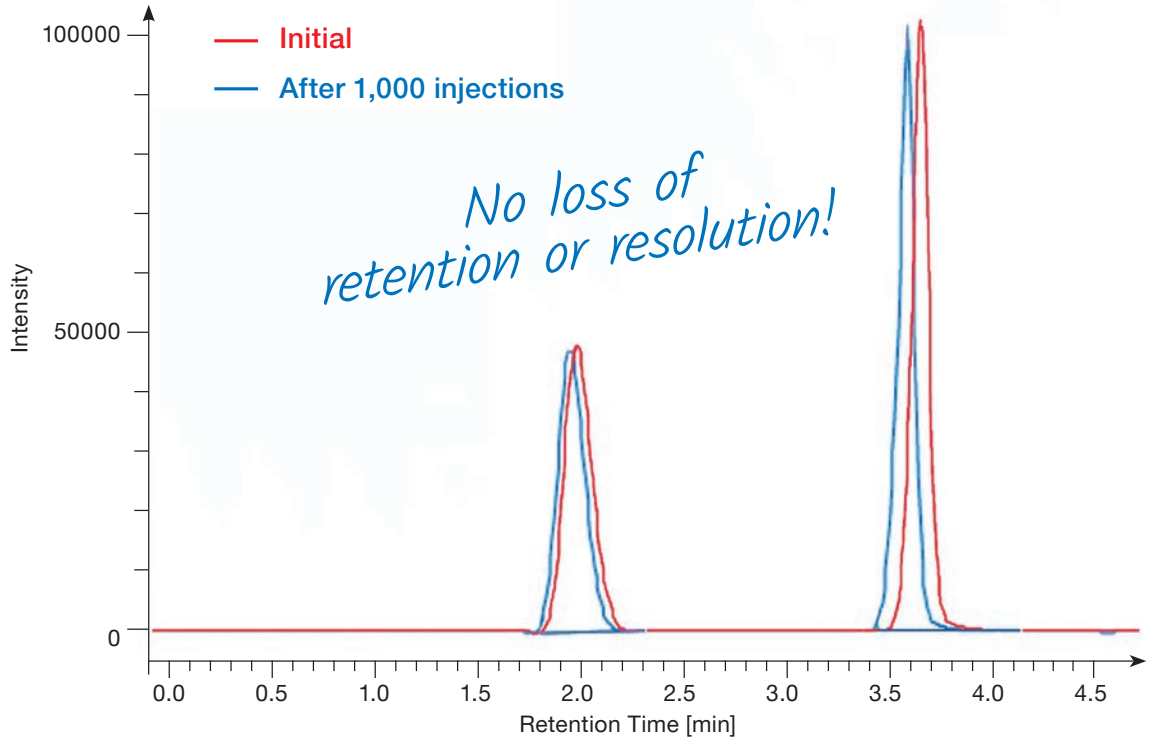
Column: YMC-Triart C18 (5 µm) 150 x 4.6 mm ID
Part No.: TA12S05-1546PTH
Eluent: 50 mM KH_2PO_4 (pH 7.5 adjusted by 8 M KOH)/acetonitrile (55/45)
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV at 210 nm
Injection: 20 µL

YMC-Actus delivers SFC stability!

In general, the stability of chiral and achiral 50 mm ID SFC columns can often be reduced. Also, the inlet frit is often distorted after about 500 runs which leads to a silica leakage.

Using YMC-Actus for SFC long life times can be achieved as a result of the robust column packing. The following test shows the stability of YMC-Actus.

YMC-Actus SIL (5 µm) 250 x 50 mm ID



	Repeated injections	Standard test
Mobile Phase	CO_2/methanol (70/30)	CO_2/methanol (70/30)
Flow Rate	195 mL/min	195 mL/min
Pressure	12 MPa (at column head)	12 MPa (at column head)
Detection	254 nm	254 nm
Temperature	30 °C	30 °C
Backpressure	10 MPa	10 MPa
Sample	Methanol	1. Toluene (5 µL/mL), 2. Caffeine (500 µg/mL)
Injection Volume	1 mL (inject every 1 min)	1 mL (inject every 1 min)
Pressure drop		4 MPa

In order to monitor column stability under a customer's usual SFC working conditions not only was a pressure of 12 MPa (at column head) applied but 1 mL injections were also applied every minute with a pressure drop of 4 MPa. The column performance was checked after every 100 injections.

No significant change in performance could be detected after 1,000 repeated injections (corresponding to about 17 h).

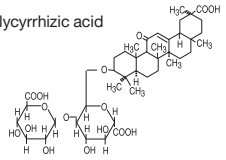
Furthermore, no significant changes in retention time, theoretical plate count and tailing factor could be determined over the complete test period.

YMC-Actus and YMC-Pack ODS-AQ

Excellent stability and efficiency under fast gradient condition at high flow rate

Glycyrrhizic acid in herb medicine

Glycyrrhizic acid



Analysis:

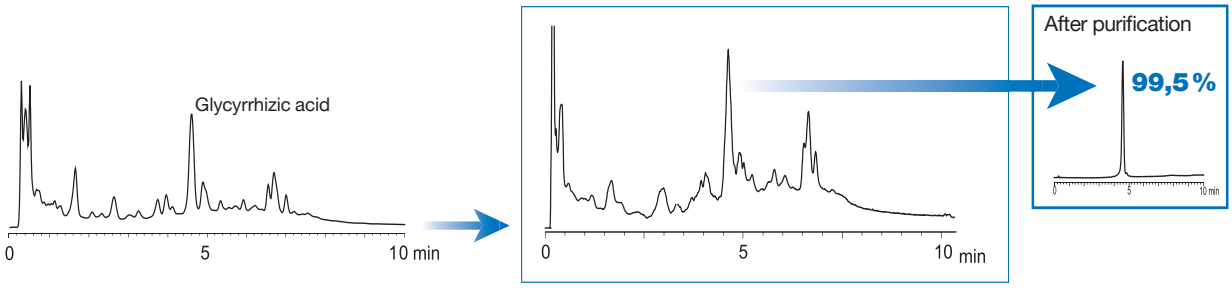
YMC-Pack ODS-AQ (5µm) 50 x 4.6mm ID

3 mL/min, 10 µl injection

Purification:

YMC-Actus ODS-AQ (5µm) 50 x 20mm ID

60 mL/min, 500 µl injection



Part No.:	AQ12S05-0546WT (analytical column) AQ12S05-0520WX (semi prep. column)
Eluent:	A) water/acetic acid (99/1) B) methanol/acetic acid (99/1)
Gradient:	20% B (0–2 min), 20-45% B (2–7 min), 45% B (7–10 min)
Temperature:	ambient
Detection:	UV at 260 nm
Sample:	water/methanol/acetic acid extract of commercially available herb medicine (0.1 g/mL)

YMC-Actus and Hydrosphere C18

Outstanding separation of highly polar compounds

Crude synthetic 30mer oligonucleotide

Analysis:

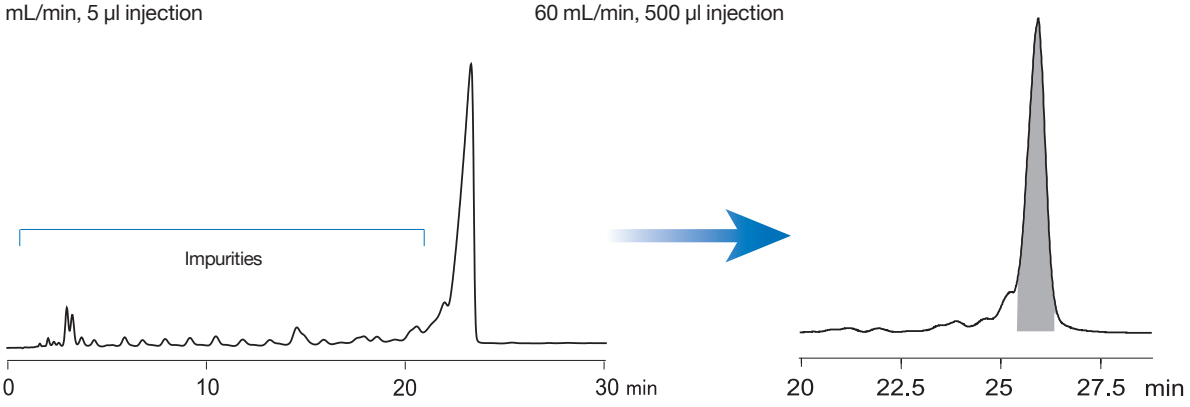
Hydrosphere C18 (5 µm) 50 x 4.6 mm ID

1 mL/min, 5 µl injection

Purification:

YMC-Actus Hydrosphere C18 (5 µm) 50 x 20 mm ID

60 mL/min, 500 µl injection



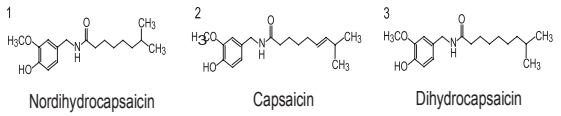
Part No.:	HS12S05-0546WT (analytical column) HS12S05-0520WX (semi prep. column)
Eluent:	A) 10 mM DBA-acetic acid (pH 6.0)/methanol (60/40) B) 10 mM DBA-acetic acid (pH 6.0)/methanol (20/80)
Gradient:	10–35% B (0–30 min)
Temperature:	ambient
Detection:	UV at 269 nm
Sample:	synthetic oligonucleotide (100 µM)

YMC-Actus and YMC-Pack Pro C18 RS

Excellent separation of compounds with similar structures

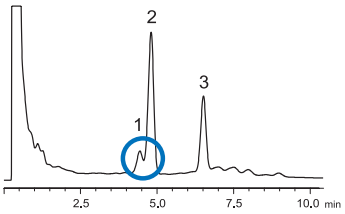
YMC-Actus shows the same excellent separation results as achieved with analytical columns.
Even compounds with similar structures can be separated with high purities.

Capsaicinoids in red pepper

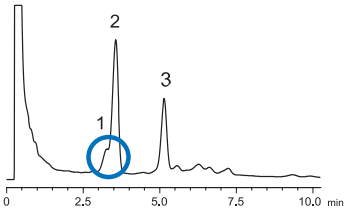


Analysis: 50 x 4.6 mm ID, 5 µm – 2.0 mL/min, 20 µL injection

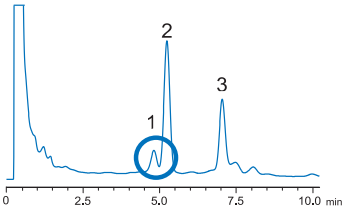
Phenomenex Luna C18



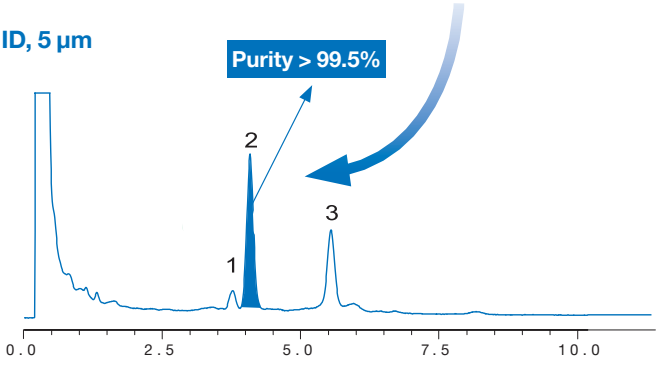
Waters XBridge C18



YMC-Pack *Pro* C18 RS

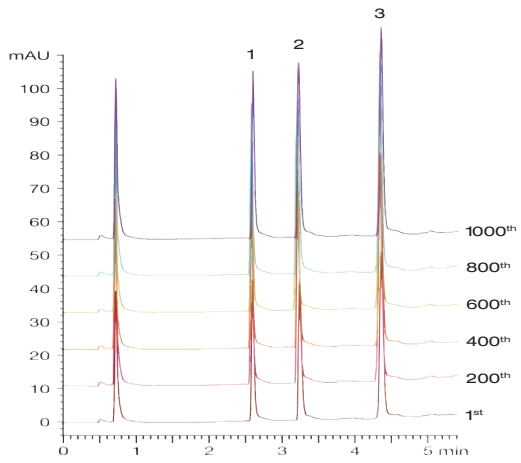


Purification: YMC-Actus *Pro* C18 RS, 50 x 20 mm ID, 5 µm
40 mL/min, 400 µL injection



Eluent:	A) methanol/water/TFA (50/50/0.1) B) methanol/TFA (100/0.1)
Gradient:	0–30% B (0–5 min), 30% B (5–10 min)
Temperature:	25 °C for 50 x 4.6 mm ID ambient for 50 x 20 mm ID
Detection:	UV at 280 nm
Sample:	methanol extract of a commercial red pepper (1 g/3 mL)

Available for high-throughput purification: Injection in DMSO



1. Ethenzamide
2. Clemastine fumarate
3. Ibuprofen

Column:	YMC-Actus *Pro* C18 RS (5 µm, 8 nm) 50 x 20 mm ID
Part No.:	RS08S05-0520WX
Eluent:	A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1)
Gradient:	10–90%B (0–3 min), 90%B (3–5 min), 10%B (5–10 min)
Flow rate:	20 mL/min
Temperature:	ambient
Detection:	UV at 270 nm
Injection:	100 µL (0.2–2 mg/mL in DMSO)

As shown in the above overlay of chromatograms, YMC-Actus columns provide outstanding stability and reproducibility for the separation of pharmaceuticals dissolved in 100% DMSO, even after 1,000 injections under the test conditions. This demonstrates that YMC-Actus columns are ideal for high-throughput purification in drug discovery.

CHIRAL ART Immobilised Polysaccharide Derivatives Series

- **applicable for normal and reversed phase modes**
- **unique immobilised chiral selector**
- **more flexibility due to wide range of usable solvents**
- **highly robust, also suitable for SFC/SMB**
- **HPLC columns and preparative grade bulk media with particle sizes of 3, 5, 10 or 20 µm available**
- **extremely attractive pricing**

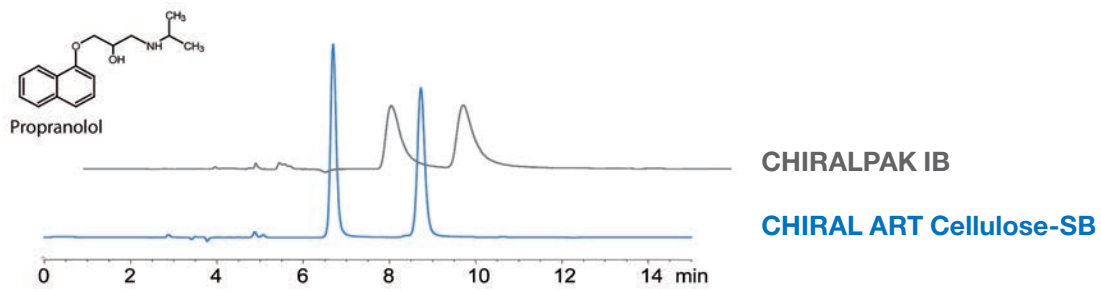
Introduction

CHIRAL ART polysaccharide derivatives are a series of chiral separation columns / packing materials with high stereo-selectivity. They are suitable for separations of a wide range of chiral compounds, cis-trans isomers and geometric isomers. The range of particle sizes and column dimensions available offer outstanding cost effectiveness for analytical to preparative separations.

Immobilised Type

CHIRAL ART immobilised polysaccharide derivatives can be used either in normal phase or in reversed phase modes. They are available in HPLC columns and in preparative grades, in large (multi kg) quantities.

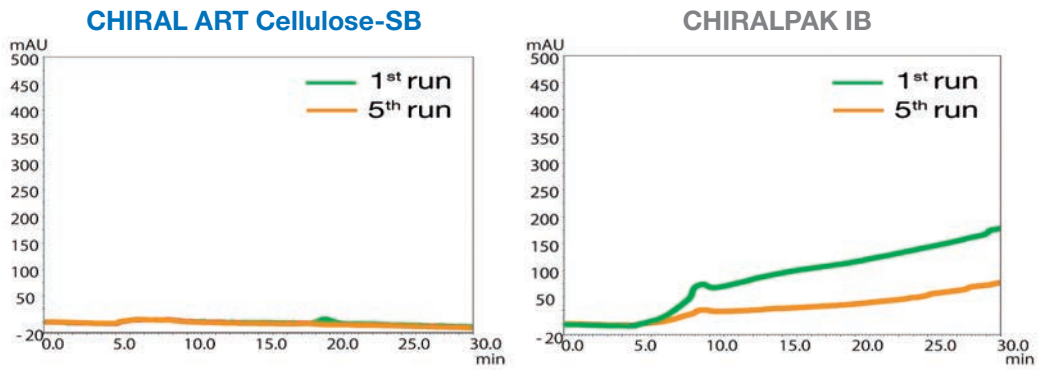
Excellent peak shape



Column:	5 µm, 250 x 4.6 mm ID	Temperature:	25 °C
Eluent:	n-hexane / IPA / DEA (80/20/0.1)	Detection:	230 nm
Flow rate:	1.0 mL/min	Injection:	10 µL (0.1 mg/mL)

CHIRAL ART polysaccharide derivatives provide excellent peak shapes for ionic and metal coordinating compounds.

Low Column Bleeding



Gradient test			
Column:	5 µm, 250 x 4.6 mm ID	Flow rate:	1.0 mL/min
Eluent:	A) *n*-hexane, B) ethanol	Temperature:	25 °C
Gradient:	2–80% B (0–30 min), 80–2% B (30–30.1 min), 2%B (30.1–60 min)	Detection:	UV at 230 nm

Immobilised Polysaccharide Derivatives Series

First to Market!

	CHIRAL ART Amylose-SA	CHIRAL ART Cellulose-SB	CHIRAL ART Cellulose-SC	CHIRAL ART Cellulose-SJ	CHIRAL ART Cellulose-SZ
Particle size	5, 10, 20 µm (3 µm)				5 µm (3 µm)
Chiral selector	Amylose tris (3,5-dimethylphenyl-carbamate)	Cellulose tris (3,5-dimethylphenyl-carbamate)	Cellulose tris (3,5-dichlorophenyl-carbamate)	Cellulose tris (4-methylbenzoat)	Cellulose tris (3-chloro-4-methyl-phenylcarbamate)
USP	L99	–	–	–	–
Type	Immobilised type				
Separation mode	Normal Phase / Reversed Phase / SFC				
Shipping solvent	*n*-hexane / 2-propanol (90/10)				
Usable pH-range	2.0–9.0				
Temperature	0–40 °C				
Pressure limit (for 5 µm)	20–30 mm ID: 30 MPa (4,350 psi) 50 mm ID: 20 MPa (2,900 psi)				

Product Line-up

Product name	Particle size	CHIRAL selector	Type	Competitive product
CHIRAL ART Amylose-SA	5 µm	Amylose tris (3,5-dimethylphenylcarbamate)	Immobilised	CHIRALPAK® IA, IA-3
CHIRAL ART Cellulose-SB	10 µm	Cellulose tris (3,5-dimethylphenylcarbamate)		CHIRALPAK® IB, IB-3
CHIRAL ART Cellulose-SC	20 µm	Cellulose tris (3,5-dichlorophenylcarbamate)		CHIRALPAK® IC, IC-3
CHIRAL ART Cellulose-SJ	(3 µm)	Cellulose tris (4-methylbenzoat)		CHIRALPAK® IJ, IJ-3 [coated CHIRALCEL® OJ(-3/H)]
CHIRAL ART Cellulose-SZ	5 µm (3 µm)	Cellulose tris (3-chloro-4-methylphenylcarbamate)		[coated CHIRALCEL® OZ-H, OZ-3]

Column Care

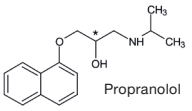
The recommended pH range for using CHIRAL ART immobilised polysaccharide columns is 2.0-9.0. Remove acid and buffer salts before storage. Store the column in n-hexane/2-propanol = 90/10 (NP) or methanol/water = 50/50 (RP).

If columns are affected by undesired contaminants or clogged inlet frits which cause back pressure increases, flush the column (in the reversed direction) with ethanol.

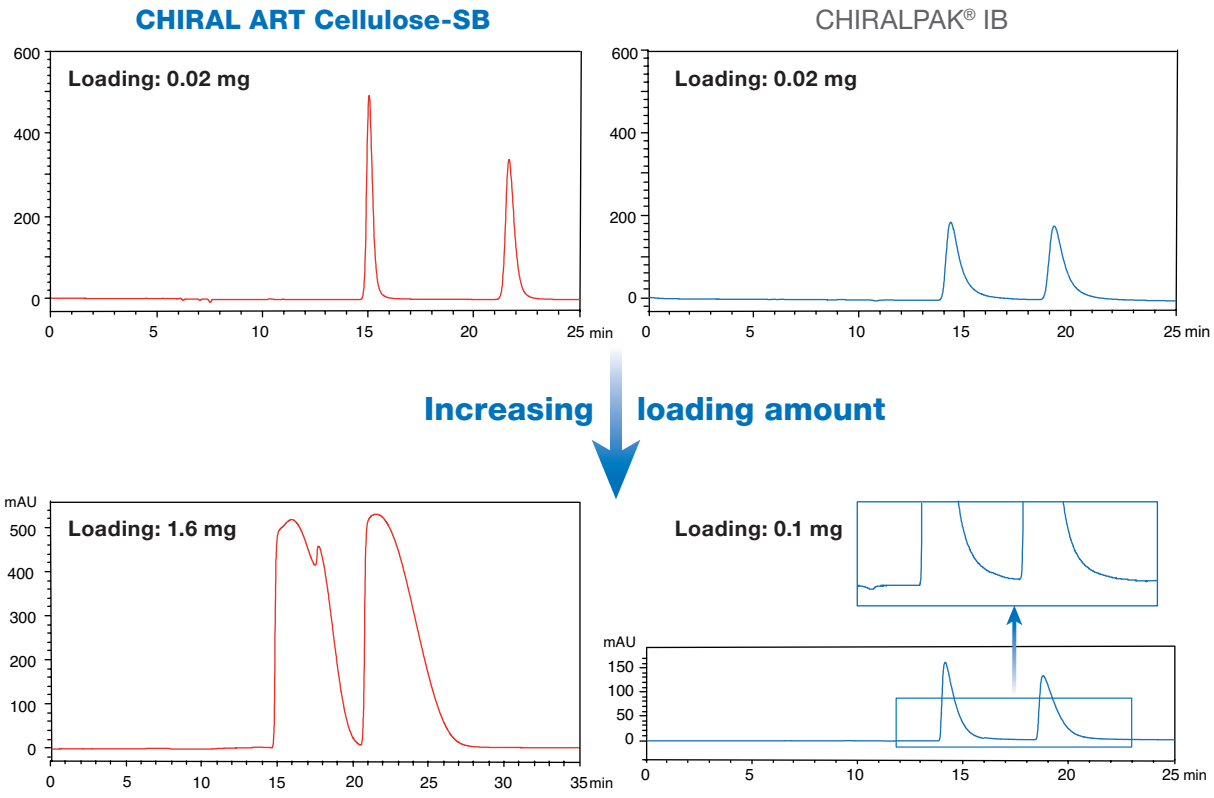
For detailed information please refer to the "Column Care and Use Instructions" which can be downloaded from ***www.ymc.eu/support-documentation.html***.

Efficient purification using YMC-Actus CHIRAL ART

Analytical scale loading studies



Propranolol



Column: 5 µm, 250 x 4.6 mm ID
Eluent: *n*-hexane/2-propanol / diethylamine (80/20/0.1)
Flow rate: 0.5 ml/min
Detection: UV at 230 nm
Temperature: 25 °C

With the competitor's product, loading amounts of more than 0.1 mg was not possible because the enantiomeric excess of the 2nd peak was already less than 98%ee with a loading amount of 0.1 mg.

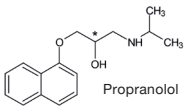
	CHIRAL ART Cellulose-SB		CHIRALPAK® IB	
	1st peak	2nd peak	1st peak	2nd peak
Enantiomeric excess	>99.9%ee	99.3%ee	>99.9%ee	97.9%ee
Recovery	99%	99%	99%	97%
Productivity (mg/h)*	3.1	3.3	0.3	0.3

*Calculated for repeated injections every 15 minutes (CHIRAL ART Cellulose-SB) and every 10 minutes (CHIRALPAK® IB).

The calculated maximum loading amount on CHIRAL ART Cellulose-SB of 1.6 mg was 10 times larger than that obtained for the competitor's product due to the large differences in the peak shapes, even though the interval between repeat injections was longer!

Efficient purification using YMC-Actus CHIRAL ART

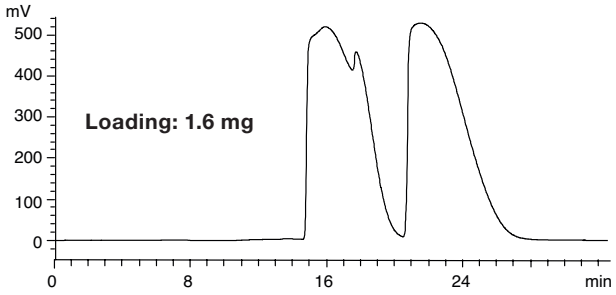
Scale-up with YMC-Actus CHIRAL ART



Propranolol

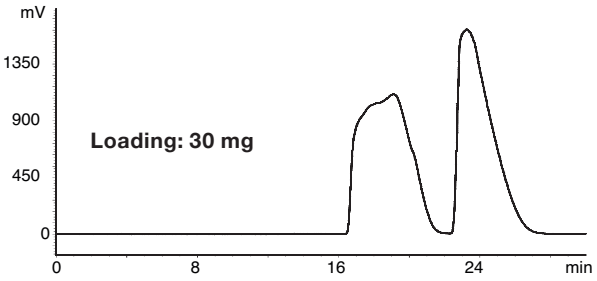
Analytical
5 µm, 250 x 4.6 mm ID
at 0.5 mL/min
linear velocity: 0.5 mm/s

x 18.9

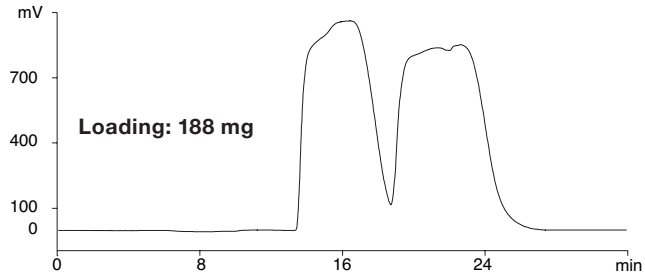


Semi-preparative
5 µm, 250 x 20 mm ID
at 9.5 mL/min
linear velocity: 0.5 mm/s

x 6.25



Preparative
10 µm, 250 x 50 mm ID
at 59 mL/min
linear velocity: 0.5 mm/s



Chiral stationary phase: CHIRAL ART Cellulose-SB
Eluent: *n*-hexane/2-propanol/diethylamine (80/20/0.1)
Detection: UV at 237 nm
Temperature: ambient

	Analytical 250 x 4.6 mm ID		YMC-Actus Semi-preparative 250 x 20 mm ID		Self-packed DAC Preparative 250 x 50 mm ID	
	1st peak	2nd peak	1st peak	2nd peak	1st peak	2nd peak
Enantiomeric excess	>99.9%ee	99.3%ee	99.9%ee	99.8%ee	99.1%ee	99.3%ee
Recovery	99%	99%	97%	99%	99%	94%
Productivity (mg/h)	3.1	3.3	58.6	62.4	366	390

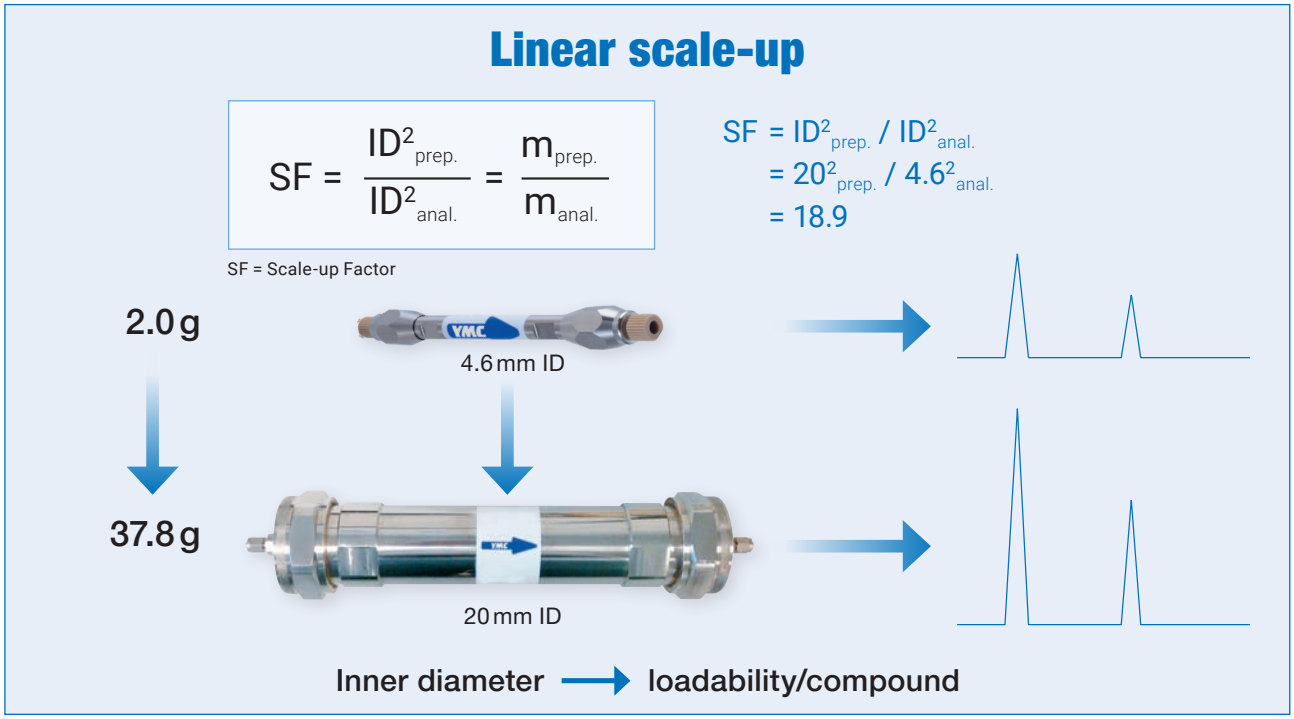
Linear scale-up was performed using the appropriate scaling factors. The Dynamic Axial Compression Column self-packed with CHIRAL ART Cellulose-SB 10 µm can be easily and linearly scaled-up for an even greater purification scale. The final productivity is 366 and 390 mg/h respectively for peaks 1 and 2.

Linear scale-up

In order to simplify the scale-up process the three most important scale-up factors are summarised below.

Scalable factor SF	ID "Linear scale-up"	Column length	Column length and ID "Volume"
	$SF = \frac{ID^2_{prep.}}{ID^2_{anal.}}$	$SF = \frac{L_{prep.}}{L_{anal.}}$	$SF = \frac{ID^2_{prep.}}{ID^2_{anal.}} / \frac{L^2_{prep.}}{L^2_{anal.}}$
Impact	Flow rate Eluent composition	Retention time Cycle time Plate number	Amount of adsorbent

In most cases it is beneficial to start development of a semi-preparative method using an analytical scale column. The analytical separation carried out on a 150 x 4.6 mm ID column has to be scaled up to 150 x 20 mm ID. Therefore the chromatographic parameters such as flow rate and column load have to be adjusted according to the following equation:



Guideline for Sample Load according to column ID

Column ID (mm)	Scale–up factor	Typical loadability (mg)
4.6	1	1–4
10	4.7	5–20
20	18.9	20–80
30	42.5	40–160
50	118	80–350
75	266	270–980
100	472	470–1,900
150	1,060	1,000–4,200

Optimisation of preparative chromatography

The main task for a preparative chromatographer is to find the suitable system. In order to simplify the decisions that have to be made YMC have developed a **"Preparative Column Selection Guide".**

			Lab scale → Production scale								
Column inner diameter [mm ID]			**4.6**	10	20	30	50	100	200	500	1,000
Cross sectional area ratio			**1.0**	4.7	19	42	118	473	1,890	11,800	47,300
Example of calculation	**Flow rate** [ml/min]		**0.5**	2.4	9.5	21	60	235	950	6,000 (6 L)	24,000 (24 L)
			1.0	4.7	19	42	120	470	1,900	12,000 (12 L)	47,000 (47 L)
	Loading [mg]		**5**	25	100	220	600	2,500	10,000	60,000 (60 g)	240,000 (240 g)
Column efficiency, Pressure, Costs HIGH → LOW	**Particle size** [µm]	**5**	+++	+++	+++	+++	++	+	+		
		10	++	+++	+++	+++	+++	++	++	++	++
		10–20	+	++	++	++	+++	+++	+++	++	++
		15–30		+	+	+	++	+++	+++	+++	++
		50~					+	++	++	+++	+++

Flow rate equation (Use the same equation to calculate the sample load)

$$F' = F \times (Dc'/Dc)^2$$

F': Preparative column flow rate [mL/min]
F: Analytical column flow rate [mL/min]
Dc: Analytical column diameter [mm ID]
Dc': Preparative column diameter [mm ID]

+++ Most appropriate, ++ Appropriate, + Depending on purpose

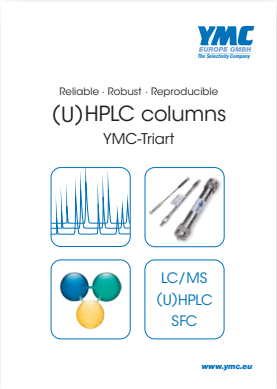
The **"Preparative Column Selection Guide"** will help selection of:

1. the column ID for the required sample loading
2. the particle size for optimum efficiency
3. the column length for the necessary resolution

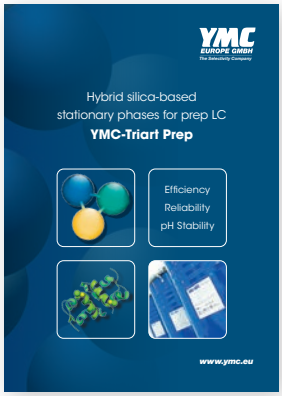
R&D Kits

To minimise the problems that the process of scale-up may introduce, YMC offers YMC R&D kits, which consist of one analytical column and one YMC-Actus column packed with exactly the same packing material from the same production batch. Therefore, no further method development is needed, just a simple linear scale-up calculation.

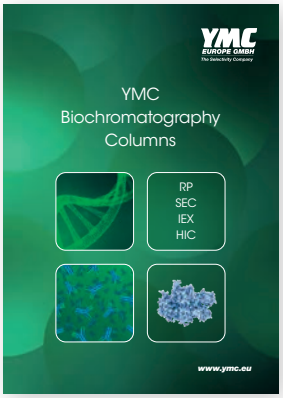
Other Catalogues/Brochures Available



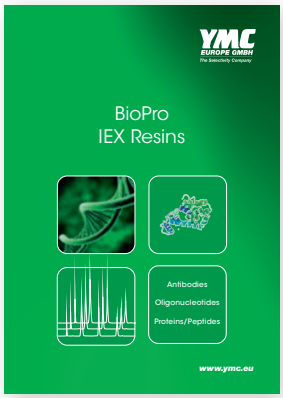
(U)HPLC columns YMC-Triart



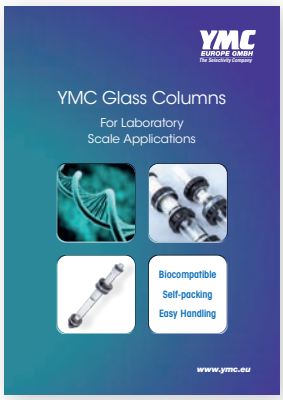
YMC-Triart Prep



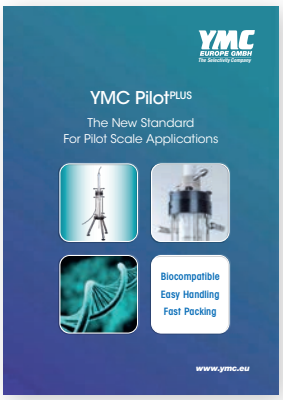
YMC Biochromatography Columns



BioPro IEX Resins



YMC Glass Columns



YMC Pilot^{Plus}

Application data mainly by courtesy of YMC Co., Ltd.

Ordering Information

Product code: **XXXXXXX-**
Phase (code)

Available Phases

Phase	Particle size [µm]	Pore size [nm]	Phase code
YMC-Triart C18	5	12	TA12S05-
YMC-Triart C18 ExRS	5	8	TAR08S05-
YMC-Triart Bio C18	5	30	TA30S05-
YMC-Triart C8	5	12	TO12S05-
YMC-Triart Bio C4	5	30	TB30S05-
YMC-Triart Phenyl	5	12	TPH12S05-
YMC-Triart PFP	5	12	TPF12S05-
YMC-Triart Diol-HILIC	5	12	TDH12S05-
YMC-Pack Pro C18	5	12	AS12S05-
Hydrosphere C18	5	12	HS12S05-
YMC-Pack Pro C18 RS	5	8	RS08S05-
YMC-Pack Pro C8	5	12	OS12S05-
YMC-Pack Pro C4	5	12	BS12S05-
YMC-Pack ODS-A	5	12	AA12S05-
YMC-Pack ODS-AQ	5	12	AQ12S05-
YMCbasic	5	20	BA99S05-
YMC-Triart Prep C18-S	7	12	TAS12S07-
	10	12	TAS12S11-
	15	12	TAS12S16-
	20	12	TAS12S21-
YMC-Triart Prep C8-S	10	12	TOS12S11-
	15	12	TOS12S16-
	20	12	TOS12S21-
YMC-Triart Prep Bio200	10	20	TOB20S11-
YMC-Triart Prep Phenyl-S	10	12	TPS12S11-
YMC Omega	10	–	OMG99S11-
CHIRAL ART Amylose-C Neo	5	–	KBN99S05-
	10	–	KBN99S11-
	20	–	KBN99S21-
CHIRAL ART Cellulose-C	5	–	KCN99S05-
	10	–	KCN99S11-
	20	–	KCN99S21-
CHIRAL ART Amylose-SA	5	–	KSA99S05-
	10	–	KSA99S11-
	20	–	KSA99S21-
CHIRAL ART Cellulose-SB	5	–	KSB99S05-
	10	–	KSB99S11-
	20	–	KSB99S21-
CHIRAL ART Cellulose-SC	5	–	KSC99S05-
	10	–	KSC99S11-
	20	–	KSC99S21-
CHIRAL ART Cellulose-SJ	5	–	KSJ99S05-
	10	–	KSJ99S11-
	20	–	KSJ99S21-
CHIRAL ART Cellulose-SZ	5	–	KSZ99S05-

-XXXXXX
Hardware/Dimensions (code)

Example: YMC-Triart C18 5 µm, 100 x 20 mm ID
1. Phase code: **TA12S05-**
2. Hardware code: **-1020WX**
→ **Product code: TA12S05-1020WX**

Available Dimensions

Column ID [mm]	Column length (mm)					Guard cartridges* with 10 mm length
	50	75	100	150	250	(pack of 2)
20	-0520WX	–	-1020WX	-1520WX	-2520WX	-0120CCN
30	-0530WX	-L530WX	-1030WX	-1530WX	-2530WX	-0130CCN
50	–	–	-1053DX	-1553DX	-2553DX	(-0553DXG)**

*holder required: 20 mm guard column ID: XPGHFSP20ID; 30 mm guard column ID: XPGHFSP30ID
**no holder required for 50 x 50 mm ID guard columns (no cartridge)

YMC-Actus CHIRAL ART columns are available with 100 mm, 150 mm and 250 mm length.

50 mm ID columns are also available with a 1/16" connection (AX) while the standard is a 1/8" connection (DX).

Adapter for 1/8" Connection: DX

Adapter for 1/16" Connection: AX

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