



Preparative Media

Contents

• Economy	272-277
- Economy in analytical separations	272
- Economy in preparative separations	273
- Case study	274-276
- Results	276
- Conclusion	277
• Quality Assurance	278-279
• General Properties	280-283
• Overview Preparative Phases	284-285
• YMC*Gel ProC18	286-287
• YMC*Gel ODS-A	288-289
• YMC*Gel ODS-AQ	290-291
• YMC*Gel Polymer C18	292-293
• YMC*Gel C8 (Octyl)	294-295
• YMCbasic	296-297
• YMC*Gel Ph (Phenyl)	298-299
• YMC*Gel C4 (Butyl)	300-301
• YMC*Gel TMS (C1)	302-303
• YMC Chiral Prep CD	304-307
• YMC Chiral NEA	308-311
• YMC*Gel NH ₂ (Amino)	312-313
• YMC*Gel CN (Cyano)	314-315
• YMC*Gel Diol	316-317
• YMC*Gel SIL (Silica)	318-319

Introduction

Media for Preparative Chromatography

YMC is one of the very few global manufacturers in the market who meet all the demands in preparative scale chromatography. Our ambition is to provide chromatographic solutions for any compound from its discovery throughput scaling-up into production and its quality control in the lab. We therefore offer one of the world's largest portfolios of selectivities, designed to handle even the most demanding separations, as well as meaningful support, chromatographic tools and technical assistance.

Production Capacity

The substantial investment into facilities and staff represent YMC's ongoing commitment towards high quality products and technical support: YMC's state-of-the-art silica production facilities allow large batches of more than 500 kg/Lot. Our large-scale bonding site, opened in 2004, has allowed Lots of over 200 kg of bonded silica to become routine operations. The capacity of YMC's production plants amounts to multiple tons of spherical silica to be produced each year.

Economy

- process scale separations
- key parameter: selectivity
- purification economy



General

The purification process often represents a very cost intensive step in the production of a pharmaceutical product. With the increasing financial pressures in the pharmaceutical industry, the need to optimise this process and achieving an economical and efficient separation process has intensified. In order to reduce long-term costs, more thought and diligence has to be given to preparative method development and process optimisation than in analytical HPLC method development.

Economy in analytical separations

In analytical chromatography, it is most common for samples containing many different compounds with various molecule structures to be analysed in order to get information about the qualitative and quantitative composition of the sample.

The target is a separation of all compounds and a chromatogram showing fully separated, symmetrical and sharp peaks for each component. Cost efficiency of an analytical chromatographic method can be improved by reducing separation time and allowing a higher sample throughput and a lower cost for time and eluents.

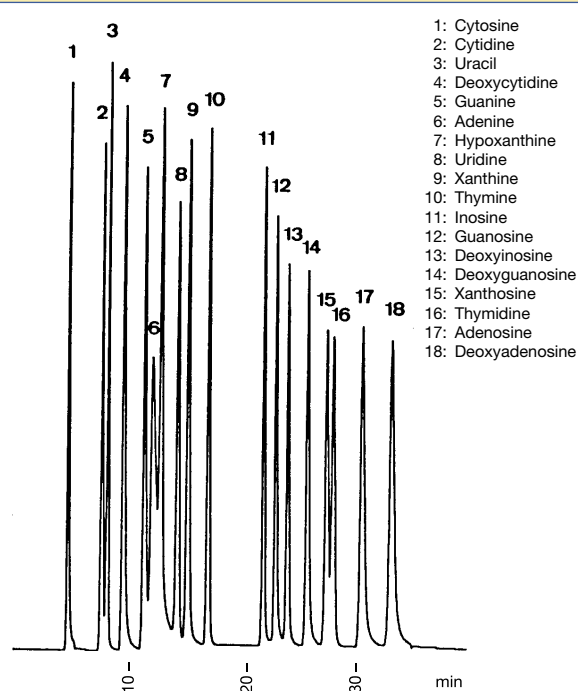
As a result, the most important criteria for an efficient analytical separation is:

1. Selectivity: The basis of any efficient analytical analysis is the appropriate selectivity that separates all relevant compounds of the sample in best time.

2. Resolution: For precise information about the qualitative and quantitative composition of the sample, maximum of resolution is needed.

3. Efficiency: Maximising throughput and minimising time and costs via faster separations times is essential.

Nucleosides



Column: YMC-Pack ODS-AQ (5 μ m, 12 nm) 250 x 4.6 mm i.d.
 Eluent: A = CH₃COOH-CH₃COONH₄ (pH 3.5)
 B = CH₃COOH-CH₃COONH₄ (pH 3.5) / methanol = 90/10 (v/v)
 Gradient: 30% B (0-5 min), 30-100% B (5-13 min, linear),
 100% B (13-40 min)
 Flow: 0.7 ml/min
 Detection: UV at 260 nm
 Temperature: 30 °C

Source: Courtesy of YMC Co., Ltd.

Economy

Economy in preparative separations

In preparative chromatography, however, the objective is not to produce a high-resolution chromatogram but to isolate a maximum quantity of product of the defined purity at the lowest cost within the shortest time. To achieve this, it is frequently not necessary to achieve a complete separation of all components contained in the sample, in contrast to analytical separations.

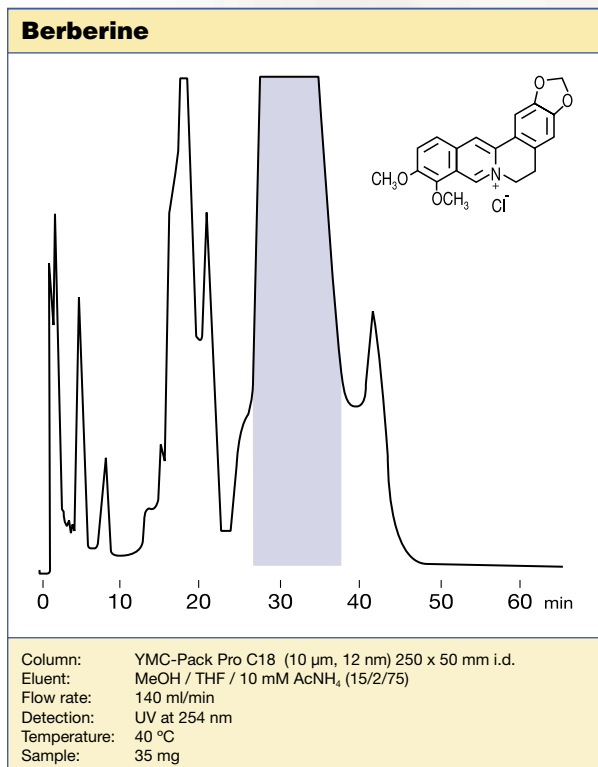
The total costs of a preparative separation process include variable operating costs for solvents, waste processing, column packings, and labour as well as fixed costs for equipment, including the column, pumps, tanks etc. Some of these cost factors are not important in analytical scale, e.g. for solvent costs can become significant for production scale. All these aspects have to be considered carefully when developing a method for a purification process. Therefore, each separation has to be optimised according to its own specific process requirements.

Method development for an economic preparative separation process requires optimisation of:

1. Selectivity: The optimal selectivity, i.e. the ideal combination of the most suitable stationary phase and elution conditions, is the basis for every economic preparative separation. Only the optimal selectivity allows highest productivity: maximum loading capacity and yield in the shortest cycle time.

2. Loading level: Both the operating costs and the fixed costs for downstream processing and equipment can be significantly reduced by maximising the amount of sample loaded per injection: A high loading level saves time, solvent and packing material and allows a high throughput and a higher concentrated product fraction.

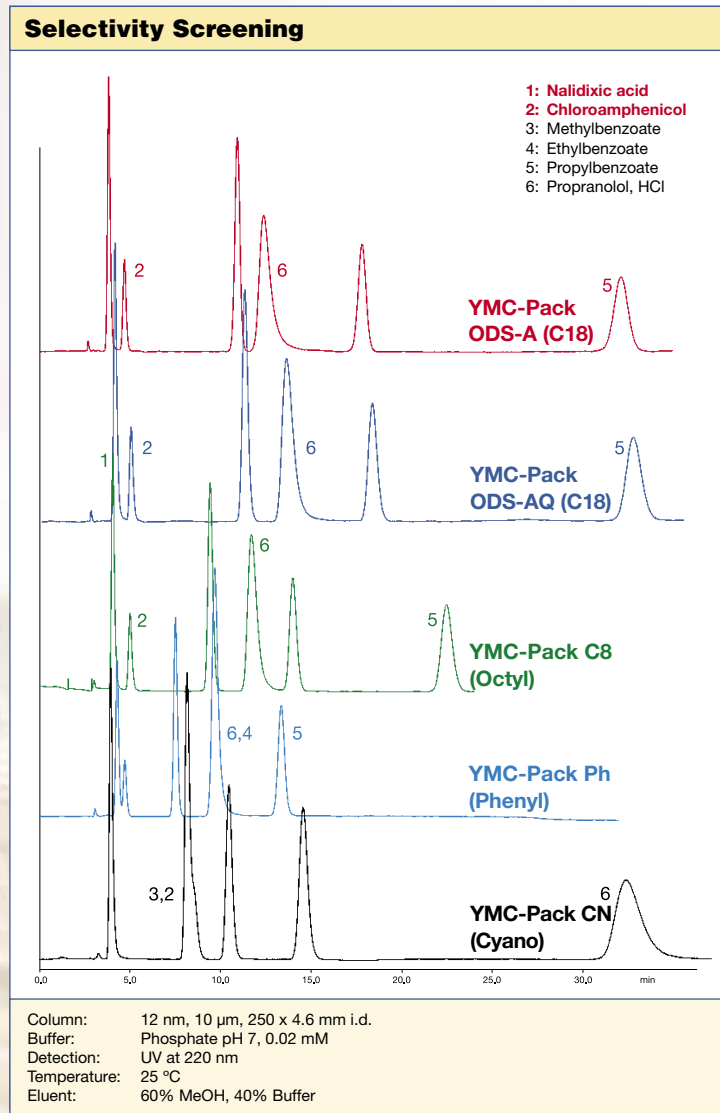
3. Efficiency: Short cycle times enhance throughput and productivity in addition to reducing costs for solvent and labour.



Source: Courtesy of YMC Co., Ltd.

Economy

Case Study



Source: Courtesy of YMC Europe GmbH

Basic essentials for an economic purification are the reproducibility and robustness of the process as well as a long life cycle for the column packing. In addition, the process must be compliant with current environmental policies.

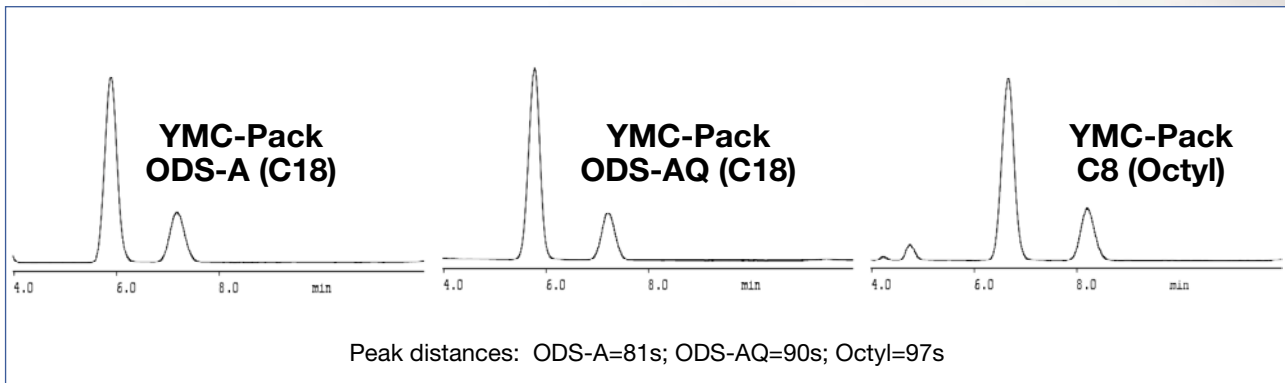
Method development for a preparative separation process starts – just like analytical method development – with the selection of the optimal stationary phase, i.e. the ideal combination of the most suitable stationary phase and elution conditions. The figure on the left illustrates the massive impact of the stationary phase on the elution order, resolution and retention times.

For the purification of nalidixic acid or propranolol the cyano phase shows the optimum performance, with one of the substances eluting in the very front of the chromatogram and the other one as the last peak is the ideal starting point for a preparative separation. Loadability for these compounds is very high and an economical purification can easily be achieved. By overlapping injections, cycle times can be reduced and, if necessary, the retention time of **propranolol (6)** can be shortened further by increasing the amount of methanol in the eluent mixture.

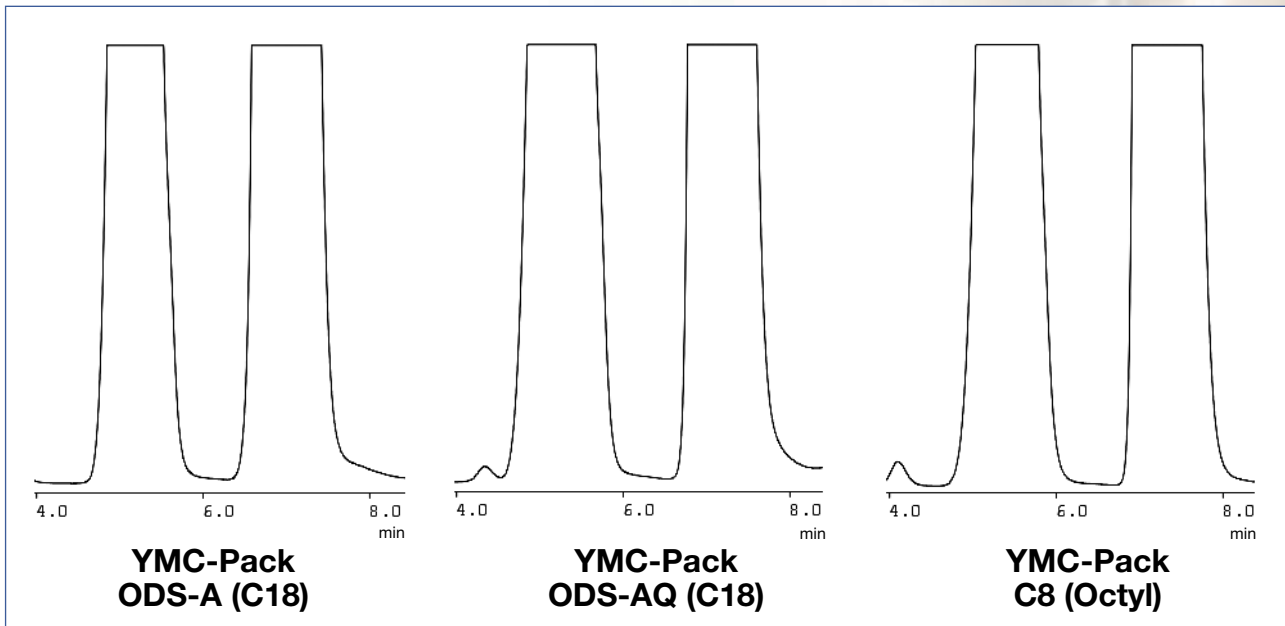
However, if the target molecule is chloroamphenicol, the situation is very different. The cyano phase is no longer the ideal solution because of the co-elution with methylbenzoate.

Instead, three reversed phase materials show potential for a scalable separation. The C8 (Octyl), a C18 (ODS-A) and the slightly more polar aqueous-compatible phase (ODS-AQ) are candidates for a scale up, all of them showing the same critical pair of nalidixic acid and chloroamphenicol. In order to evaluate the best candidate, the eluent mixture was adjusted with a slightly higher amount of water (50% water; 50% MeOH), resulting in a better resolution of the peaks in the beginning of the chromatogram (as shown below).

Economy



As a volume overload study shows, the C8 phase (Octyl) seems to be the best phase. This can be validated by the touching band method. A baseline separation is achieved at 100 μ l at a concentration of 6.5 mg/ml for the octyl material, whereas the other possibilities, ODS-A and ODS-AQ, display baseline resolution at 95 μ l. See figure below:

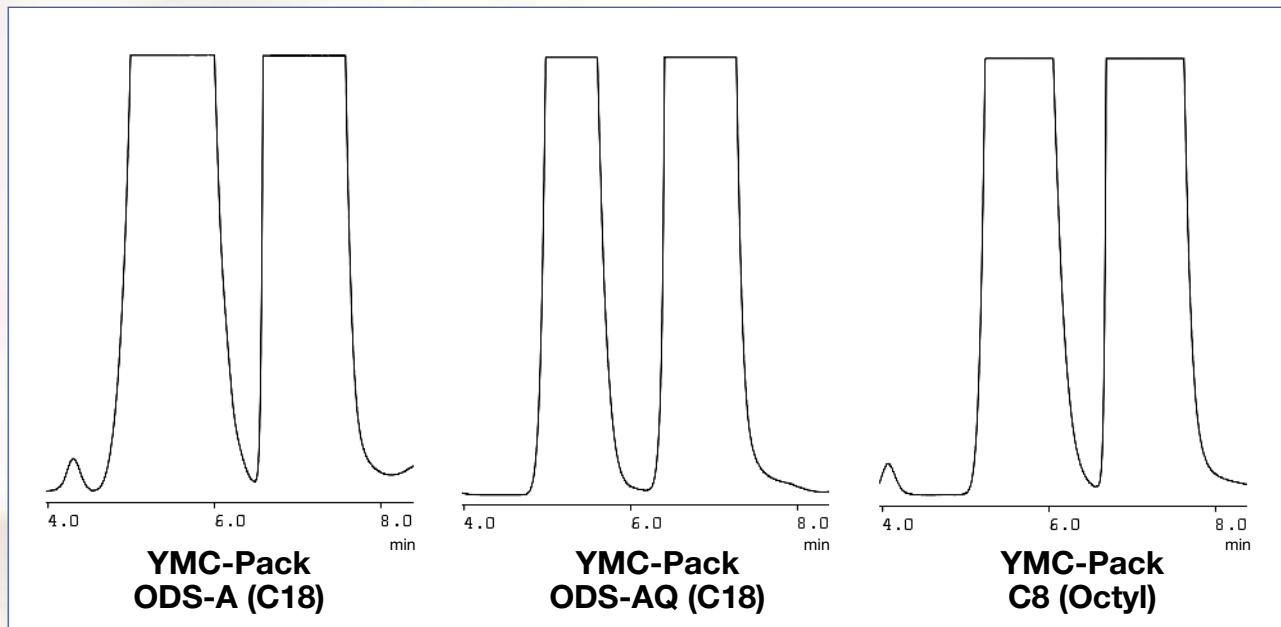


Source: Courtesy of YMC Europe GmbH

Column: 12 nm, 10 μ m, 250 x 4.6 mm i.d.
 Standard concentration: Nalidixic acid: 0.45 mg/ml; Chloroamphenicol: 6.5 mg/ml
 Injection volume: ODS-A: 95 μ l; ODS-AQ: 95 μ l; Octyl (C8): 100 μ l

Economy

A subsequent concentration overload study further underlines the better loadability of the octyl phase. Using the touching band method again this material shows a loadability of 50 μl at a concentration of 38.5 mg/ml chloroamphenicol. The two C18 phases, ODS-A and ODS-AQ, only allow 30 to 35 μl of a standard solution of this concentration for the same resolution. See figure below:



Source: Courtesy of YMC Europe GmbH

Column: 12 nm, 10 μm , 250 x 4.6 mm i.d.

Standard concentration: Nalidixic acid: 1.9 mg/ml; Chloroamphenicol: 38.5 mg/ml

Injection volume: ODS-A: 30 μl ; ODS-AQ: 35 μl ; Octyl (C8): 50 μl

Results

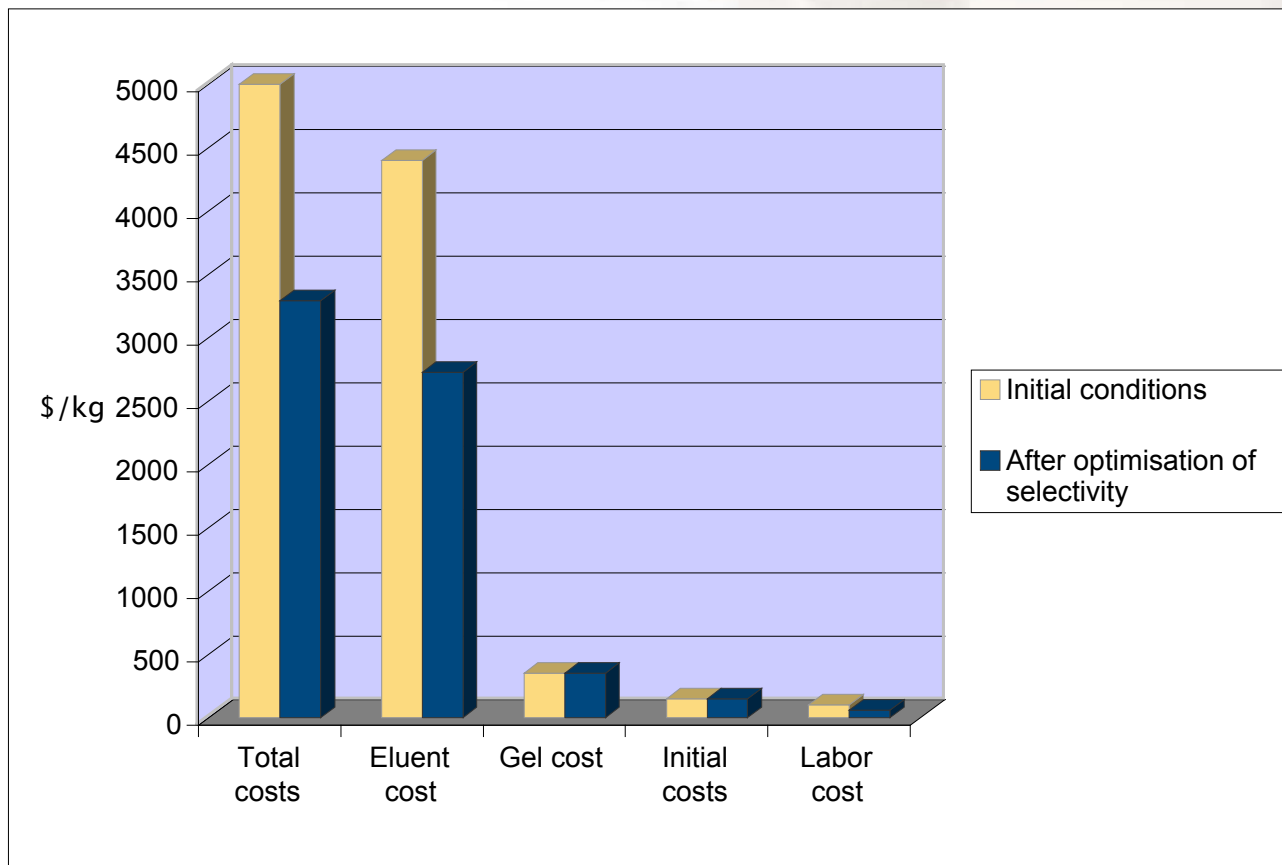
As a result, the loading capacity and solvent consumption strongly depend on the selectivity of the stationary phase as shown in the figure below:

	Specific productivity $SP = \frac{m_{\text{Feed}}}{V_{\text{Column}} \cdot t} \cdot \frac{[\text{g}]}{[\text{l} \cdot \text{h}]}$	Specific solvent consumption $SC = \frac{V_{\text{Eluent}}}{m_{\text{Feed}}} \cdot \frac{[\text{l}]}{[\text{g}]}$
Octyl (C8)	$SP_{\text{OC}} = 3.355 \frac{\text{g}}{\text{l} \cdot \text{h}}$	$SC_{\text{OC}} = 4.3 \frac{\text{l}}{\text{g}}$
ODS-AQ (C18)	$SP_{\text{AQ}} = 2.27 \frac{\text{g}}{\text{l} \cdot \text{h}}$	$SC_{\text{AQ}} = 6.4 \frac{\text{l}}{\text{g}}$
ODS-A (C18)	$SP_{\text{AA}} = 2.085 \frac{\text{g}}{\text{l} \cdot \text{h}}$	$SC_{\text{AA}} = 6.9 \frac{\text{l}}{\text{g}}$

Economy

Conclusion

Using the optimal phase, in this case the Octyl (C8) material, provides about 32-38% higher productivity and saves 2.6 l/g solvent.



In a previous study¹⁾ we were able to show that the costs for eluents are the most important expense factor in purification processes. The costs for eluents account for as much as 88% of the total costs of a separation process. For a product with an estimated total purification cost of 5000 \$/kg this would mean eluent costs of 4400 \$/kg.

Simply by choosing the optimal selectivity these costs can be reduced to 2728 \$/kg a saving of more than a third of the total purification costs, namely 1672 \$/kg!

In addition, cycle times can be optimised (most often reduced) by varying the strength of the mobile phase. The reduction of the effective duration of a separation cycle results in an increase of production rate and a decrease in solvent consumption and labour costs. Switching to isocratic rather than gradient conditions avoids long equilibration times between runs and reduces costs for equipment.

The throughput per run can be optimised by maximising the amount of sample loaded per injection. Loadability directly affects process economics: A high loading level decreases costs for work, solvent and packing material as more product per run can be purified. It also results in a more concentrated product fraction, which can reduce costs for downstream processing and equipment.

Sometimes process efficiency can be improved further by modifying the packing material, for example by customising the carbon content, pore size or endcapping.

YMC provides multi-ton capacity for the production of silica based materials with a wide range of selectivities, all fully scalable, to allow an economic solution for virtually any separation process.

¹⁾ K. Morishita, Y. Yamada, M. Omote, N. Kuriyama: "Development of an effective purification method for peptides and proteins using silica gel based reversed phase packing material", YMC Co.Ltd, 2006

Quality Assurance

- **particle size and distribution**
- **pore size and distribution**
- **surface area**
- **pore volume**
- **pH and metal content**



YMC's Quality Assurance

YMC has more than 25 years experience in manufacturing high quality, bonded phases. During these years, YMC has built its reputation on the supply of consistently high quality, highly reproducible HPLC media and columns. To maintain this high level of quality, all YMC products must pass stringent internal performance criteria at every stage of manufacture. These rigorous quality control procedures and tight production specifications guarantee consistency in silica purity, particle size, pore size, bonding, endcapping and performance.

Quality control of the silica supports

The rigorous quality control procedure set by YMC starts with the YMC*Gel silica supports. The silica support is tested against demanding specifications, which include particle size and distribution, pore size and distribution, surface area, pore volume, pH and metal content, etc.. Only when the bulk silica satisfies the strict criteria for each parameter can the Lot be allowed to proceed to bonding.

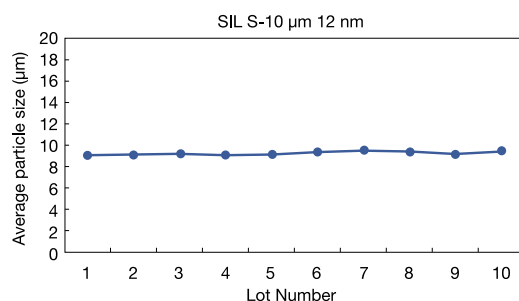


Fig. 1: 10 batches of YMC*Gel SIL S-10 μm 12 nm with respect to average particle size

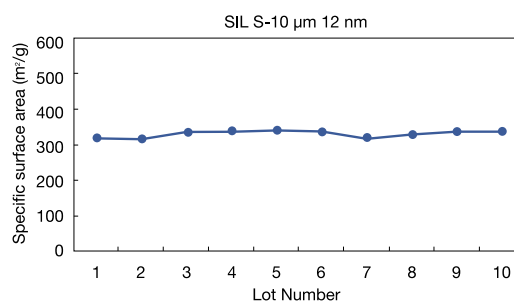


Fig. 2: 10 batches of YMC*Gel SIL S-10 μm 12 nm with respect to specific surface area

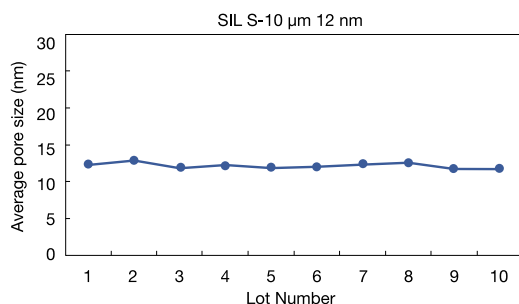


Fig. 3: 10 batches of YMC*Gel SIL S-10 μm 12 nm with respect to average pore size

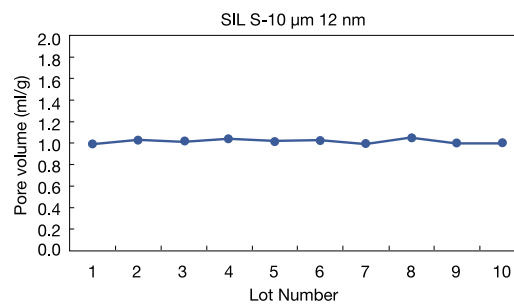


Fig. 4: 10 batches of YMC*Gel SIL S-10 μm 12 nm with respect to pore volume

Quality Assurance

Quality control of the bonded media

YMC's rigorous quality control is reflected in the reproducible separations obtained by the chromatographer. Every bonded lot is evaluated for reproducibility to ensure consistent performance with chromatographic tests for:

- hydrophobicity
- performance with acidic compounds
- performance with basic compounds
- performance with coordination compounds

Only materials which meet YMC's stringent quality standards are given a YMC[®]Gel bonding Lot number and are accepted or column packing. All test data on the unbonded silica and the bonded product is retained for further reference.

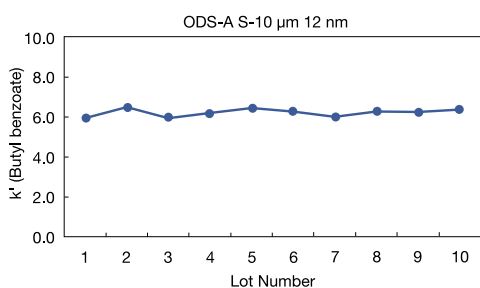


Fig. 5: Batch to batch reproducibility of YMC[®]Gel ODS-A S-10 μ m 12 nm with respect to hydrophobicity

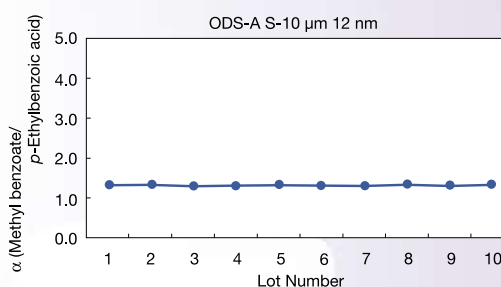


Fig. 6: Batch to batch reproducibility of YMC[®]Gel ODS-A S-10 μ m 12 nm with respect to acidic compounds

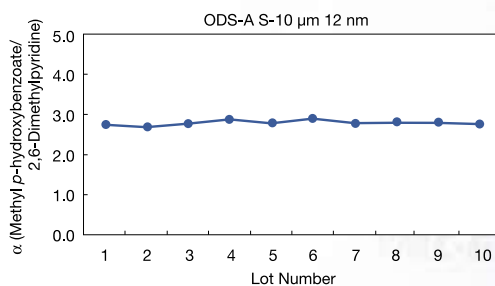
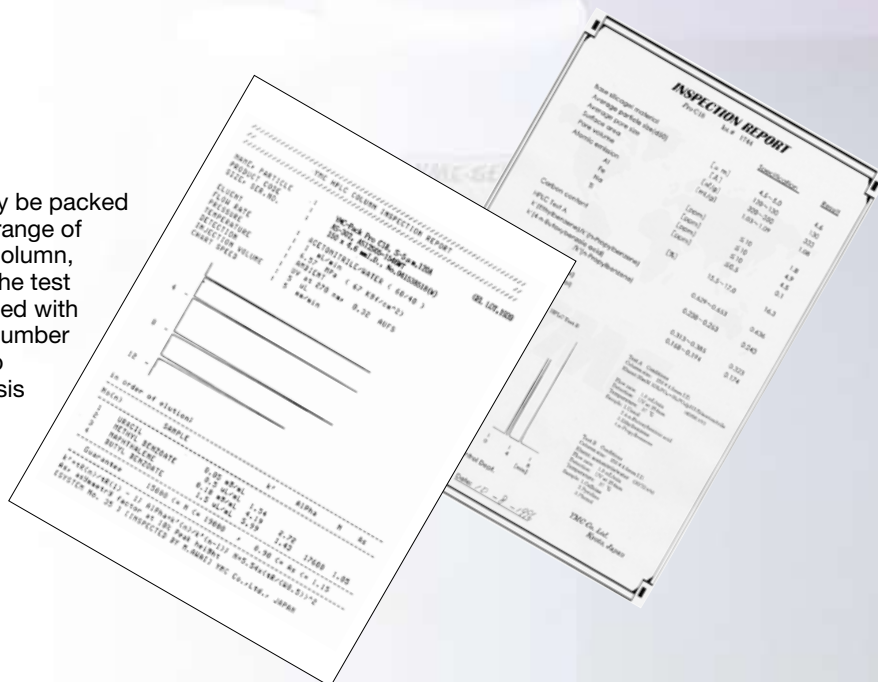


Fig. 7: Batch to batch reproducibility of YMC[®]Gel ODS-A S-10 μ m 12 nm with respect to basic compounds

Final product evaluation

Once the bonded media is accepted, it may be packed into columns. Each column is subject to a range of tests which indicates the efficiency of the column, retention characteristics and symmetry of the test peak. Test chromatograms which are shipped with every column indicate the column's serial number and the gel (bonding) Lot. YMC can refer to this information and the certificate of analysis data in our production files to answer any questions you may have about column performance with your unique sample.



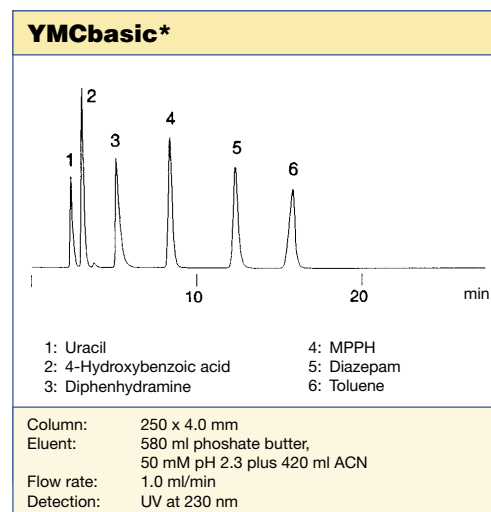
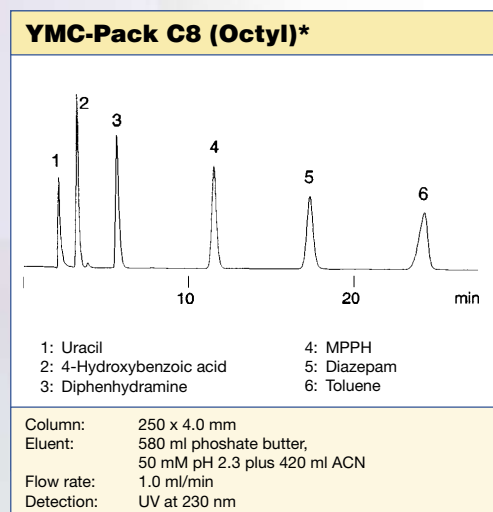
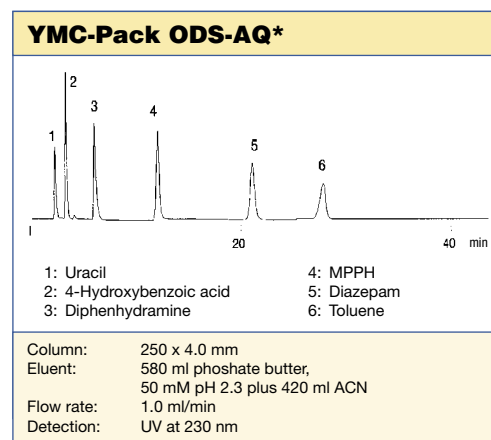
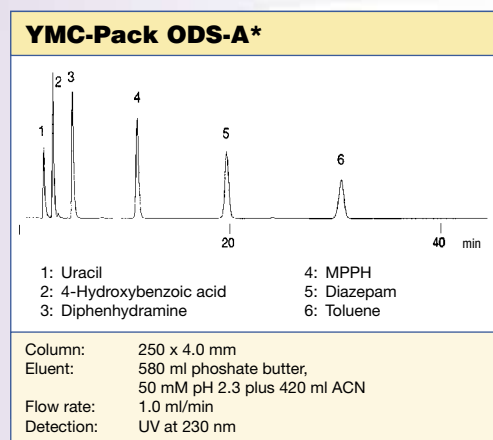
General Properties

Selectivity choice

The basis for every successful separation is the selection of the appropriate stationary phase. YMC offers one of the world's largest portfolios of selectivities, designed to handle even the most difficult and demanding separations.

With the choice of more than 16 preparative selectivities YMC is able to solve virtually any separation need. Many of these stationary phases are fully scalable and often available in a wide range of pore sizes from 6 to 100 nm and particle sizes from 2 to 150 μm . In addition to that, most YMC products can be further customised in terms of optimised pore size, endcapping and/or carbon content to allow maximum efficiency for individual separations.

The retention characteristics of YMC's most popular preparative selectivities are shown in the chromatograms below. Conditions were selected to simulate a broad application range on both basic and acidic compounds.



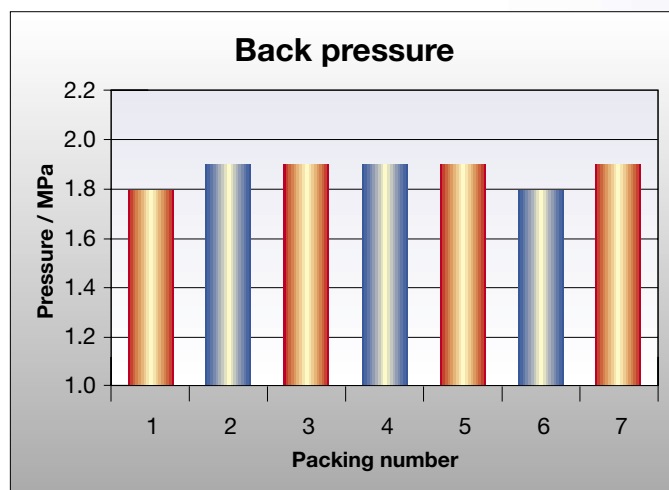
* Source: Courtesy of YMC Co., Ltd.

General Properties

High Performance Silica Supports

YMC spherical media has high mechanical strength for long column life combined with excellent performance. Spherical particles with a narrow particle size distribution pack more uniformly than “spheroidal” or irregular supports and produce only a low pressure drop. The greater mechanical stability of the column bed eliminates premature voiding. With the use of DAC-systems the material may be packed and repacked several times.

In a test procedure using repeated packing and unpacking, YMC*Gel packings show high mechanical strength (see below).



Source: Courtesy of YMC Co., Ltd.

Packing and test conditions:

Packing material:
YMC*Gel ODS A, 15 μm , 12 nm (AA12S16)
Column:
Dynamic Axial Compression column
Inner diameter: 50 mm
Bed length: 200 mm
Packing pressure: 6.4 MPa (= 64 bar)
Eluents: methanol / water (85/15)
Flow rate: 150 ml/min.

Change of back pressure following repeated packing.

High Surface Area

YMC spherical silica supports are completely porous, providing a very high surface area for greater retention and increased resolution. In preparative applications, a high surface area also means greater sample loading and hence better throughput. High sample loading, excellent resolution and long column life combine to provide maximum productivity and economy in preparative separations.

pore size (nm)	YMC*Gel (m^2/g)
6	650
8	450
12	330
20	175
30	100

Comparison of surface areas

State-of-the-Art Bonding and Endcapping

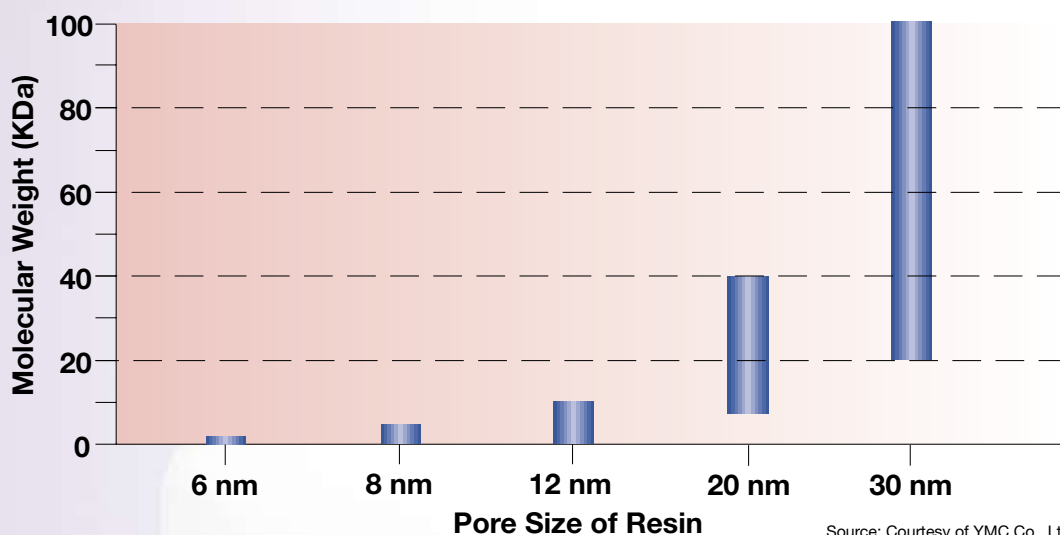
Silica supports are the foundation of most advanced HPLC media, enabling these phases to tolerate the high pressures of modern HPLC. When a silica particle is bonded, “residual silanols” (unbonded surface silanol sites: $-\text{SiOH}$) can interact with polar samples and eluents. Whilst these interactions are desirable with some samples, with basic samples and aqueous eluents, however, residual silanols can cause problems with peak symmetry and shorten column life. “Endcapping” is a process by which residual silanols are bonded to minimise interaction with solute molecules. The nature and completeness of the endcapping process greatly influence the performance and quality of an HPLC column and, ultimately, the separation.

YMC has devoted years of bonding and endcapping research to its line of stationary phases. YMC combines this expertise with high-surface silica supports to produce phases with a combination of selectivity, efficiency and durability available only from YMC.

General Properties

Impact of Pore-Size Differences

YMC[®]Gel is available in a variety of different pore sizes. Pore sizes are usually matched to sample molecule sizes. Pore sizes can also be used to adjust ligand density and hence retention characteristics of a bonded phase, since the size of the pores also affects the total media surface area in a packed column.



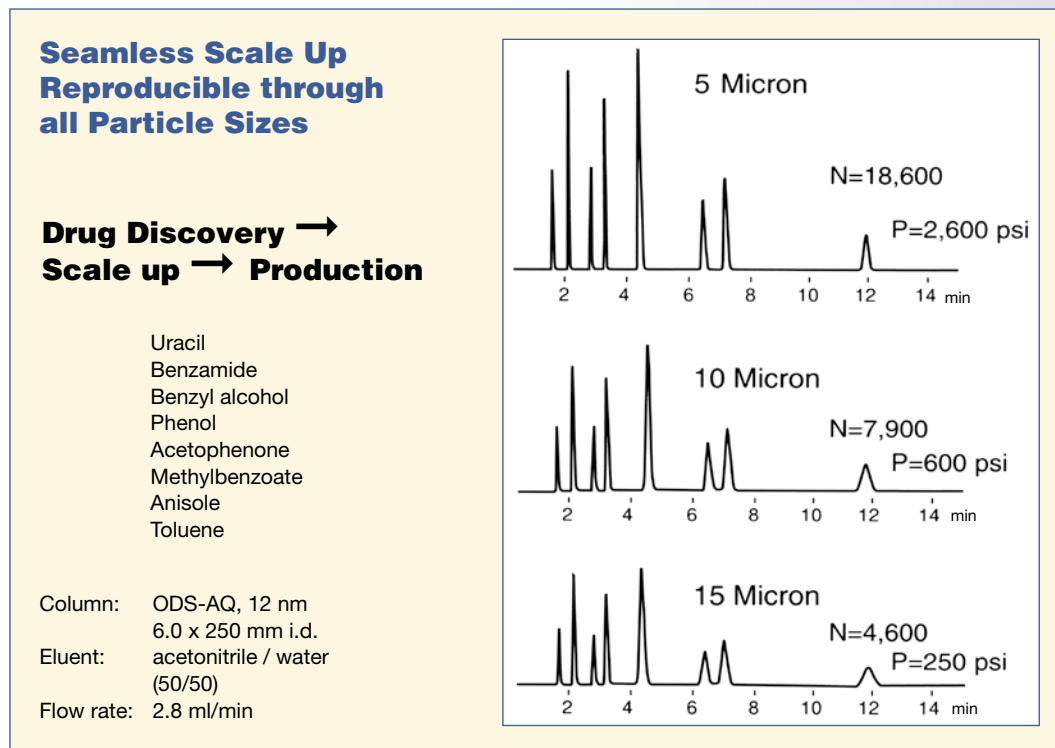
Source: Courtesy of YMC Co., Ltd.

Please note extended molecular weight range when applying SEC.

Pore Size	Recommendation
6 nm	<ul style="list-style-type: none"> • For the separation of small organic molecules in normal phase separations or SEC mode. • Very high surface area and loadability • Available in YMC Silica for normal phase separations and in YMC[®]Gel Diol for normal phase and size exclusion chromatography
8 nm	<ul style="list-style-type: none"> • Available in ODS-AQ for the preparative separation of small hydrophilic compounds • Enhanced surface area for high sample loading
12 nm	<ul style="list-style-type: none"> • Suitable for the majority of separations • For most organic compounds • For peptides less than 20 kDa • Higher surface area and sample loading than 20 nm and 30 nm media
20 nm	<ul style="list-style-type: none"> • For peptides and smaller proteins from 10 kDa to 50 kDa • For bulky organic compounds • Higher surface area and higher sample loading than 30 nm media
30 nm	<ul style="list-style-type: none"> • For large proteins and biomolecules larger than 40 kDa • For organic compounds with excessive retention on smaller pore materials

Scalability

YMC simplifies the process of scaling-up by offering more than 16 fully scalable selectivities with a particle sizes ranging from 2 to 150 μm which maintain the integrity of the separation throughout the entire scale-up.



Source: Courtesy of YMC Co., Ltd.

Large particle media is available in smaller diameter columns (scout columns) to facilitate method development, scale-up and process monitoring. Process scouting kits and scale-up kits are also available.

Availability

YMC provides an extensive selection of more than 16 fully scaleable stationary phases from 2 to 150 μm in various pore sizes and specifications to address virtually any separation need. In addition, YMC can also custom manufacture specific properties, e.g. pore size and/or carbon content, for most of their products during the production process, to provide optimal suitability to individual separations. This unique choice of selectivities meets the highest demand in conventional column separations and also dynamic axial or dynamic radial compression columns and simulated moving bed (SMB) techniques.

Bulk Packing Material

Preparative and process scale YMC bulk packing materials (10 to 150 μm) can be obtained in gram to multi-ton scale quantities. YMC's advanced production facilities are able to manufacture multi-ton quantities of silica per annum, with large batches in excess of 500 kg/lot. YMC's large-scale bonding plants have a capacity of more than 200 kg/lot.

Long Term Supply

In order to meet increasing demands in analytical and preparative chromatography, chromatographers highly depend on a reliable source of supply throughout a validated method. Therefore, YMC will never knowingly change or modify an existing product which has any such customer base. Any product improvements will result in an entirely new YMC product.

World Wide Availability

Pre-packed columns and bulk materials are available worldwide through a dedicated support network headed by YMC operations in Japan, the US and in Europe to ensure facile method transfer between research and production sites across the world.

Stationary Phases

- spherical high purity packing material from 2 µm to 150 µm
- large lot sizes up to more than 200 kg/lot
- lot reservation available on request
- various wide-pore and speciality stationary phases
- packed columns from 0.05 to 200 mm i.d. and above



PRODUCT	CODE	PHASE (silica-based unless noted)	USP CLASS NO.
Pro C18	AS	latest generation C18 using ultrapure silica base (99.999%), with very low residual non-specific interactions	L1
ODS-A	AA	one of YMC's international bestsellers, traditional high performance C18 silica	L1
ODS-AQ	AQ	"hydrophilic" endcapping, for 100% aqueous eluent systems, substantially increased retention of polar compounds	L1
Polymer C18	PC	polymethacrylate-matrix, stable towards shrinking and swelling, wide pH applicability	-
C8 (Octyl)	OC	traditional C8, high coverage monomeric bonding chemistry	L7
YMCbasic	BA	specifically designed for the separation of basic compounds and peptides	L7
Ph (Phenyl)	PH	monomeric bonded phenyl, the π electron interaction gives a separation selectivity different from ODS	L11
C4 (Butyl)	BU	traditional C4, less hydrophobic surface structure than C8 packing material	L26
TMS (C1)	TM	trimethylsilane bonding, excellent hydrolytic stability	L13
Chiral Prep CD ST	ST	cyclodextrin based stationary phase for chiral reversed phase separations	L45
Chiral Prep CD PM	PM	phenyl modified cyclodextrin based phase, for normal phase and reversed phase applications	L45
Chiral Prep NEA	NR	chiral polymer covalently bound to silica, (α -naphthyl)ethylamine as chiral selector, for normal and reversed phase applications (with inverted elution availability)	-
NH ₂ (Amino)	NH	primary amino derivative, high coverage monomeric bonding chemistry, suitable for HILIC	L8
CN (Cyano)	CN	traditional cyano derivative, useful also for SFC applications, suitable for HILIC	L10
Diol	DN	for aqueous GPC or normal phase applications, high recovery for biological material, suitable for HILIC and SFC	-
SIL (Silica)	SL	ultra high purity, high mechanical stability, suitable for HILIC and SFC	L3





Stationary Phases

The basis for every successful separation is the selection of the appropriate stationary phase. YMC provides an extensive selection of scalable spherical stationary phases to satisfy virtually any separation need.

PORE SIZE (nm)	PARTICLE SIZE (µm spherical)	CARBON LOAD (%C)	pH	TYPICAL APPLICATIONS
12	10	16	2.0-8.0	pharmaceuticals, vitamins, amino acids, peptides, PTC-amino acids, basic compounds, general purpose phase
12 20 30	10; 15; 20; 50; 75; 150 10; 15; 20 10; 15; 20	17; 12; 7	2.0-7.5	pharmaceuticals, vitamins, peptides, PTC-amino acids, general purpose phase
8 12 20	10 10; 15; 20; 50 10; 15	15; 14; 10	2.0-7.5	strong polar compounds, pharmaceuticals, antibiotics, peptides and proteins, nucleic acids, amino acids and nucleotides
proprietary	10; 50	C18 = 10%	1.5-13.0	phenols, anilines, peptides in high pH, pharmaceuticals, quaternary amines
12 20 30	10; 15; 20 10; 15; 20 10; 15; 20	10 7 4	2.0-7.5	proteins and peptides, estrogens, general purpose phase
wide pore	10; 15; 20	7	2.0-7.5	basic molecules w/o modifiers, peptides
12	10; 15; 20	9	2.0-7.5	phenols, fullerenes, sweeteners, aromatics
12 20 30	10; 15; 20 10; 15; 20 10; 15; 20	7; 5; 3	2.0-7.5	biological separations, polar compounds, proteins
12	10; 15; 20	4	2.0-7.5	water-soluble vitamins
12	10; 20; 50	-	2.0-7.0	chiral separations, structural isomers
12	10; 20; 50	-	2.0-7.0	chiral separations, structural isomers
30	10	-	2.0-6.5	chiral polar pharmaceutical compounds, chiral alcohols, amines and carboxylic acids, for SFC applications
12	10	3	2.0-7.5	saccharides, nucleotides, water-soluble vitamins
12	10; 15; 20	7	2.0-7.5	proteins, steroids, catechols, for SFC applications
12 20	10; 15 15	-	2.0-7.5	polar natural products, pharmaceuticals
6 12 20 30 100	10; 15; 20; 50; 75; 150 10; 15; 20; 50; 75; 150 10; 15 10; 15 10; 50	-	-	small organic molecules, fat-soluble vitamins, tocopherols



YMC*Gel Pro C18



- based on ultra high purity silica (99.999%)
- extreme narrow specifications
- high lot-to-lot reproducibility
- high column-to-column reproducibility
- ideal for basic, acidic and polar compounds



YMC*Gel Pro C18	Specification
Pore size / nm	12
Particle size / μm	10
Surface area / m^2g^{-1}	340
Carbon content / %	16
pH range	2.0 - 8.0
Metal content	(Randomly selected lot, 10 μm particle size)
Al / ppm	0.3
Fe / ppm	1.6
Na / ppm	1.0
Ti / ppm	0.1

Properties

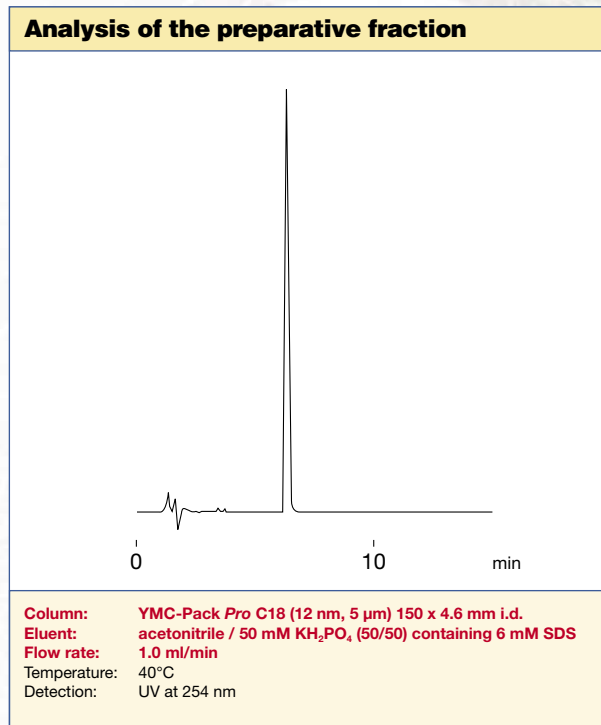
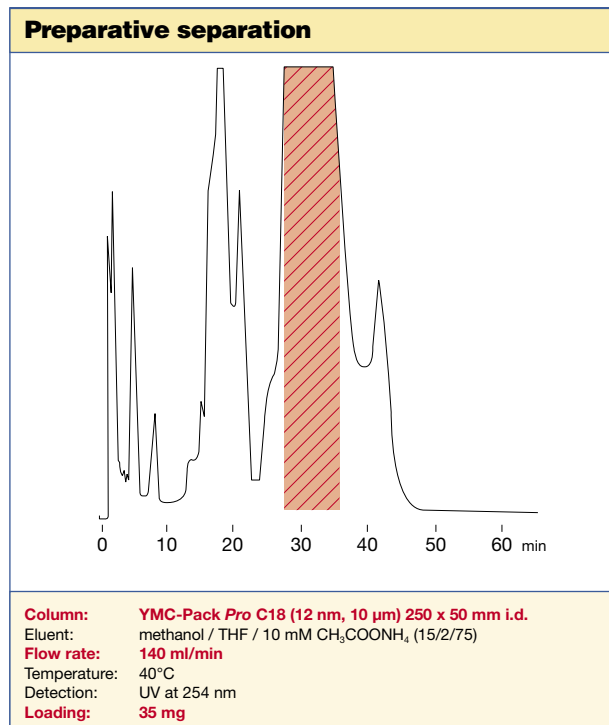
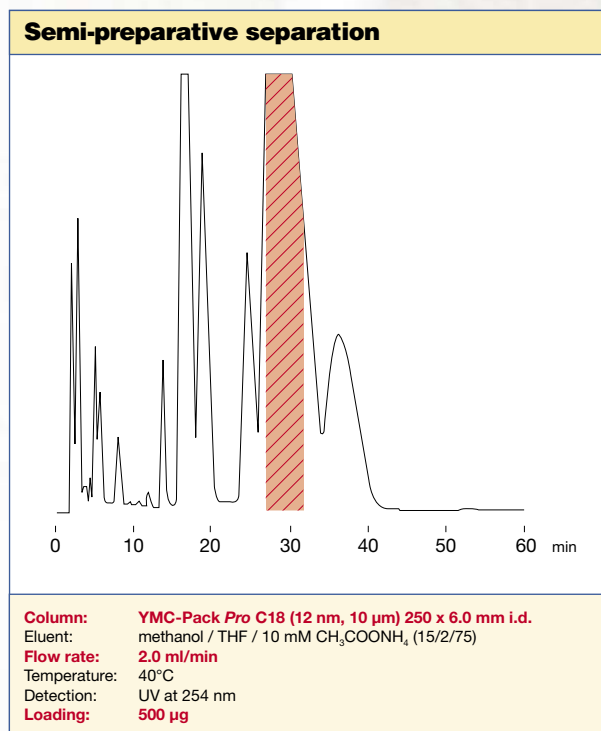
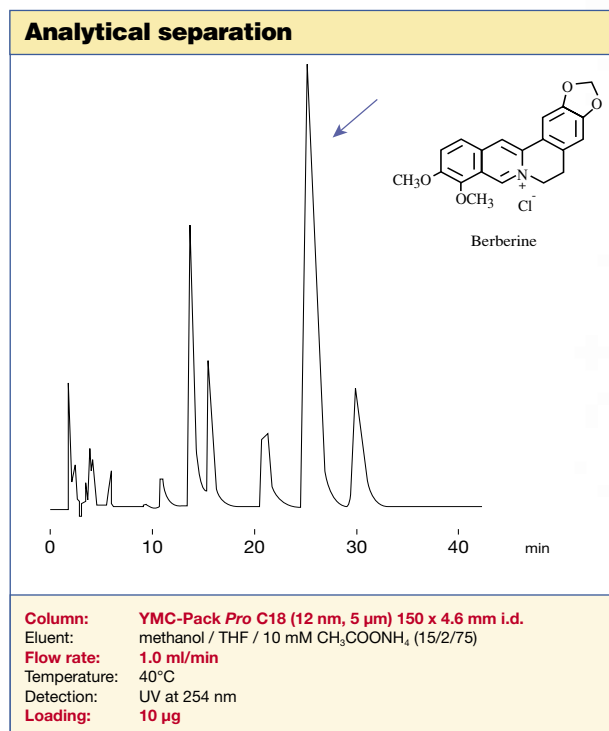
YMC*Gel Pro C18 is based on YMC's ultra high purity silica support, which is used as the basis for the ProFamily of analytical phases, in order to suppress complexation reactions with metal impurities or non-specific interactions with acidic silanol groups.

Due to a proprietary endcapping process specially designed for this type of silica, YMC*Gel Pro C18 is ideally suited for the separation of acidic, basic and neutral molecules. The inertness of the silica makes it an excellent choice for the separation of drugs or metabolites, compounds that are susceptible to polar interactions with residual silanol groups and metal impurities as demonstrated in the following comparison (see next page). This extremely basic substance was selected to demonstrate the very good performance of YMC*Gel Pro C18 for the separation which gives the peak performance that cannot be achieved with classical materials.



YMC*Gel Pro C18

Isolation of berberine



Ordering Information

Pore Size (nm)	Particle Size (µm)	Product Code
12	10	AS12S11

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel ODS-A



- fully endcapped C18 material
- classic “workhorse” phase
- highly versatile ODS phase
- for polar to moderately nonpolar pharmaceuticals, organic chemicals, biologicals and natural products



YMC*Gel ODS-A	Specification		
Pore size / nm	12	20	30
Particle size / μm	10; 15; 20; 50; 75; 150	10; 15; 20*	10; 15; 20*
Surface area / m^2g^{-1}	330	175	100
Carbon Content / %	17	12	7
Recommended pH range	2.0 - 7.5	2.0 - 7.5	2.0 - 7.5

* on request

General

YMC*Gel ODS-A, YMC's classic reversed phase packing material, is renowned worldwide because of its unique performance and reproducibility. This fully scalable C18 phase is used successfully for validated analytical HPLC as well as for large-scale preparative purification processes. Over the years YMC*Gel ODS-A has proved its worth in numerous pharmaceutical, biochemical and environmental applications as well as in separations in the field of food technology.

Properties

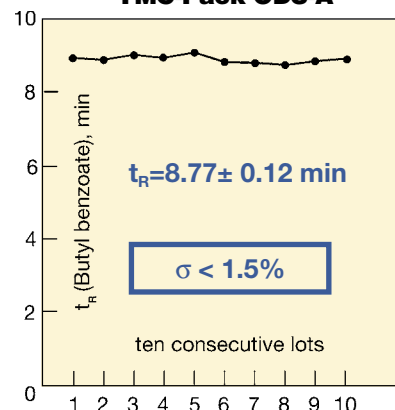
The production of the base silica for YMC*Gel ODS-A, and the subsequent derivatisation process, are both performed in large bulk batches. Exhaustive endcapping reliably reduces the activity of residual silanol groups and minimises non-specific secondary retention. In addition to standard characterisation methods, such as the determination of adsorption isotherms, particle size distribution and carbon content, YMC applies an extensive range of analytical methods to ensure consistent and reproducible selectivity of the reversed phase packings.

The base material used for YMC*Gel ODS-A is YMC's high purity silica. This premium silica contains only very low levels of metal contaminants and so prevents significant tailing of sample molecules that easily form coordination complexes with metal ions on the silica surface.

As coordination functional groups are frequent structural components in pharmaceutical compounds, YMC*Gel ODS-A is an excellent tool for reproducible separations of these compounds without secondary retention or tailing.

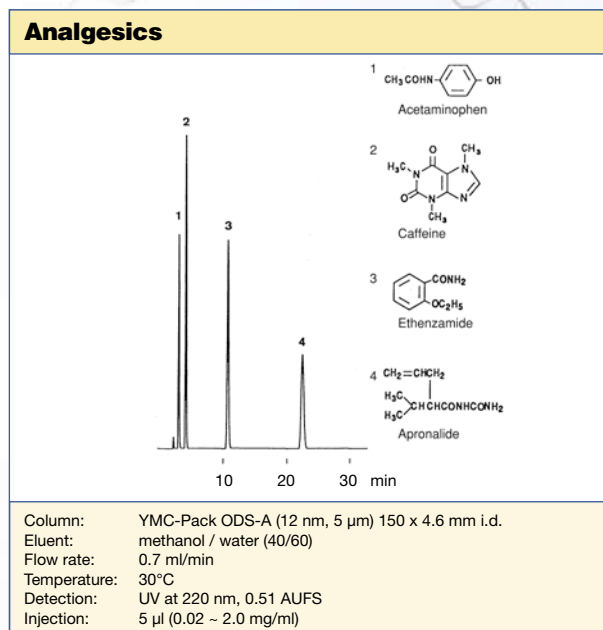
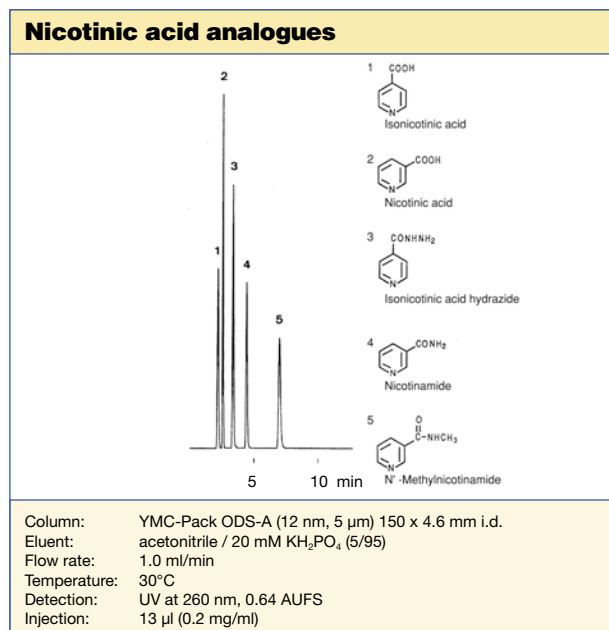
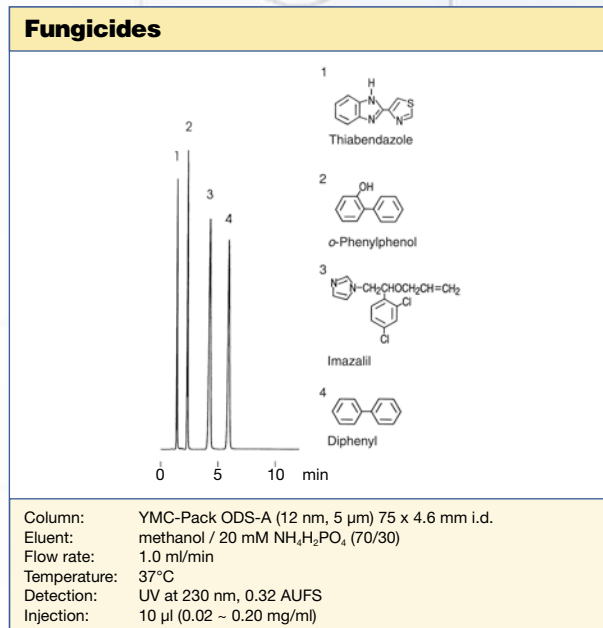
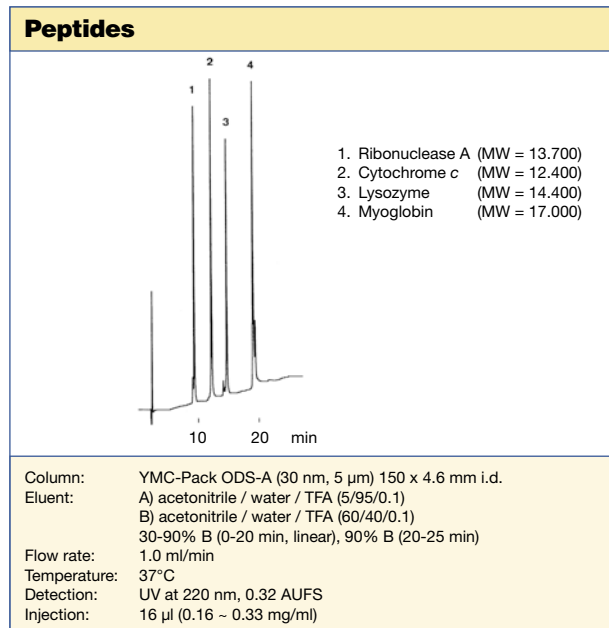
YMC*Gel ODS-A is available in 3, 5, 10, 15, 20, 50, 75 and 150 μm particle sizes. As the selectivity is identical throughout the whole particle size range, this phase is ideal for scale-up from analytical to process scale applications.

Reproducibility of YMC-Pack ODS-A



YMC*Gel ODS-A

Applications



Ordering Information

Pore Size (nm)	Particle Size (µm)	Product Code
12	10	AA12S11
	15	AA12S16
	20	AA12S21
	50	AA12S50
	75	AA12S75
	150	AA12SA5
20	10	AA20S11
	15	AA20S16
	20	AA20S21

Pore Size (nm)	Particle Size (µm)	Product Code
30	10	AA30S11
	15	AA30S16
	20	AA30S21

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel ODS-AQ



- “hydrophilic” C18 phase
- for 100% aqueous applications
- for the separation of highly polar compounds, including metabolites and nucleotides



YMC*Gel ODS-AQ	Specification		
Pore size / nm	8	12	20
Particle size / μm	10	10; 15; 20; 50	10; 15
Surface area / m^2g^{-1}	480	330	175
Carbon Content / %	15	14	10
Recommended pH range	2.0 - 7.5	2.0 - 7.5	2.0 - 7.5

General

YMC*Gel ODS-AQ is a C18 reversed phase silica-based HPLC packing material specifically designed for use in 100% aqueous eluents. As a result of the proprietary derivatisation process, YMC*Gel ODS-AQ exhibits a different selectivity to that of traditional C18 stationary phases. This difference in selectivity of YMC*Gel ODS-AQ can be used to advantage for HPLC separations, which are difficult to achieve with conventional C18 columns.

Properties

The proprietary YMC derivatisation process creates the different selectivity of YMC*Gel ODS-AQ, where:

1. The activity of acidic unreacted silanols is reduced, allowing moderately basic compounds to be eluted with little or no peak tailing.
2. The balanced hydrophilic/lipophilic nature of the YMC*Gel ODS-AQ stationary phase leads to strong retention of polar solutes even in aqueous eluents.

These properties of YMC*Gel ODS-AQ are beneficial for the separation of polar organic compounds, which tend not to be retained or are unresolved when conventional C18 columns are used.

Many conventional ODS packings lose their ability to retain polar compounds in highly aqueous mobile phases as shown on the next page. They appear less lipophilic with densely folded C18 chains. However, in similar mobile phases, YMC*Gel ODS-AQ maintains its brush-like C18 chain structure and its lipophilic properties and provides excellent retention of polar compounds.

Applications

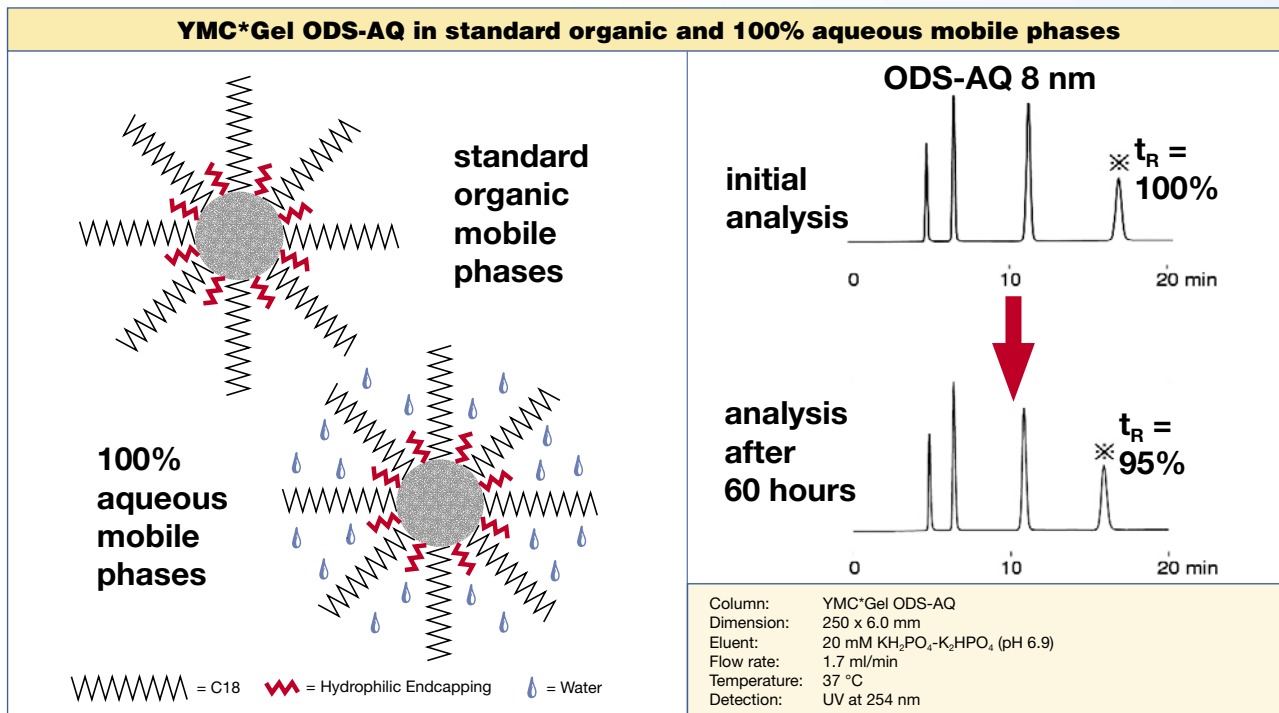
YMC*Gel ODS-AQ is able to resolve compounds with minor differences in polarity from closely related chemical structures. As a result, YMC*Gel ODS-AQ is an excellent tool for the separation of drugs and their corresponding metabolites, pesticides and their degradation products, or peptides and protein digests etc. This capability of “polar recognition” opens up a broad range of application for YMC*Gel ODS-AQ in life sciences and pharmacology.

Genuine linear scale-up from analytical to large scale separations is easily achievable with YMC products such as YMC*Gel ODS-AQ, where particle sizes from 3 to 50 μm are available in large lot sizes up to several hundred kilograms, if needed. This, together with the outstanding selectivity of YMC*Gel ODS-AQ, make it an essential tool to enhance the productivity of large-scale chromatographic processes.

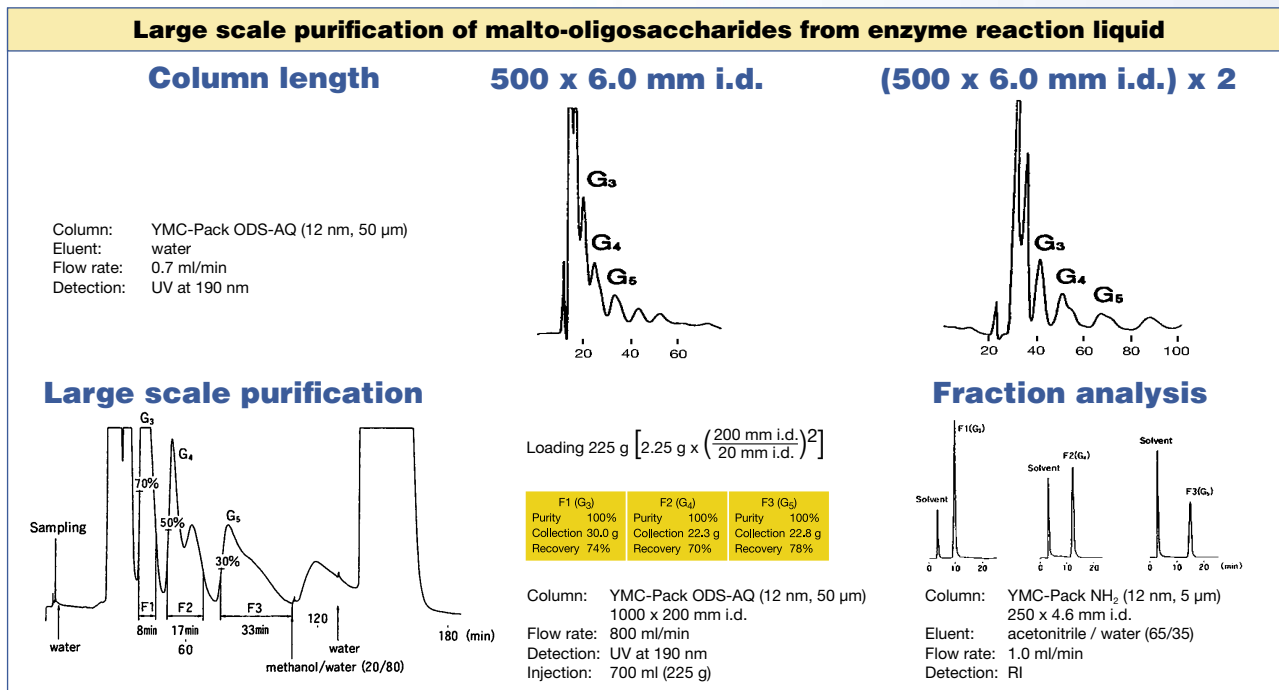


YMC*Gel ODS-AQ

YMC*Gel ODS-AQ in standard organic and 100% aqueous mobile phases



Large scale purification of malto-oligosaccharides from enzyme reaction liquid



Source: Courtesy of YMC Co., Ltd.

Ordering Information

Pore Size (nm)	Particle Size (μm)	Product Code
8	10	AQ08S11
12	10	AQ12S11
	15	AQ12S16
	20	AQ12S21
	50	AQ12S50
20	10	AQ20S11
	15	AQ20S16

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel PolymerC18



- based on hydrophilic polymethacrylate support for performance similar to silica-based C18
- for greater reproducibility methacrylate is functionalised with C18 before polymerisation
- no silanol or metal contaminants
- pH stable from pH 1.5 - 13.0
- compatible with all standard reversed phase solvents



YMC*Gel PolymerC18	Specification
Pore Size / nm	-
Particle Size / μm	10; 50
Surface area / m^2g^{-1}	-
Carbon content / %	C18 = 10%
Recommended pH range	1.5 - 13.0

General

YMC*Gel PolymerC18 is a pure organic packing which provides a broad range of solvent choices and a pH range from 1.5 – 13.0. YMC*Gel PolymerC18 is manufactured from a hydrophilic methacrylate polymer which is cross-linked with C18 ligand-containing reagents. YMC*Gel PolymerC18 offers a maximum application range: A wide variety of compounds such as organic acids, organic amines, peptides, pharmaceuticals and proteins can be separated using YMC*Gel PolymerC18.

Properties

YMC*Gel PolymerC18 is prepared from a hydrophilic methacrylate polymer bonded with a hydrophobic octadecylsilane reagent to make the C18 functionality an integral part of the polymeric structure. PolymerC18 is a three-dimensional polymer matrix, which is not based on a silica gel support. As such, it has no residual silanols or metal impurities to interfere with the separation of basic organic compounds.

The selectivity and retention of YMC*Gel PolymerC18 is similar to that of standard silica-based C18 phases, due to its hydrophobic bonding on a hydrophilic support. Consequently, its selectivity is closer to that of silica-based C18 supports than to styrene/DVB-based supports. It should be noted that interactions between aromatic or conjugated systems and the methacrylate backbone provide slightly greater retention when compared with silica-based C18 columns, whereas highly aliphatic compounds show greater retention on silica-based C18 supports.

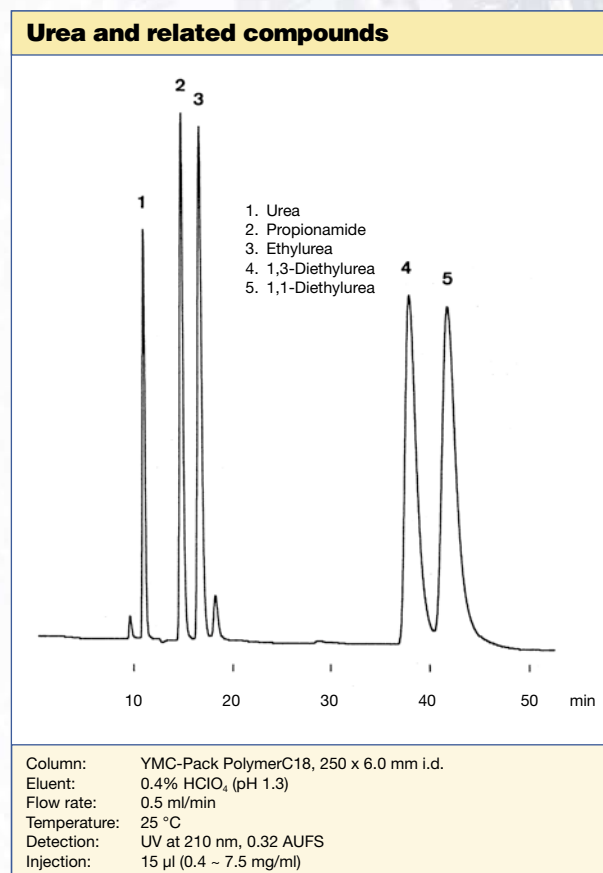
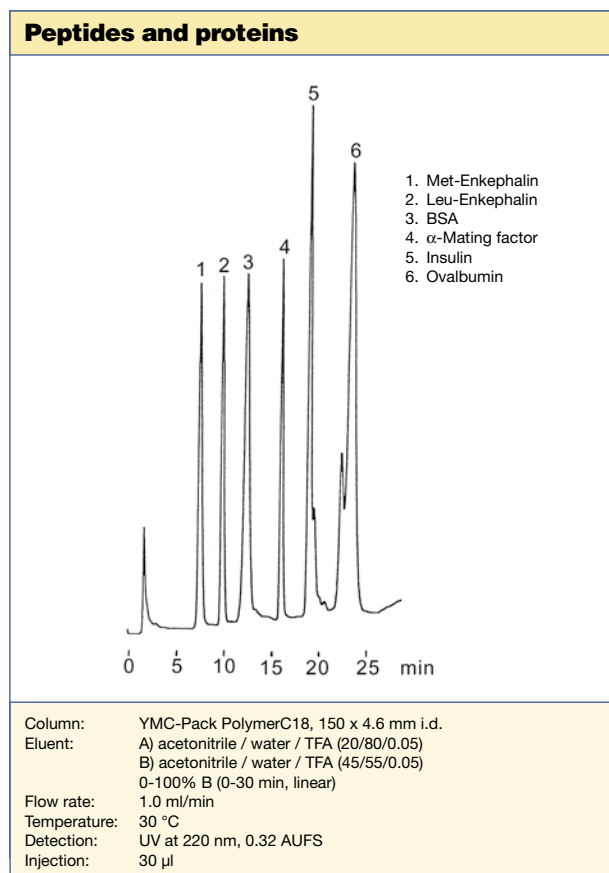
YMC*Gel PolymerC18 is compatible with all common reversed phase eluents such as water, methanol, acetonitrile and THF. Virtually all aqueous buffers and acid modifiers, including TFA and phosphoric acid, as well as base modifiers such as sodium hydroxide and ammonium hydroxide can be used. Since it resists shrinking and swelling, YMC*Gel PolymerC18 can be used with eluents ranging in composition from 100% aqueous to 100% organic component.

In addition, YMC*Gel PolymerC18 can easily be sterilised by flushing with 0.1N sodium hydroxide in 20% acetonitrile/water.



YMC*Gel PolymerC18

Applications



Ordering Information

Particle Size (μ m)	Product Code
10	PC99S11
50	PC99S50

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request.
Contact YMC Europe GmbH for details and ordering information.

YMC*Gel C8 (Octyl)



- alternative phase to C18 with moderate hydrophobicity
- fully endcapped, high coverage monomeric bonded chemistry
- ideal for method development and routine separations
- excellent retention for all types of organic molecules, especially peptides, proteins and pharmaceuticals



YMC*Gel C8 (Octyl)	Specification		
Pore Size / nm	12	20	30
Particle Size / μm	10; 15; 20*	10; 15*; 20*	10; 15*; 20*
Surface area / m^2g^{-1}	330	175	100
Carbon content / %	10	7	4
Recommended pH range	2.0 - 7.5	2.0 - 7.5	2.0 - 7.5

* on request

General

YMC*Gel C8 is one of YMC's most commonly used bonded phases and an excellent alternative to C18 selectivities. Due to its moderate hydrophobicity, YMC*Gel C8 is well suited for the separation of hydrophobic compounds which are too strongly retained on C18 phases or for samples that require greater retention than provided by C4 packings. Compared to C18 phases, retention times of non-polar compounds will be lower on C8 material due to the reduced carbon load.

Properties

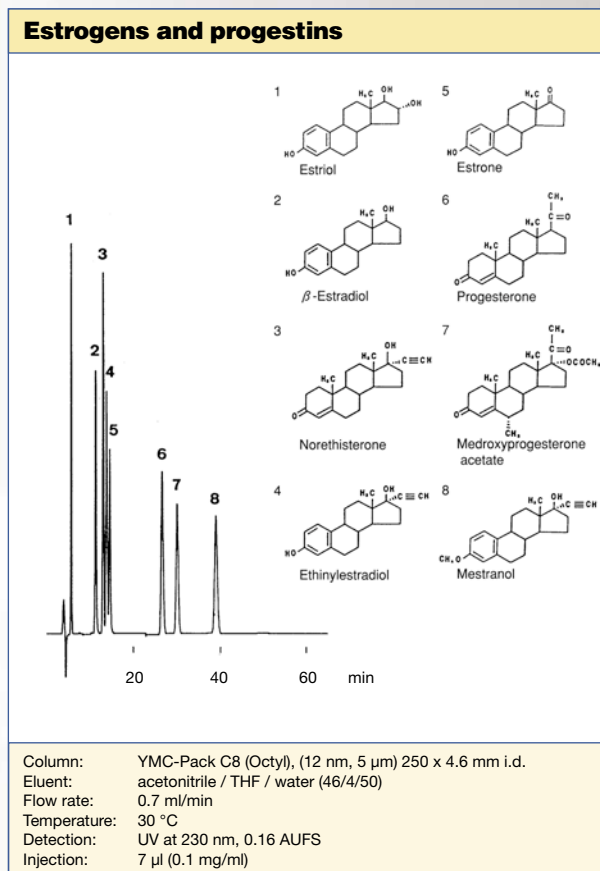
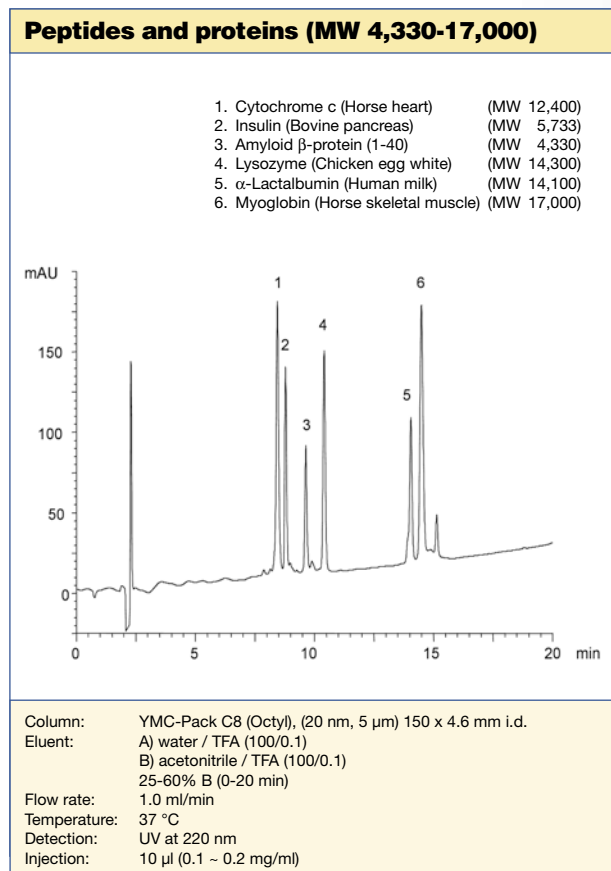
YMC*Gel C8 is prepared by exhaustive bonding of a monomeric octylsilane to YMC's totally spherical and porous silica gel. The functionalised silica is then treated with a thorough endcapping process. This produces a moderate 10% carbon loading on YMC's standard 12 nm pore material.

Available in three porosities, 12, 20 and 30 nm, YMC*Gel C8 packings will separate many classes of compounds including pharmaceuticals, organic chemicals, peptides, proteins and other biological molecules, making it ideal for method development. For optimum yield in preparative applications, choose the smallest pore size that provides adequate retention and resolution. This is because sample loading is generally proportional to surface area. Smaller pore packings provide a greater surface area and hence greater loadability.



YMC*Gel C8 (Octyl)

Applications



Ordering Information

Pore Size (nm)	Particle Size (μ m)	Product Code
12	10	OC12S11
	15	OC12S16
	20	OC12S21
20	10	OC20S11
	15	OC20S16
	20	OC20S21
30	10	OC30S11
	15	OC30S16
	20	OC30S21

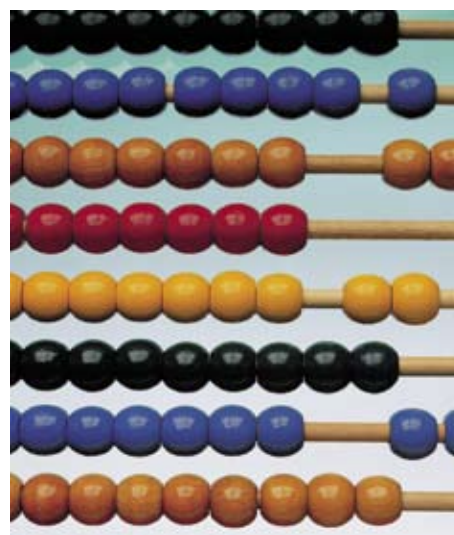
Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMCbasic



- excellent selectivity for peptide separations (MW 5.000 - 20.000)
- superior peak shape
- scalable from analytical to process scale



YMCbasic	Specification
Pore size / nm	wide pore
Particle size / μm	10; 15; 20*
Surface area / m^2g^{-1}	proprietary
Carbon content / %	7
Recommended pH range	2.0 - 7.5

* on request

General

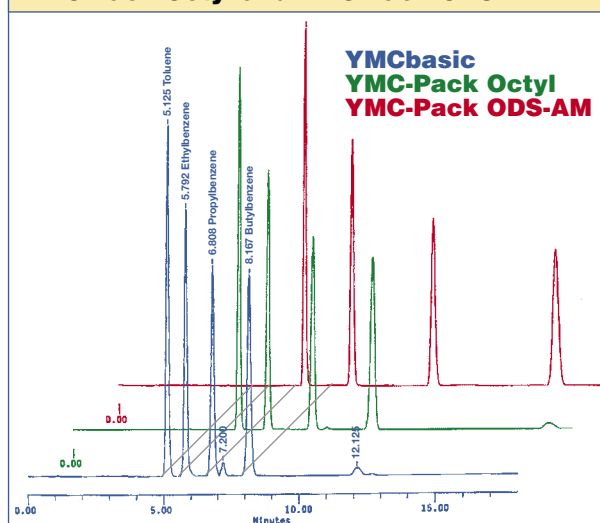
YMC created YMCbasic in 1988 for the separation of basic pharmaceuticals and similar compounds, yet it is still fully up-to-date technology. This bonded phase is prepared by bringing together a support containing neutral silanol groups, which have minimal interactions with acidic and basic compounds, and a novel bonded phase consisting of monomerically bonded alkyl chains. The proprietary derivatization procedure for YMCbasic allows YMC to produce a material with controlled surface coverage, which shows excellent lot-to-lot reproducibility due to the close monitoring both the production of the silica support and the bonding process.

The resulting YMCbasic material shows a different hydrophobicity compared to C8 or C18 phases as shown in the diagram. In addition, it also represents an interesting alternative to short chain selectivities.

Properties

YMCbasic is a phase with true reversed phase characteristics, providing high resolution and excellent peak symmetry for basic compounds without the need for ion pair reagents or amine modifiers (see separation of anilines using acetonitrile/water eluent). Unlike many base-deactivated phases, YMCbasic is also suitable for separation of acidic compounds, showing slight retention of highly polar acid compounds such as maleate. YMCbasic provides an alternative selectivity to conventional C8 and C18 materials, but without peak tailing for basic compounds.

Hydrophobicity of YMCbasic versus YMC-Pack Octyl and YMC-Pack ODS-AM



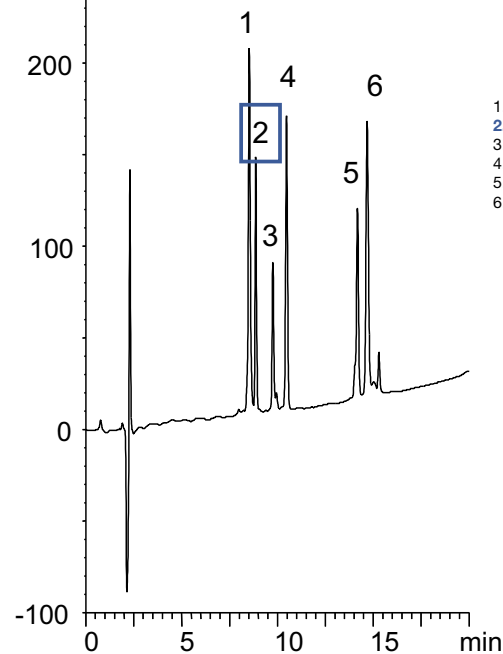
Column: 250 x 4.6 mm
 Eluent: acetonitrile / water (75/25)
 Flow: 1.0 ml/min
 Detection: UV at 254 nm



YMCbasic

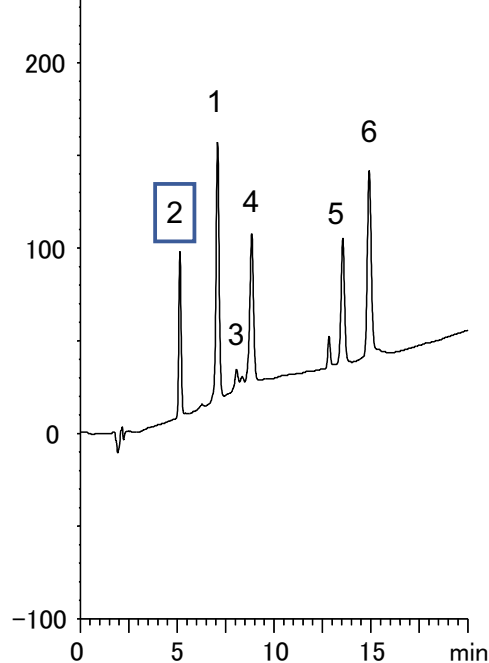
Peptides

Acetonitrile
25-60% B (0-20 min)



1. Cytochrome C (0.2 mg/ml)
2. Insulin(bovine) (0.1 mg/ml)
3. Amyloid β -protein (0.1 mg/ml)
4. Lysozyme (0.1 mg/ml)
5. α -Lactalbumin (0.1 mg/ml)
6. Myoglobin (0.2 mg/ml)

Ethanol
35-65% B (0-20 min)



Column: YMCbasic (5 μ m), 150 x 4.6 mm i.d.
 Eluent: A) water / TFA (100/0.1)
 B) organic solvent / TFA (100/0.1)
 Flow rate: 1.0 ml/min
 Temperature: 37 $^{\circ}$ C
 Detection: UV at 220 nm
 Injection: 10 μ l

Ordering Information

Pore Size (nm)	Particle Size (μ m)	Product Code
wide pore	10	BA99S11
	15	BA99S16
	20	BA99S21

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel Ph (Phenyl)



- fully endcapped, monomeric phenyl phase
- unique selectivity due to π - π interactions
- preferential retention of aromatic compounds
- alternative selectivity to C18 or C4 bonded phases for the analysis of peptides and other biomolecules



YMC*Gel Ph (Phenyl)	Specification
Pore Size / nm	12
Particle Size / μm	10; 15; 20
Surface area / m^2g^{-1}	330
Carbon content / %	9
Recommended pH range	2.0 - 7.5

General

YMC*Gel Ph (Phenyl) is a high density bonded phase (9% carbon load on 12 nm silica) and is fully endcapped. This results in a superior bonded phase with proven performance and exceptional lifetime for a phenyl reversed phase column.

Properties

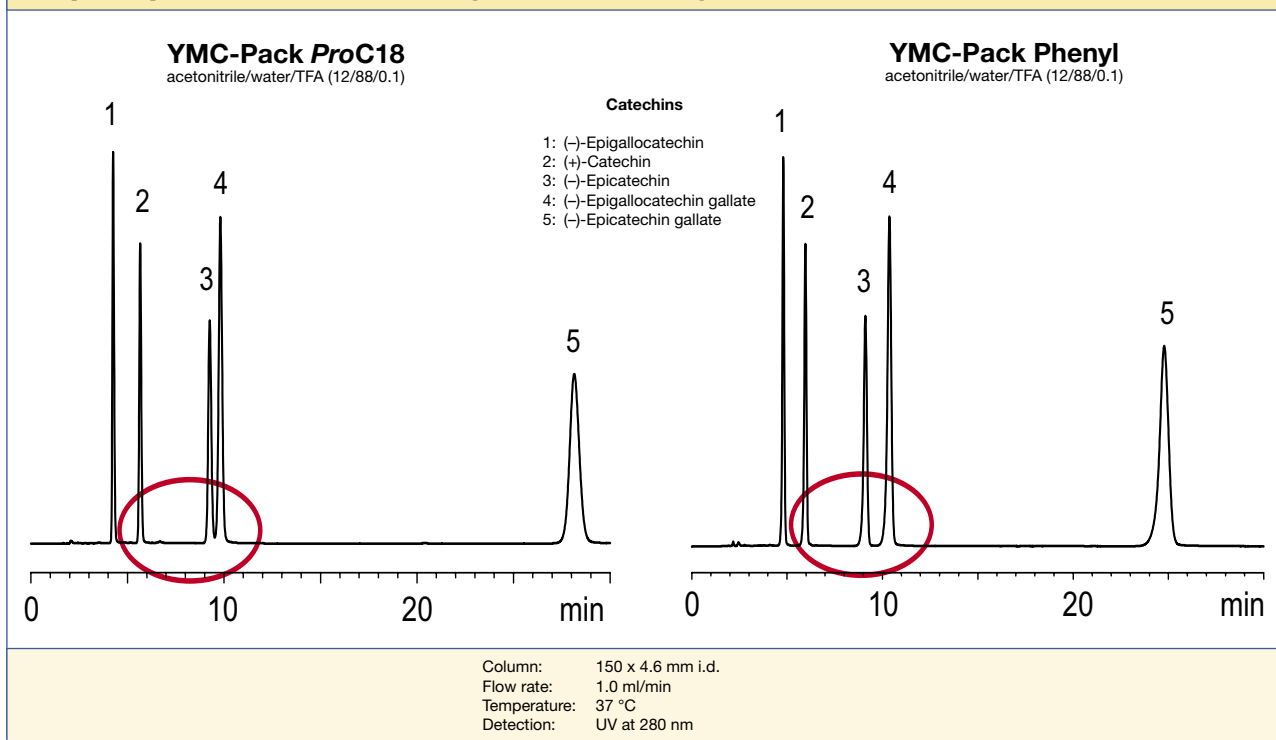
YMC*Gel Ph (Phenyl) provides a unique selectivity when compared to aliphatic straight chain reversed phases such as C18, C8 or C4. The π -electrons of the phenyl groups can interact with aromatic residues of an analyte molecule in addition to hydrophobic interactions to increase retention relative to non-aromatic species.

Phenyl phases are convenient for the separation of aromatic compounds and provide a useful alternative to C18 or C4 phases for the separation of peptides and other biomolecules.



YMC*Gel Ph (Phenyl)

Simple separation conditions using YMC-Pack Phenyl



Ordering Information

Pore Size (nm)	Particle Size (µm)	Product Code
12	10	PH12S11
	15	PH12S16
	20	PH12S21

Packing Size: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request.
Contact YMC Europe GmbH for details and ordering information.

YMC*Gel C4 (Butyl)



- low hydrophobicity phase
- high coverage monomeric bonding
- fully endcapped
- ideally suited for the separation of biomolecules, especially non-polar peptides and proteins



YMC*Gel C4 (Butyl)	Specification		
Pore Size / nm	12	20	30
Particle Size / μm	10; 15; 20*	10; 15; 20*	10; 15; 20*
Surface area / m^2g^{-1}	330	175	100
Carbon content / %	7	5	3
Recommended pH range	2.0 - 7.5	2.0 - 7.5	2.0 - 7.5

* on request

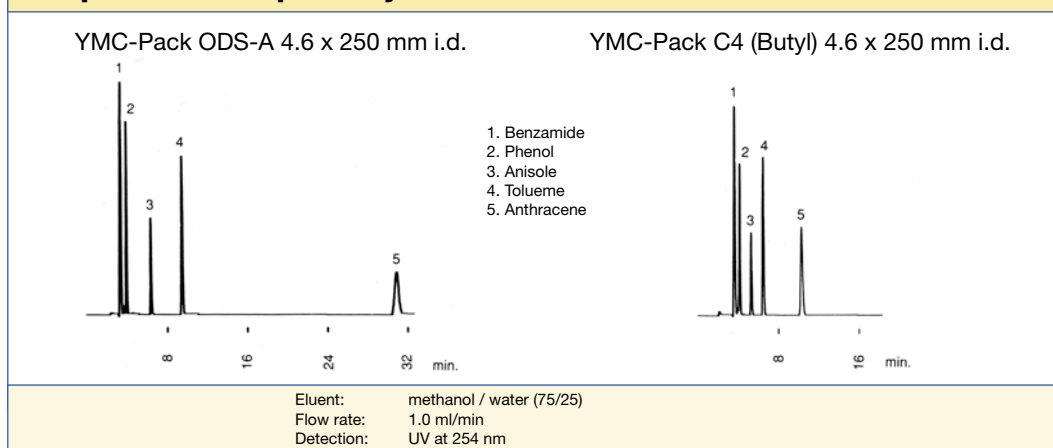
General

Due to shorter alkyl chains YMC*Gel C4 has a lower hydrophobicity than both C18 and C8 phases. As a result retention times for non-polar samples tend to be shorter on YMC*Gel C4, making it an ideal choice for faster separations.

Properties

YMC*Gel C4 packings are less hydrophobic and generally require more aqueous conditions than C8 or C18 packings. When using the same eluent, YMC*Gel C4 shows significantly shorter retention times for non-polar compounds than either C8 or C18 phases while still maintaining high resolution. Retention of polar compounds, however, is not affected significantly. Therefore, YMC*Gel C4 is ideally suited for separating complex samples with a wide range of component polarity.

Comparison of Sample Analysis Time for C18 vs C4

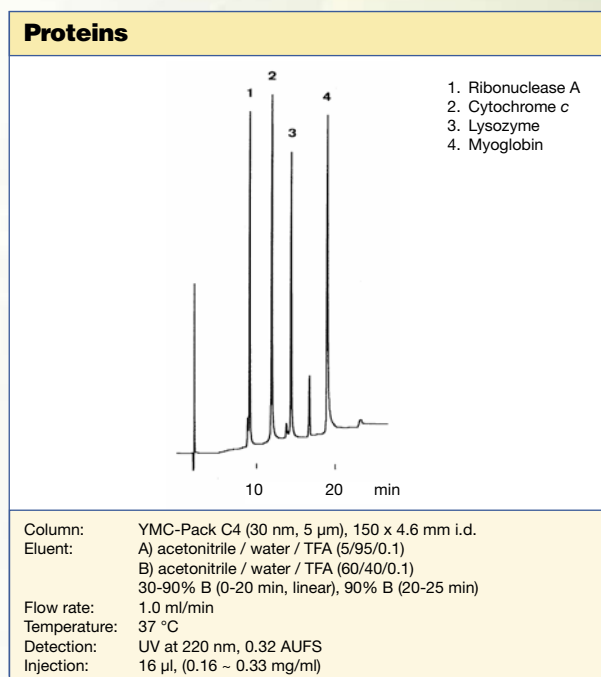
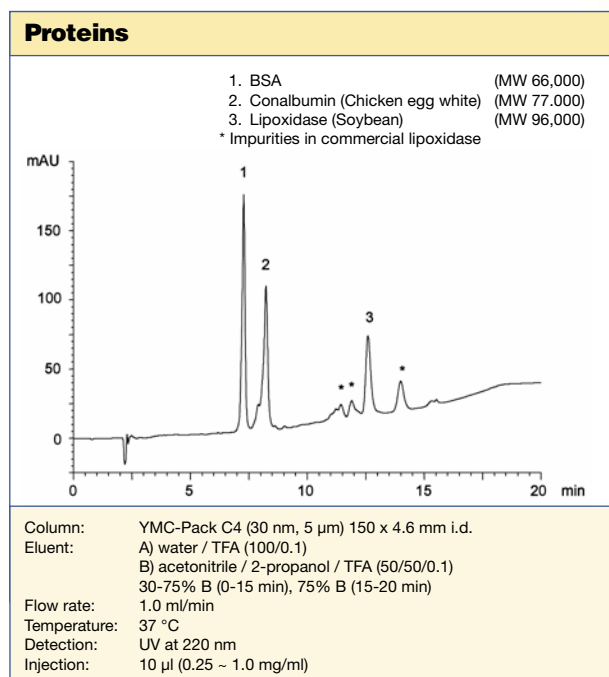
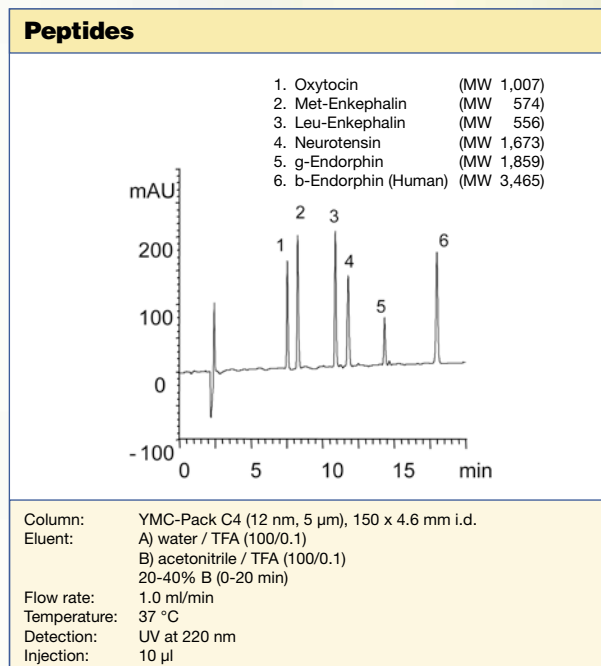
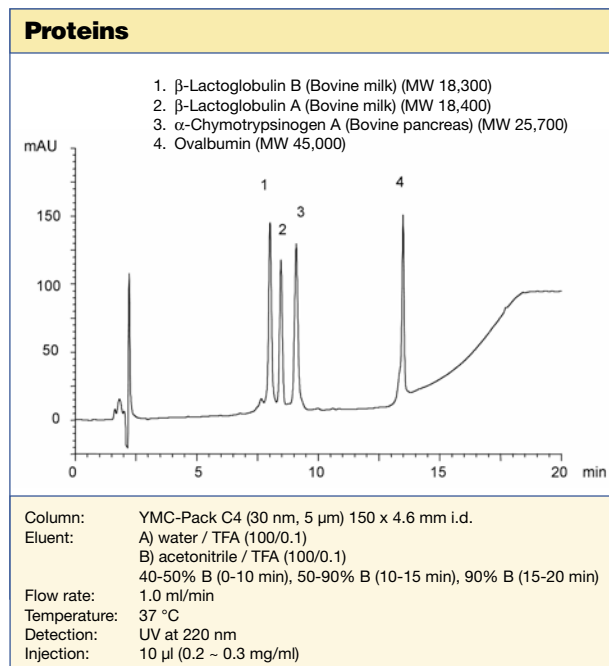


YMC*Gel C4 is available in three porosities to allow optimum separations of virtually any molecular weight compound. The 12 nm phase is used extensively for non-polar peptides which have very long retention times on C8 and C18. The 20 nm and 30 nm pore butyl phases effectively resolve many classes of proteins and biopolymers. The wide pore butyl chemistry allows minimal distortion of tertiary conformation of large biomolecules and results in fractions that are pure, concentrated and retain high biological activity.



YMC*Gel C4 (Butyl)

Applications



Ordering Information

Pore Size (nm)	Particle Size (μ m)	Product Code
12	10	BU12S11
	15	BU12S16
	20	BU12S21
20	10	BU20S11
	15	BU20S16
	20	BU20S21

Pore Size (nm)	Particle Size (μ m)	Product Code
30	10	BU30S11
	15	BU30S16
	20	BU30S21

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request.
 Contact YMC Europe GmbH for details and ordering information.

YMC*Gel TMS (C1)



- stationary phase with the lowest hydrophobicity of all reversed phase packing materials
- intermediate polarity between normal phase silica and other alkyl bonded reversed phases
- for fast separations of highly hydrophobic compounds
- alternative to C18 for the separation of hydrophilic compounds



YMC*Gel TMS (C1)	Specification
Pore Size / nm	12
Particle Size / μm	10; 15*; 20*
Surface area / m^2g^{-1}	330
Carbon content / %	4
Recommended pH range	2.0 - 7.5

* on request

General

YMC*Gel TMS shows lower retention due to hydrophobic interaction than all other reversed phase packing materials. It is useful for fast separations of highly hydrophobic samples that exhibit strong retention characteristics and are difficult or impossible to separate on conventional reversed phase packings. In addition, YMC*Gel TMS can sometimes achieve greater retention and better separations of hydrophilic compounds than other reversed phase columns.

Properties

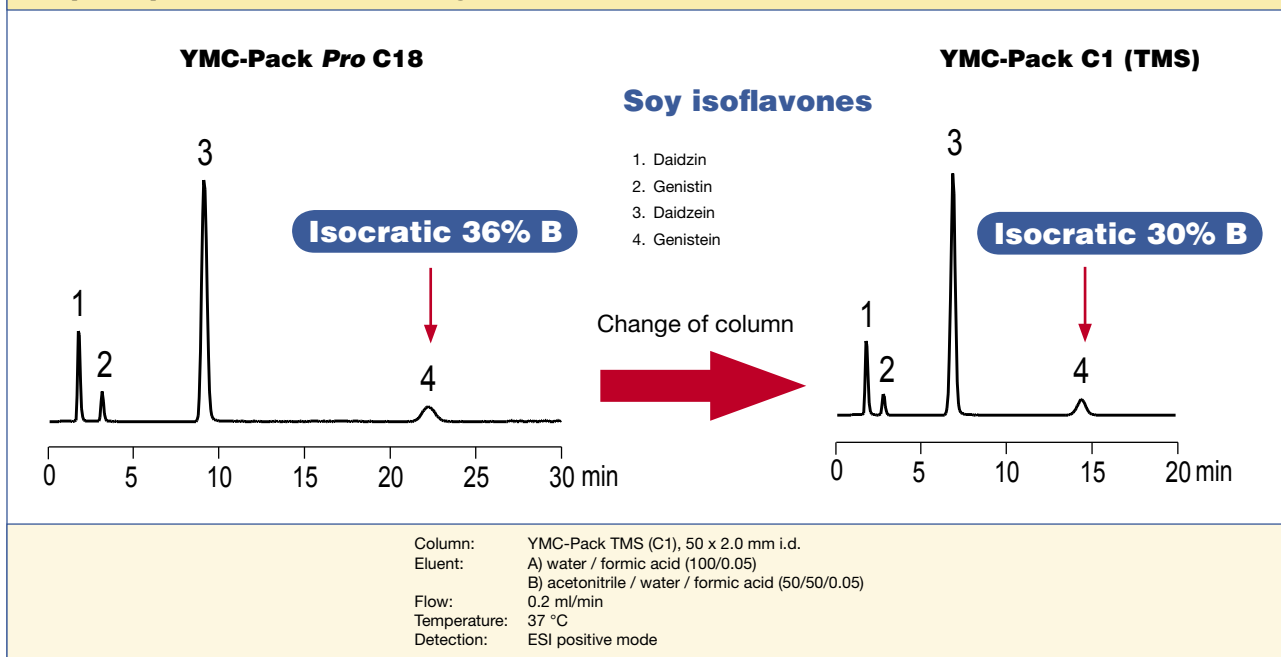
YMC*Gel TMS is bonded with trimethylmonochlorosilane to create a phase with intermediate polarity for separation of extremely hydrophobic compounds using conventional reversed phase solvents and of highly polar compounds using normal phase solvents.

The chemistry of YMC*Gel TMS is also well-suited for the analysis of multifunctional compounds. Selectivity characteristics of a TMS bonded phase can be unique, and samples must be tested to determine the suitability of the phase.



YMC*Gel TMS (C1)

Simple separation condition using TMS



Ordering Information

Pore Size (nm)	Particle Size (µm)	Product Code
12	10	TM12S11
	15	TM12S16
	20	TM12S21

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC Chiral Prep CD ST

YMC Chiral Prep CD PM



- for normal phase and reversed phase modes
- good mechanical and chemical stability
- excellent solvent resistance
- high loadability
- very competitive pricing due to large-scale production capabilities

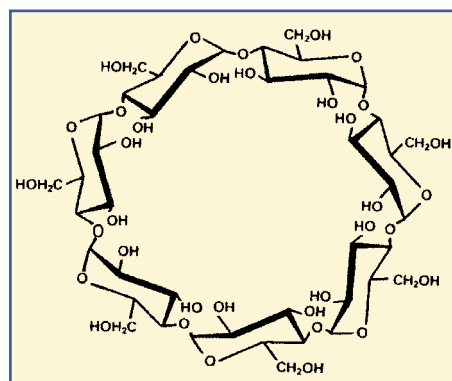


YMC Chiral Prep CD	Specification ST	Specification PM
Pore Size / nm	12	12
Particle Size / μm	10; 20; 50	10; 20; 50
Surface area / m^2g^{-1}	proprietary	proprietary
Carbon content / %	-	-
Recommended pH range	2.0 - 7.0	2.0 - 7.0

General

YMC Chiral Prep CD is a cyclic malto-oligosaccharide, consisting of seven α -D-glucopyranose units linked through α -(1,4)-linkages, covalently bonded to YMC's high purity silica.

YMC Chiral Prep CD is available in two versions with different selectivities: The unmodified standard (ST) version is suitable for reversed phase applications whilst the phenyl modified (PM) version can be used under both normal and reversed phase conditions.



Properties

The unique characteristics of β -cyclodextrin provide excellent stereospecific selectivity for the separation of enantiomers (mirror-image or optical isomers). The active chiral moiety, β -cyclodextrin, has a toroidal structure with a hydrophobic cavity formed with the glucoside oxygens and carbon backbones of the sugar residues, while a hydrophilic surface is formed with the primary and secondary hydroxy groups.

As the β -cyclodextrin ligands are bonded covalently to the silica support, the phase shows excellent solvent resistance: In addition to water, alcohol or acetonitrile; hexane, dichloromethane, THF and other organic solvents can be used as mobile phase.

The high ligand density provides excellent loadability and recovery, making YMC chiral Prep CD one of the first choice packing materials for preparative chiral separations.

YMC Chiral Prep CD is suitable for conventional column separations as well as for dynamic axial compression (DAC) columns and simulated moving bed (SMB) systems.

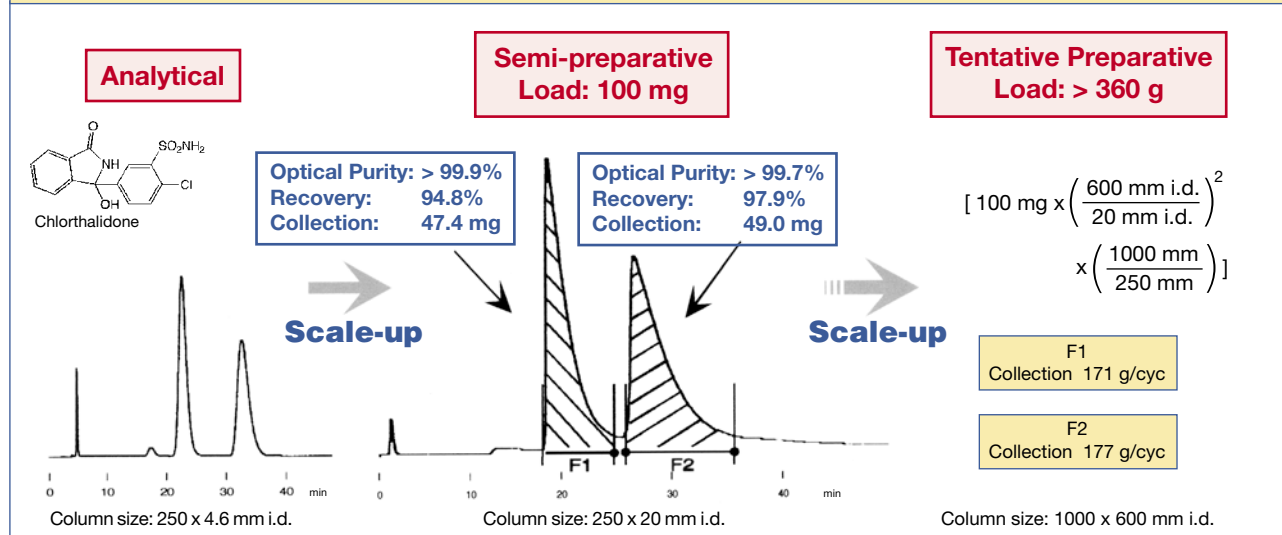
YMC Chiral Prep CD will be of interest to those developing or up-scaling chiral purification processes due to its surprising cost effectiveness. In addition, method development is made easier by use of scout columns for selectivity screening and loading studies.



YMC Chiral Prep CD ST

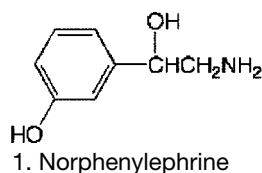
YMC Chiral Prep CD PM

Example for a preparative separation of optical isomers on YMC Chiral Prep CD ST (12 nm, 10 μm)



Source: Courtesy of YMC Co., Ltd.

Preparative Separations



Compound	Type of Packing	Sample Load	Optical Purity	Collection Fraction 1	Recovery Fraction 1	Flow [ml/min]	Pressure [bar]
1	PM	100 mg in 10 ml	> 99.9%	49.6 mg	99.2%	9 ml/min	1 bar
2	ST	100 mg in 10 ml	> 99.9%	47.7 mg	94.8%	9 ml/min	1 bar
3	PM	200 mg in 5 ml	> 99.9%	96.3 mg	96.3%	9 ml/min	1 bar
3	PM	250 mg in 5 ml	> 99.9%	114.2 mg	91.3%	9 ml/min	1 bar

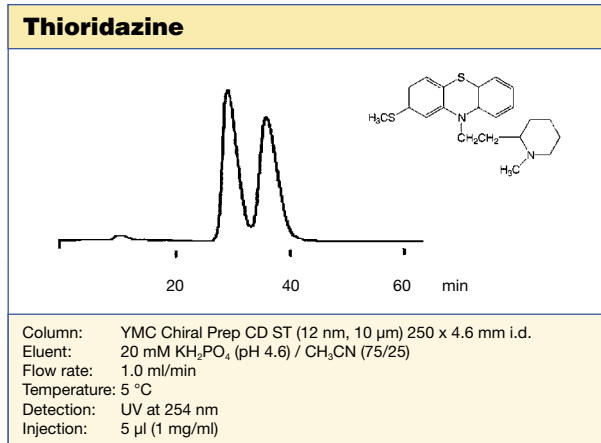
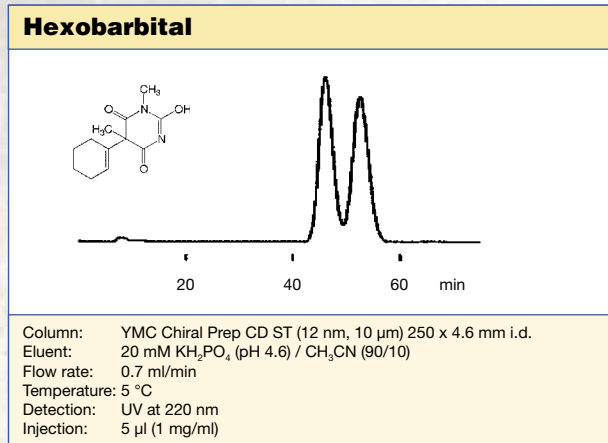
Eluents: (1) 25 mM KH_2PO_4 / MeOH (20/80)
 (2) 20 mM AcNH_4 + AcOH/MeOH (70/30)
 (4) 0.5 M NaClO_4 / MeCN (90/10)

Column size: 250 mm x 20 mm i.d.

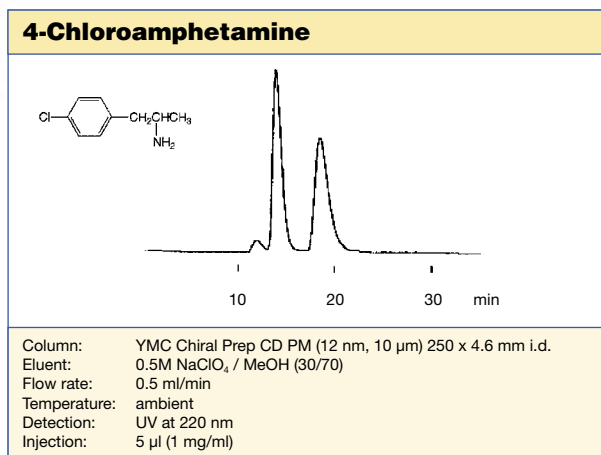
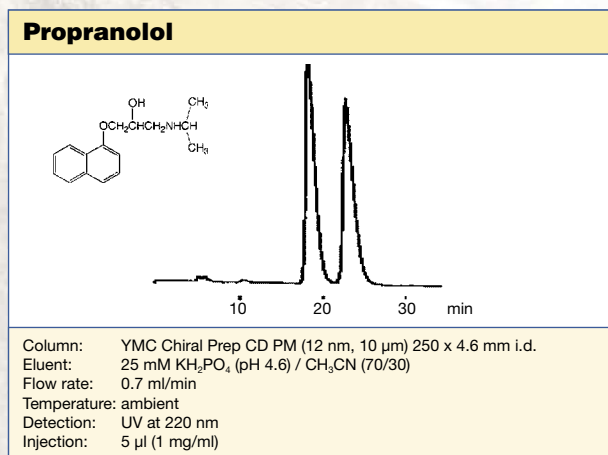
YMC Chiral Prep CD ST

YMC Chiral Prep CD PM

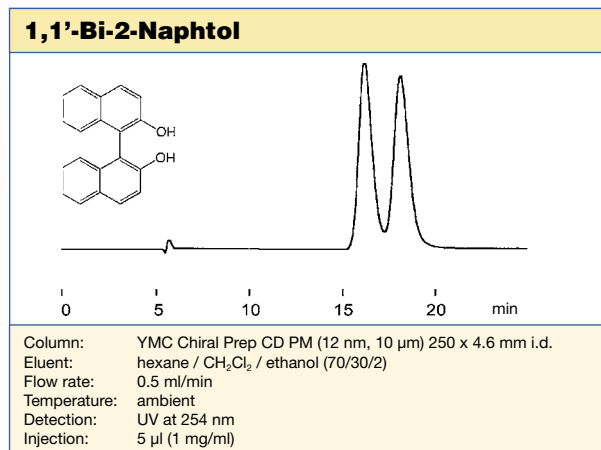
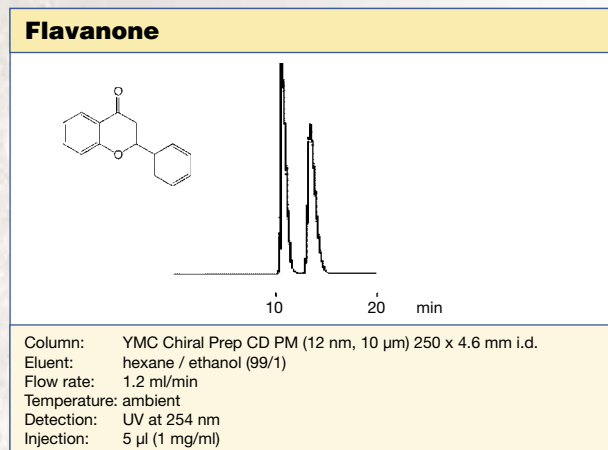
YMC CHIRAL PREP CD ST – Reversed Phase Applications



YMC CHIRAL PREP CD PM – Reversed Phase Applications



YMC CHIRAL PREP CD PM – Normal Phase Applications



Ordering Information

Column-Kits

R & D Scale-up Kit:

YMC helps with the process of scaling up to preparative separations by supplying pre-configured scale-up column kits. Each scale-up kit consists of one 4.6 mm i.d. scout column and one or more preparative columns packed from the very same Lot of bonded phase.

By excluding any variation in the packing material, this method provides the safest opportunity to scale up from analytical to semi-preparative or preparative scale. Important parameters such as loadability and yield can be easily determined using a 4.6 mm i.d. scout column. Being packed with the same gel lot and hence showing exactly the same specifications, the preparative columns included in the scale-up kit allow the reproducibility of the results in larger scale to be obtained.

Therefore, YMC scale-up kits provide the ultimate assurance that a chromatographic separation developed on YMC scout columns can be transferred to semi-preparative, pilot or production scale without method modification ... Guaranteed.

Type	Pore Size [nm]	Spherical Shape	Particle Size [µm]	Column Length [mm]	Inner Diameter [mm]	Part Number
ST or PM	12	S	10	250	4.6 + 20 4.6 + 50 4.6 + 20 + 50	xx12S11RD07 xx12S11RD15 xx12S11RD34
ST or PM	12	S	20	250	4.6 + 20 4.6 + 50 4.6 + 20 + 50	xx12S21RD07 xx12S21RD15 xx12S21RD34
ST or PM	12	S	50	250	4.6 + 20 4.6 + 50 4.6 + 20 + 50	xx12S50RD07 xx12S50RD15 xx12S50RD34

Please replace **xx** with **ST** for beta-cyclodextrin (standard) or **PM** for phenyl modified beta-cyclodextrin

Method Development Starter Kit

Chiral separations often require a more or less random trial and error approach with regard to identifying and confirming suitable selectivities. However, YMC Chiral Prep CD columns should routinely be used for scouting, method development or loadability studies due to their competitive pricing.

Since columns from different manufacturers and hence, different column hardware connecting geometries are used in screening systems, YMC offers a Chiral Starter Kit consisting of the following 250 x 4.6 mm i.d. columns:

- one analytical column packed with YMC Chiral Prep CD ST (10 µm, 12 nm)
- one analytical column packed with YMC Chiral Prep CD PM (10 µm, 12 nm)
- one single end unit Sure-Fit™ connector (see page 251) for quick and reliable connection of virtually any analytical column to existing chromatographic systems.

Part Number for Method Development Starter Kit:
CHIRAL SK 2007 P

YMC Chiral Prep CD ST / PM

YMC Chiral Prep CD, in either unmodified (ST) or phenyl modified (PM) version, is available based on silica gel with an average pore-size of 12 nm and average particle sizes of 10, 20 or 50 µm. These materials are available in large batch sizes up to several hundred kilograms together with YMC's quality, reproducibility and technical support. They provide a significant tool for downstream processing at pilot or production scale.

Pore Size (nm)	Particle Size (µm)	Product Code
12	10	ST12S11
	20	ST12S21
	50	ST12S50
12	10	PM12S11
	20	PM12S21
	50	PM12S50

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel Chiral NEA



- for normal phase and reversed phase modes
- covalently bonded CSP: suitable for all standard LC eluents
- reversal of elution order by selecting (R) or (S) versions
- excellent cost performance



YMC*Gel Chiral NEA	Specification
Pore Size / nm	30
Particle Size / μm	10
Surface area / m^2g^{-1}	proprietary
Carbon content / %	-
Recommended pH range	2.0 - 6.5

General

YMC*Gel Chiral NEA is compatible with aqueous and organic solvents, and suitable for both reversed phase and normal phase separations of polar pharmaceutical compounds.

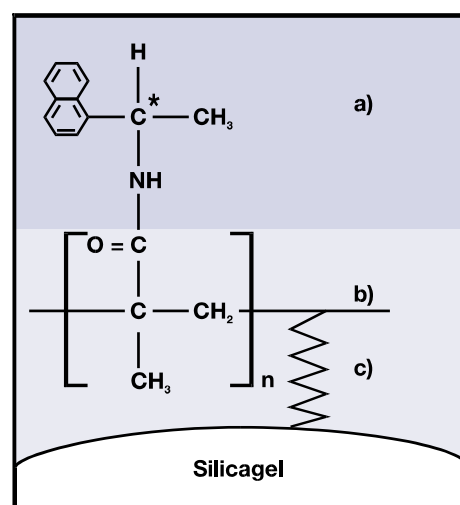
Due to its easy handling, excellent performance and exceptional cost-efficiency, YMC*Gel Chiral NEA is particularly convenient for the development and scale-up of chiral purification processes.

The stationary phase consists of a methacrylate-(α -naphthyl)ethylamine copolymer bonded to ultra-pure wide pore YMC silica (see figure). This covalent bonding makes YMC*Gel Chiral NEA shows excellent column durability.

(R) and (S) versions of the stationary phase are available, which provides the ability to invert the elution order of enantiomers pairs allowing the target enantiomer to be eluted prior to the byproduct for easy fractionation.

YMC*Gel Chiral NEA is easily scalable from analytical to large scale separations: The stationary phase is available in 5 and 10 μm particle size in prepacked columns. The 10 μm material is also available in bulk for use in dynamic axial compression columns, in Lot sizes up to 200 kg. Larger particle sizes will be available on request. In addition, scout columns are available for a convenient method development.

YMC*Gel Chiral NEA provides a significant tool for chiral purifications from bench scale to production scale.



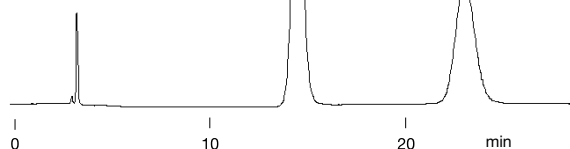
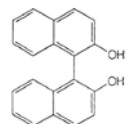
- a) Chiral selector
b) Polymeric chain
c) Spacer



YMC*Gel Chiral NEA

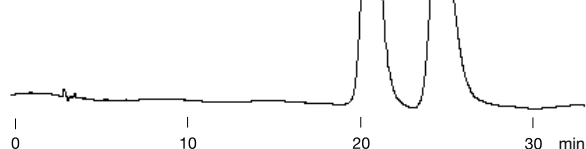
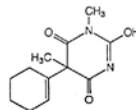
Normal Phase Applications

1,1'-Bi-2-naphthol



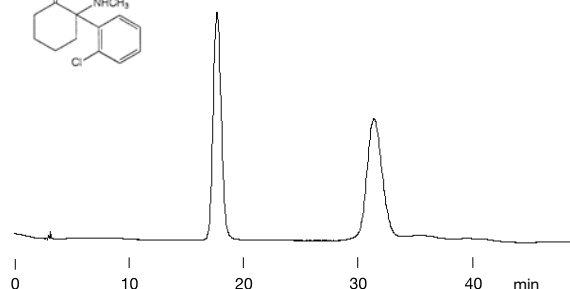
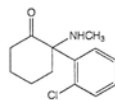
Column: Chiral NEA (30 nm, 10 μ m) 250 x 4.6 mm i.d.
 Eluent: hexane / dichloromethane / ethanol (70/30/2)
 Flow rate: 1.0 ml/min
 Temperature: ambient
 Detection: UV at 235 nm
 Pressure: 0.6 MPa

Hexobarbital



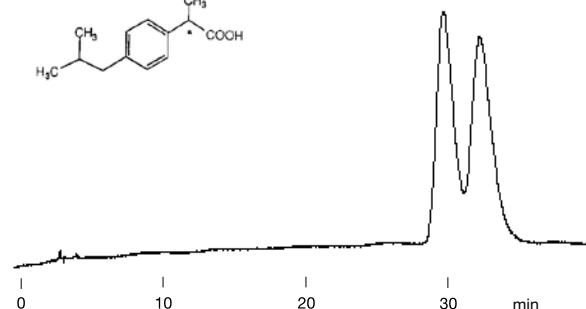
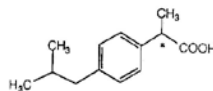
Column: Chiral NEA (30 nm, 10 μ m) 250 x 4.6 mm i.d.
 Eluent: hexane / dichloromethane / ethanol (90/10/2)
 Flow rate: 1.0 ml/min
 Temperature: ambient
 Detection: UV at 220 nm
 Pressure: 0.6 MPa

Ketamine



Column: Chiral NEA (30 nm, 10 μ m) 250 x 4.6 mm i.d.
 Eluent: hexane / dichloromethane / methanol / acetic acid (60/40/2/1)
 Flow rate: 1.0 ml/min
 Temperature: ambient
 Detection: UV at 268 nm
 Pressure: 0.6 MPa

Ibuprofen

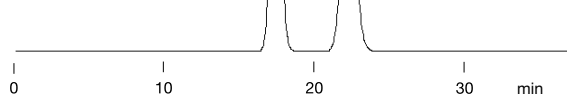
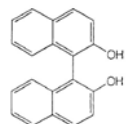


Column: Chiral NEA (30 nm, 10 μ m) 250 x 4.6 mm i.d.
 Eluent: hexane / dichloromethane / ethanol (95/5/0.5)
 Flow rate: 1.0 ml/min
 Temperature: ambient
 Detection: UV at 235 nm
 Pressure: 0.6 MPa

YMC*Gel Chiral NEA

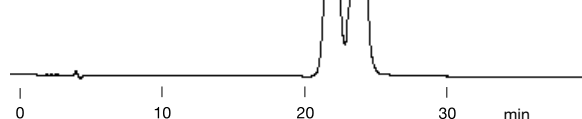
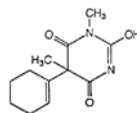
Reversed Phase Applications

1,1'-Bi-2-naphthol



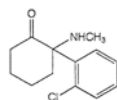
Column: Chiral NEA (30 nm, 10 μ m) 250 x 4.6 mm i.d.
Eluent: acetonitrile / water (70/50)
Flow rate: 1.0 ml/min
Temperature: ambient
Detection: UV at 235 nm
Pressure: 1.6 MPa

Hexobarbital



Column: Chiral NEA (30 nm, 10 μ m) 250 x 4.6 mm i.d.
Eluent: acetonitrile / water (30/70)
Flow rate: 0.7 ml/min
Temperature: ambient
Detection: UV at 220 nm
Pressure: 1.3 MPa

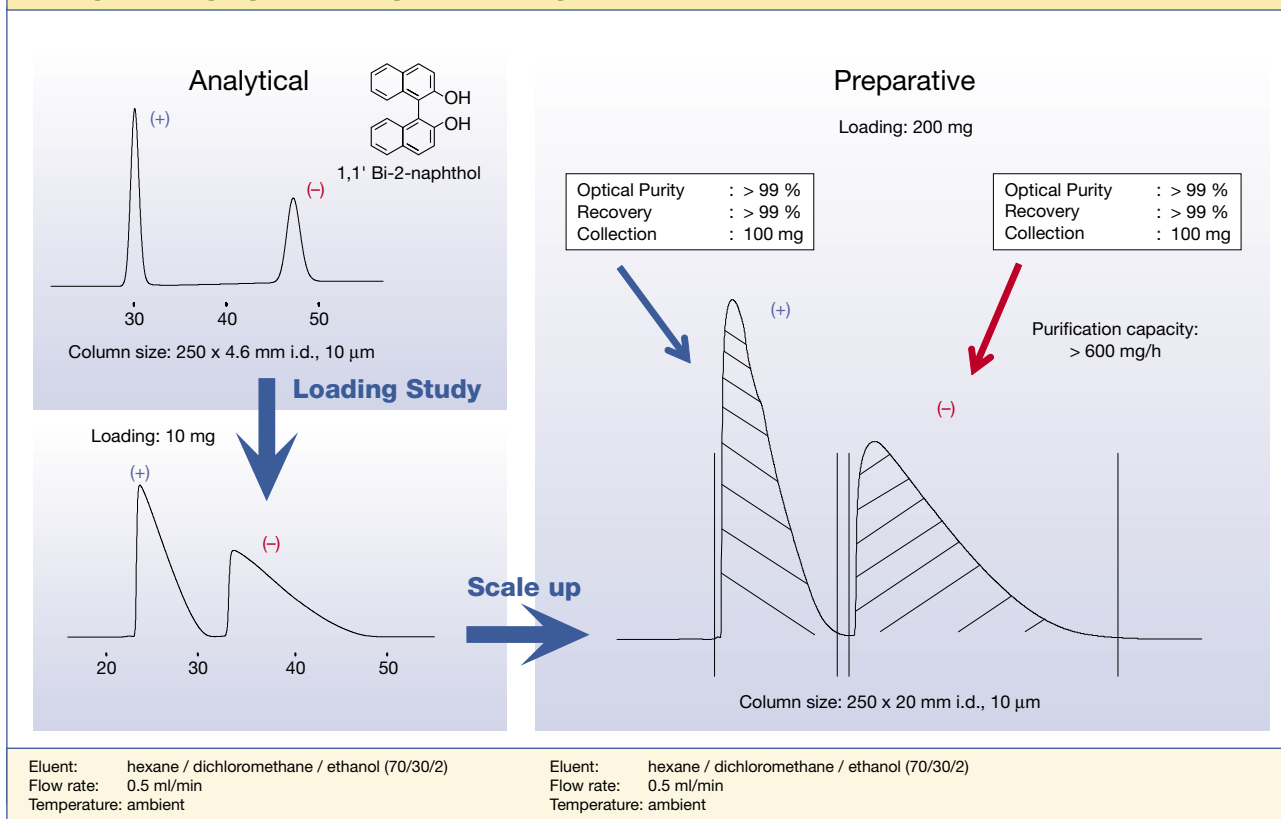
Ketamine



Column: Chiral NEA (30 nm, 10 μ m) 250 x 4.6 mm i.d.
Eluent: 0.5 M NaClO₄ / acetonitrile (60/40)
Flow rate: 1.0 ml/min
Temperature: ambient
Detection: UV at 268 nm
Pressure: 1.8 MPa

Scale Up

Example for a preparative separation of optical isomers



Source: Courtesy of YMC Co., Ltd.

Ordering Information

Bulk packing material:

Stationary Phase	Pore Size (nm)	Particle Size (µm)	Code No.	Packing Size
Chiral NEA (R version)	30	10	NR30S11	1 kg
Chiral NEA (S version)	30	10	NS30S11	10 kg
				100 kg

Note: Customised particle sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

Typical normal phase columns:

Size (mm i.d.)	Chiral NEA (R version)	Chiral NEA (S version)	Chiral NEA (R version)	Chiral NEA (S version)
	5 µm particle size		10 µm particle size	
250 x 4.6	CR30S052546	CS30S052546	CR30S112546	CS30S112546
250 x 10	CR30S052510	CS30S052510	CR30S112510	CS30S112510
250 x 20	CR30S052520	CS30S052520	CR30S112520	CS30S112520
250 x 30	CR30S052530	CS30S052530	CR30S112530	CS30S112530

Typical reversed phase columns:

Size (mm i.d.)	Chiral NEA (R version)	Chiral NEA (S version)	Chiral NEA (R version)	Chiral NEA (S version)
	5 µm particle size		10 µm particle size	
250 x 4.6	NR30S052546	NS30S052546	NR30S112546	NS30S112546
250 x 10	NR30S052510	NS30S052510	NR30S112510	NS30S112510
250 x 20	NR30S052520	NS30S052520	NR30S112520	NS30S112520
250 x 30	NR30S052530	NS30S052530	NR30S112530	NS30S112530

YMC*Gel NH₂ (Amino)



- primary amine (-NH₂) functionality
- stable, high coverage monomeric bonded chemistry
- for aqueous normal phase separations of carbohydrate compounds
- in place of silica for conventional normal phase chromatography using nonpolar solvents
- for HILIC separations of highly polar compounds



YMC*Gel NH ₂ (Amino)	Specification
Pore Size / nm	12
Particle Size / μm	10
Surface area / m ² g ⁻¹	330
Carbon content / %	3
Recommended pH range	2.0 - 7.5

General

YMC*Gel NH₂ is specifically used for the analysis of carbohydrate-type materials under aqueous normal phase elution conditions. It can also be used in place of silica for conventional normal phase chromatography using nonpolar solvents and for HILIC separations of highly polar compounds.

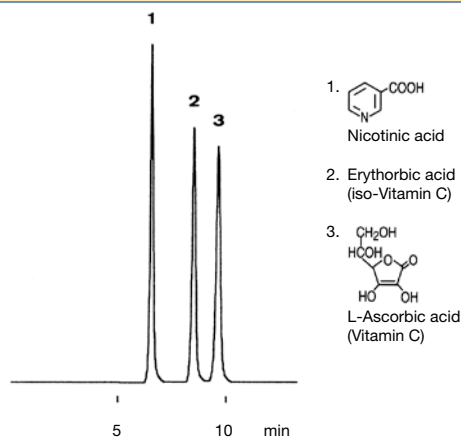
Properties

YMC*Gel NH₂ is based on a monomeric bonding of a primary propylamine functionality to YMC's spherical, high purity, high surface area silica with a mean pore diameter of 12 nm. The amine functionality provides retention and allows the separation of polar compounds under aqueous normal phase elution conditions, e.g. the analysis of carbohydrate-type materials from monosaccharides to polysaccharides using acetonitrile/water eluents. When YMC*Gel NH₂ operates under normal phase elution conditions, water, which is more polar than acetonitrile, is the stronger solvent, meaning that it can be used in HILIC mode as an alternative approach for the separation of highly polar compounds.

YMC*Gel NH₂ can also be used for the separation of isomers of tocopherols and other organic soluble compounds such as paraffins, olefins and aromatics under conventional normal phase conditions.

In aqueous low pH buffers the amino phase becomes a weak anion exchanger capable of separating negatively charged molecules.

Water-soluble vitamins

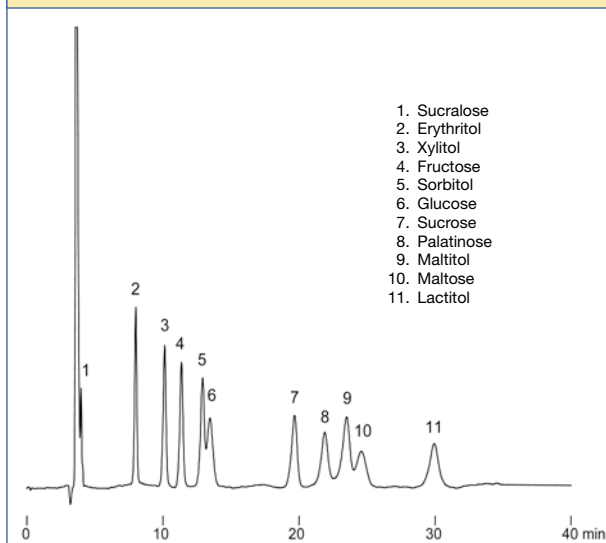


Column: 250 x 4.6 mm i.d. (5 μm, 12 nm)
 Eluent: acetonitrile / 50 mM NH₄H₂PO₄ (80/20)
 Flow rate: 1.0 ml/min
 Temperature: 40 °C
 Detection: UV at 250 nm, 0.16 AUFS
 Injection: 10 μl (0.05-0.1 mg/ml)



YMC*Gel NH₂ (Amino)

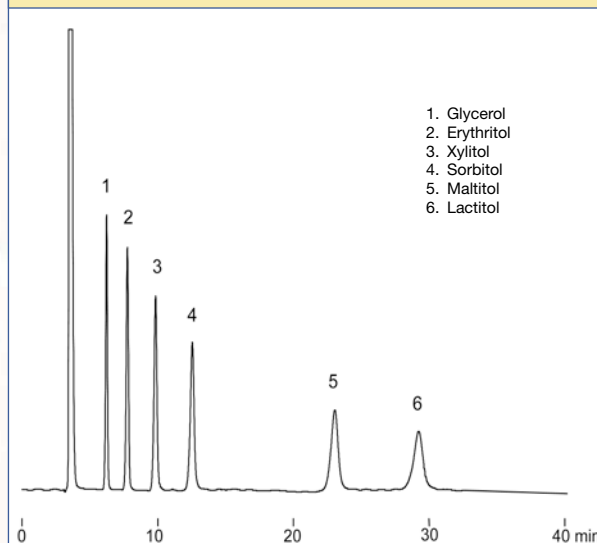
Sugars and Sweeteners



1. Sucralose
2. Erythritol
3. Xylitol
4. Fructose
5. Sorbitol
6. Glucose
7. Sucrose
8. Palatinose
9. Maltitol
10. Maltose
11. Lactitol

Column: YMC-Pack NH₂ (12 nm, 5 µm) 250 x 4.6 mm i.d.
 Eluent: acetonitrile / water (75/25)
 Flow: 1.0 ml/min
 Detection: RI
 Temperature: 25 °C
 Injection: 5 µl (5.0 mg/ml)

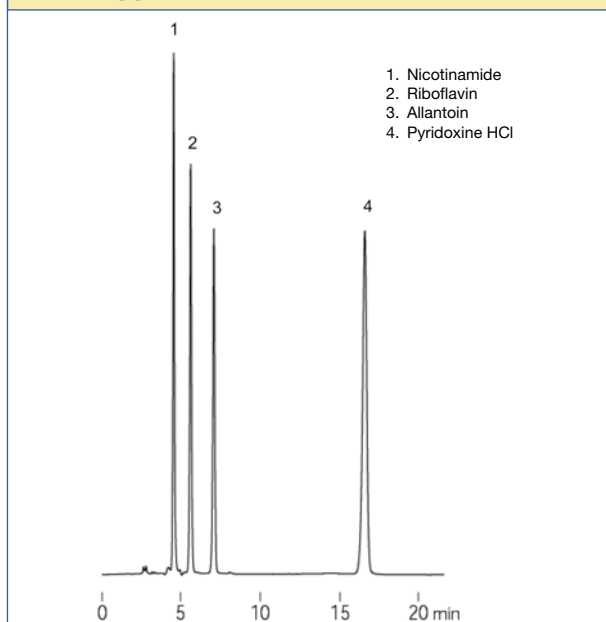
Sugar alcohols



1. Glycerol
2. Erythritol
3. Xylitol
4. Sorbitol
5. Maltitol
6. Lactitol

Column: YMC-Pack NH₂ (12 nm, 5 µm) 250 x 4.6 mm i.d.
 Eluent: acetonitrile / water (75/25)
 Flow: 1.0 ml/min
 Detection: RI
 Temperature: 25 °C
 Injection: 5 µl (5.0 mg/ml)

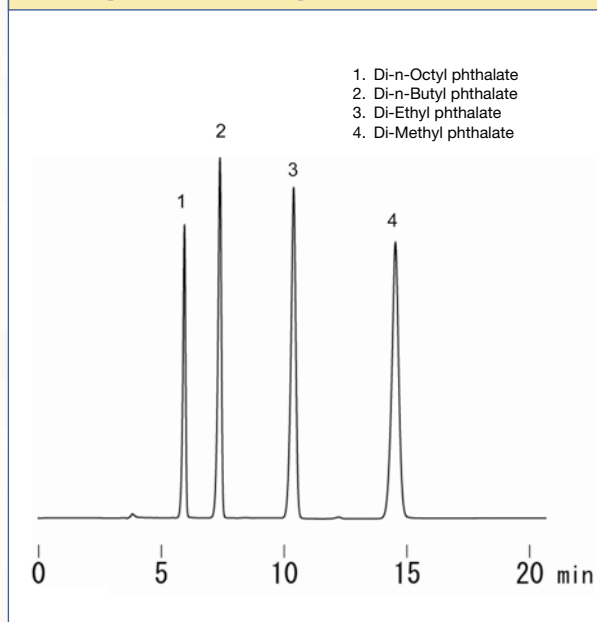
HILIC application: water-soluble vitamins



1. Nicotinamide
2. Riboflavin
3. Allantoin
4. Pyridoxine HCl

Column: YMC-Pack NH₂ (12 nm, 5 µm) 250 x 4.6 mm i.d.
 Eluent: 50 mM NH₄H₂PO₄ - H₃PO₄ (pH 2.5) / ACN (20/80)
 Flow: 1.0 ml/min
 Detection: UV at 210 nm, 0.064 AUFS
 Temperature: 37 °C
 Injection: 8 µl (0.01 ~ 0.04 mg/ml)

Non-aqueous mobile phase conditions



1. Di-n-Octyl phthalate
2. Di-n-Butyl phthalate
3. Di-Ethyl phthalate
4. Di-Methyl phthalate

Column: YMC-Pack NH₂ (12 nm, 5 µm) 250 x 4.6 mm i.d.
 Eluent: n-hexane / ethyl acetate (90/10)
 Flow: 1.0 ml/min
 Detection: UV at 254 nm
 Temperature: 30 °C
 Injection: 10 µl (0.5 mg/ml)

Ordering Information

Pore Size (nm)	Particle Size (µm)	Product Code
12	10	NH12S11

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel CN (Cyano)



- for normal, reversed phase and HILIC applications
- silica gel with cyanopropyl functionality
- faster column equilibration than normal silica gel
- most polar reversed phase column



YMC*Gel CN (Cyano)	Specification
Pore Size / nm	12
Particle Size / μm	10; 15; 20*
Surface area / m^2g^{-1}	330
Carbon content / %	7
Recommended pH range	2.0 - 7.5

* on request

General

Cyano phases are the most polar and least retentive of all reversed phase packings. Extremely hydrophobic compounds, which do not elute on standard C18 and C8 packings with typical reversed phase eluents, can be separated using cyano phases. Separations using normal phase, reversed phase and HILIC conditions can be carried out using this material.

Properties

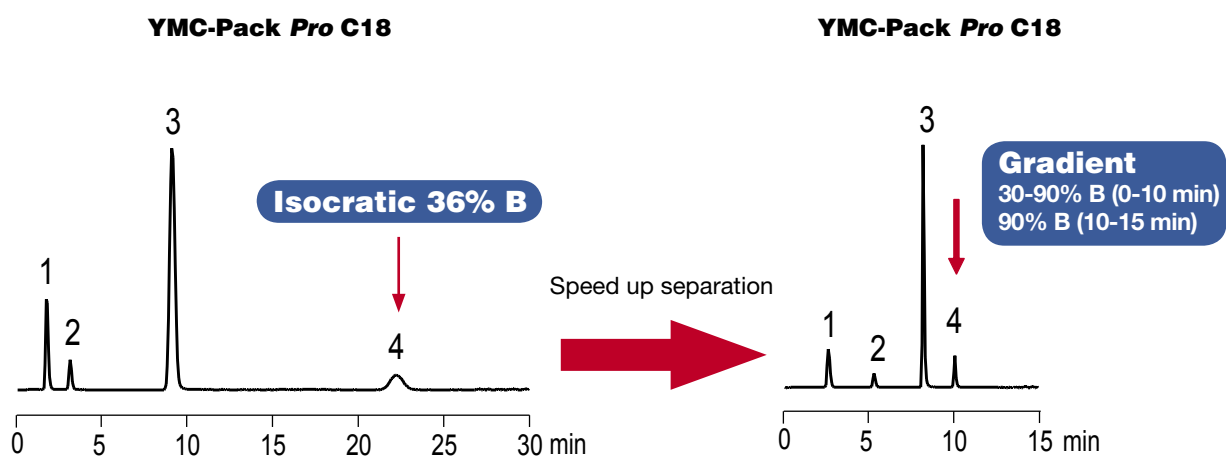
YMC*Gel CN (Cyano) provides a different selectivity from both phenyl and standard aliphatic (C18, C8 or C4) reversed phase packings. It is useful for quick and simple analysis of compounds that differ greatly in hydrophobicity, without the need to use gradient elution chromatography, making it an ideal phase for preparative separations.

Cyano packings also provide an alternative to silica for normal phase chromatography, where bonded normal phase packings have the advantage of faster equilibration, more uniform surface activity and increased resistance to dissolution compared to nonbonded silica. To extend column lifetime continued switching between normal and reversed phase solvents should be avoided.

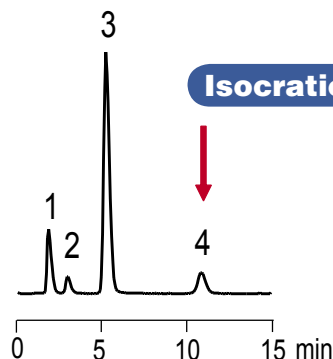


YMC*Gel CN (Cyano)

Fast separations without the need to use gradient elution chromatography



YMC-Pack CN (Cyano)



Soy isoflavones

1. Daidzin
2. Genistin
3. Daidzein
4. Genistein

Column: 50 x 2.0 mm i.d.
 Eluent: A) water / formic acid (100/0.05)
 B) acetonitrile / water / formic acid (50/50/0.05)
 Flow: 0.2 ml/min
 Temperature: 37 °C
 Detection: ESI positive mode

Source: Courtesy of YMC Co., Ltd.

Ordering Information

Pore Size (nm)	Particle Size (µm)	Product Code
12	10	CN12S11
	15	CN12S16
	20	CN12S21

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel Diol



For Normal Phase applications:

- versatile alternative to silica
- bonded phase reproducibility
- good selectivity without excessive retention
- high preparative throughput
- for polar natural products, metabolites, lipids

For aqueous GPC applications:

- high mechanical stability
- for molecular weight determination of proteins, peptides and sugars



YMC*Gel Diol	Specification	
Pore size / nm	12	20
Particle size / μm	10; 15	15
Surface area / m^2g^{-1}	330	175
Carbon content / %	-	-
Recommended pH range	2.0 - 7.5	2.0 - 7.5

A Normal Phase Alternative to Silica

YMC*Gel Diol is a versatile alternative to nonbonded silica for normal phase separations. The bonded phase hydroxyl groups provide good selectivity without excessive retention, because hydrogen bonding with the diol layer is not as strong as with the silanols on a nonbonded silica surface. Diol columns also provide improved reproducibility and stability when compared with nonbonded silica.

As with all YMC silica-based bonded phases, YMC*Gel Diol starts with a base silica support of exceptional purity and mechanical stability. The silica purity greatly reduces non-specific sample adsorption, thereby providing excellent sample recovery. The high surface area, together with the large number of available sites for interaction of the 1,2-dihydroxypropyl ligands, provides high preparative loading.

YMC*Gel Diol can be cleaned repeatedly with methanol or even water, thus ensuring a longer column life than for underivatized silica.

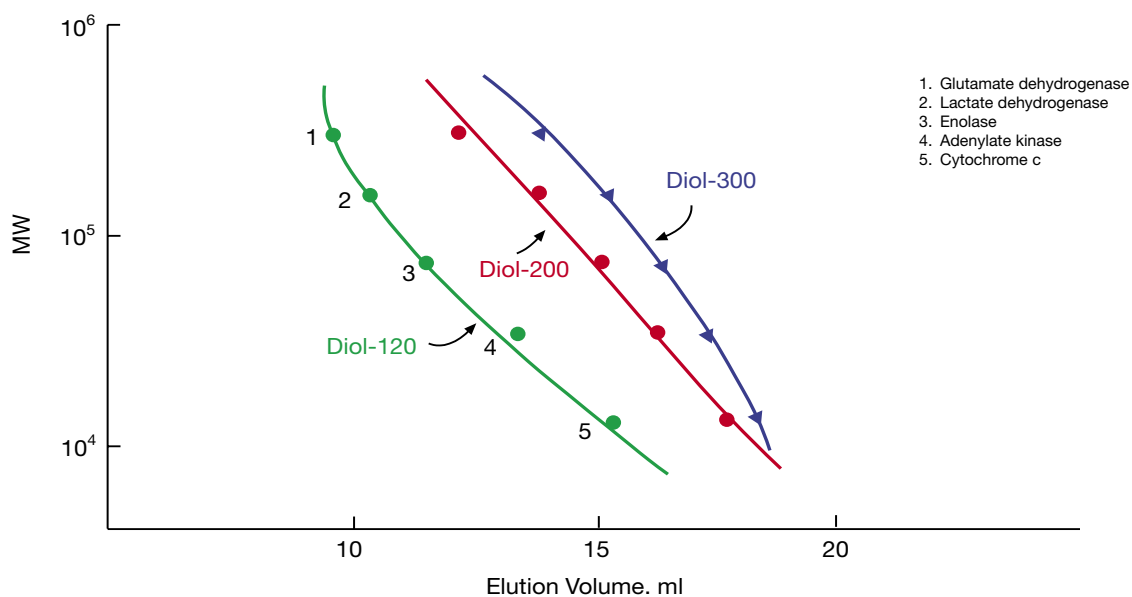
Silica-based aqueous GPC/SEC medium

The silica-based YMC*Gel Diol is a rugged and efficient size exclusion material. It is generally used for the separation of biomolecules and pharmaceuticals. As the non-specific adsorptive sites have been eliminated it exhibits better performance characteristics for size separations than nonbonded silica. YMC*Gel Diol is available in four porosities: 6, 12, 20 and 30 nm. Diol-6 is most suitable for the separation of peptides or oligosaccharides with molecular weights of 10,000 or less, whereas Diol-12, -20 and -30 (either used individually or in combination) are suitable for separations of proteins and other water-soluble compounds with molecular weights of 10,000 to several hundred thousands.



YMC*Gel Diol

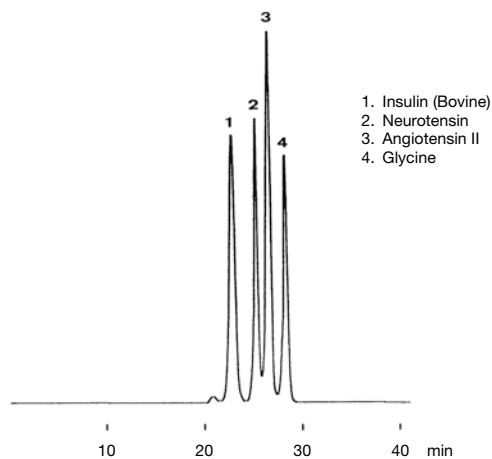
GPC applications: proteins and peptides



Column: YMC-Pack Diol (5 μ m) 500 x 8.0 mm i.d.
Eluent: 0.1M KH_2PO_4 - K_2HPO_4 (pH 7.0) containing 0.2M NaCl
Flow rate: 0.7 ml/min
Temperature: ambient
Detection: UV at 280 nm

Source: Courtesy of YMC Co., Ltd.

Normal Phase application: peptides



Column: YMC-Pack Diol-120 (12 nm, 5 μ m) 500 x 8.0 mm i.d. x 2
Eluent: 0.1 M KH_2PO_4 - K_2HPO_4 (pH 7.0) containing 0.2 M NaCl / acetonitrile (70/30)
Flow: 0.7 ml/min
Detection: UV at 215 nm, 0.16 AUFS
Temperature: ambient (25 $^{\circ}$ C)
Injection: 25 μ l (0.07 ~ 5.3 mg/ml)

Source: Courtesy of YMC Co., Ltd.

Ordering Information

Pore Size (nm)	Particle Size (μ m)	Product Code
12	10	DL12S11
	15	DL12S16
20	15	DL20S16

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.

YMC*Gel SIL (Silica)



- high purity silica
- high mechanical stability
- highly porous, totally spherical particles
- fully scalable for analytical, semi-prep, preparative and process scale applications
- convenient for separating small organic compounds with similar structures



YMC*Gel SIL (Silica)	Specification				
Pore size / nm	6	12	20	30	100
Particle size / μm	10; 15; 20; 50; 75; 150	10; 15; 20; 50; 75; 150	10; 15	10; 15	10; 50
Surface area / m^2g^{-1}	650	330	175	100	40
Recommended pH range	n. a.	n. a.	n. a.	n. a.	n. a.

General

YMC*Gel SIL is a fully scaleable, high purity silica gel, which provides excellent batch-to-batch reproducibility and high sample recoveries. The totally porous spherical particles are mechanically and chemically stable, yet provide high surface area for greater sample loading and increased resolution.

Properties

High purity YMC*Gel SIL combines superior performance, excellent batch-to-batch reproducibility and long column life times. The homogeneous surface, the narrow and symmetrical pore size distribution, and the narrow particle size distribution provide excellent separation characteristics and a low pressure drop.

YMC*Gel SIL provides high yields and optimal sample recovery because it is virtually free from impurities, e.g. heavy metals, which can cause non-specific sample adsorption and thus lower sample recovery.

The mechanical strength of the spherical silica particles prevents the formation of fines and high backpressures. Therefore, YMC*Gel SIL is ideal for use in all kinds of dynamic axial compression systems. Furthermore, the mechanically and chemically stable YMC*Gel SIL is the ideal support material for YMC bonded phase chemistries.

YMC*Gel SIL is completely scaleable: YMC offers numerous particle size ranges and distributions for preparative LC between 10 and 150 μm with batch sizes in excess of 500 kg/Lot.

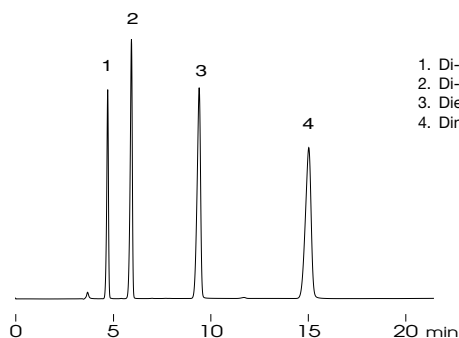


YMC*Gel SIL (Silica)

Separation characteristics of normal-phase packing media

Silica gel

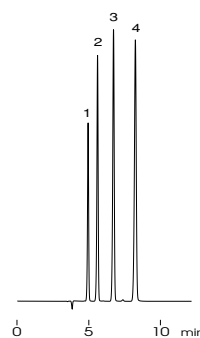
YMC-Pack SIL
(12 nm, 5 µm)



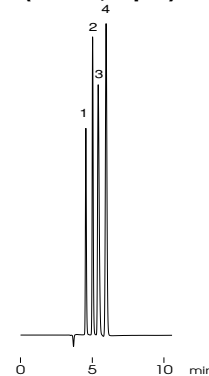
1. Di-*n*-octyl phthalate
2. Di-*n*-butyl phthalate
3. Diethyl phthalate
4. Dimethyl phthalate

Chemically bonded packing material

YMC-Pack Diol-NP
(12 nm, 5 µm)



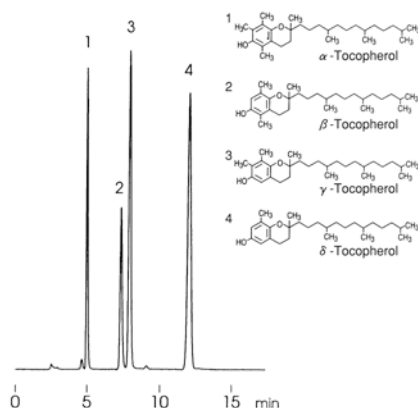
YMC-Pack CN (Cyano)
(12 nm, 5 µm)



Column: 250 x 4.6 mm i.d.
Eluent: n-hexane / ethyl acetate (90/10)
Flow: 1.0 ml/min
Detection: UV at 254 nm
Temperature: 30 °C

Source: Courtesy of YMC Co., Ltd.

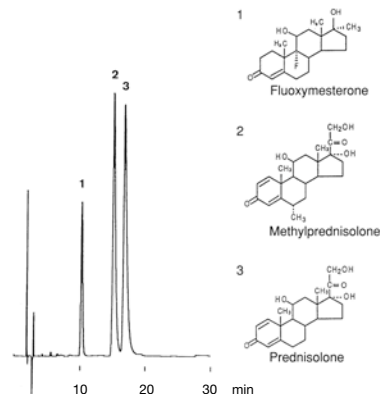
Tocopherols



Column: YMC-Pack SIL (12 nm, 5 µm) 250 x 4.6 mm i.d.
Eluent: hexane / 2-propanol / acetic acid (1000/6/5)
Flow: 1.4 ml/min
Detection: FLS at Ex 298 nm, Em 325 nm
Temperature: 35 °C
Injection: 20 µl (5 ~ 20 mg/ml)

Source: Courtesy of YMC Co., Ltd.

Steroids



Column: YMC-Pack SIL (6 nm, 5 µm) 250 x 4.6 mm i.d.
Eluent: hexane / THF / acetic acid (60/40/1)
Flow: 1.5 ml/min
Detection: UV at 250 nm, 0.16 AUFS
Temperature: 30 °C
Injection: 10 µl (0.25 mg/ml)

Source: Courtesy of YMC Co., Ltd.

Ordering Information

Pore Size (nm)	Particle Size (µm)	Product Code
6	10	SL06S11
	15	SL06S16
	20	SL06S21
	50	SL06S50
	75	SL06S75
12	10	SL12S11
	15	SL12S16
	20	SL12S21
	50	SL12S50
	75	SL12S75
	100	SL12SA5

Pore Size (nm)	Particle Size (µm)	Product Code
20	10	SL20S11
	15	SL20S16
30	10	SL30S11
	15	SL30S16
100	10	SLA0S11
	50	SLA0S50

Pack Sizes: 100 g; 500 g; 1 kg; 5 kg; 10 kg; 25 kg

NOTE: customised particle sizes and pore sizes are available on request. Contact YMC Europe GmbH for details and ordering information.