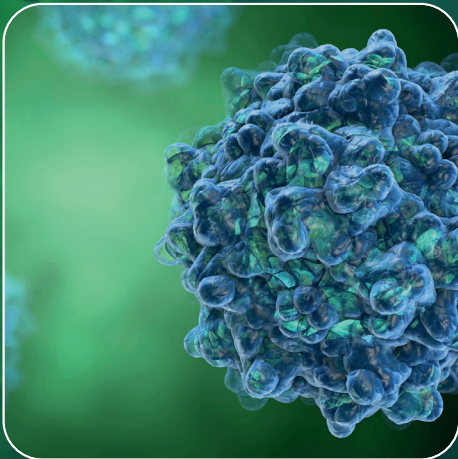




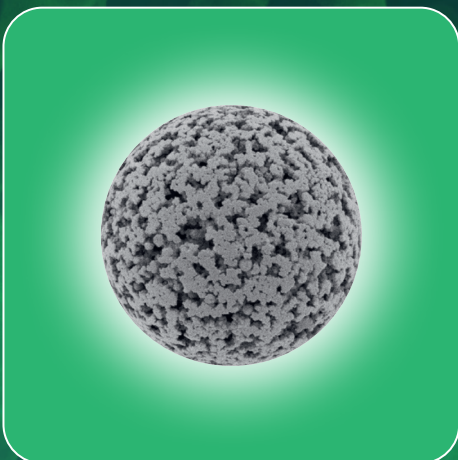
MacroSep IEX Q Resins



Viral Vectors

Protein Complexes

Plasmid DNA



MacroSep IEX Q Resins

Designed for Large Biomolecules



Viral Vectors



Plasmid DNA



Protein Complexes

Application data mainly by courtesy of YMC CO., LTD.

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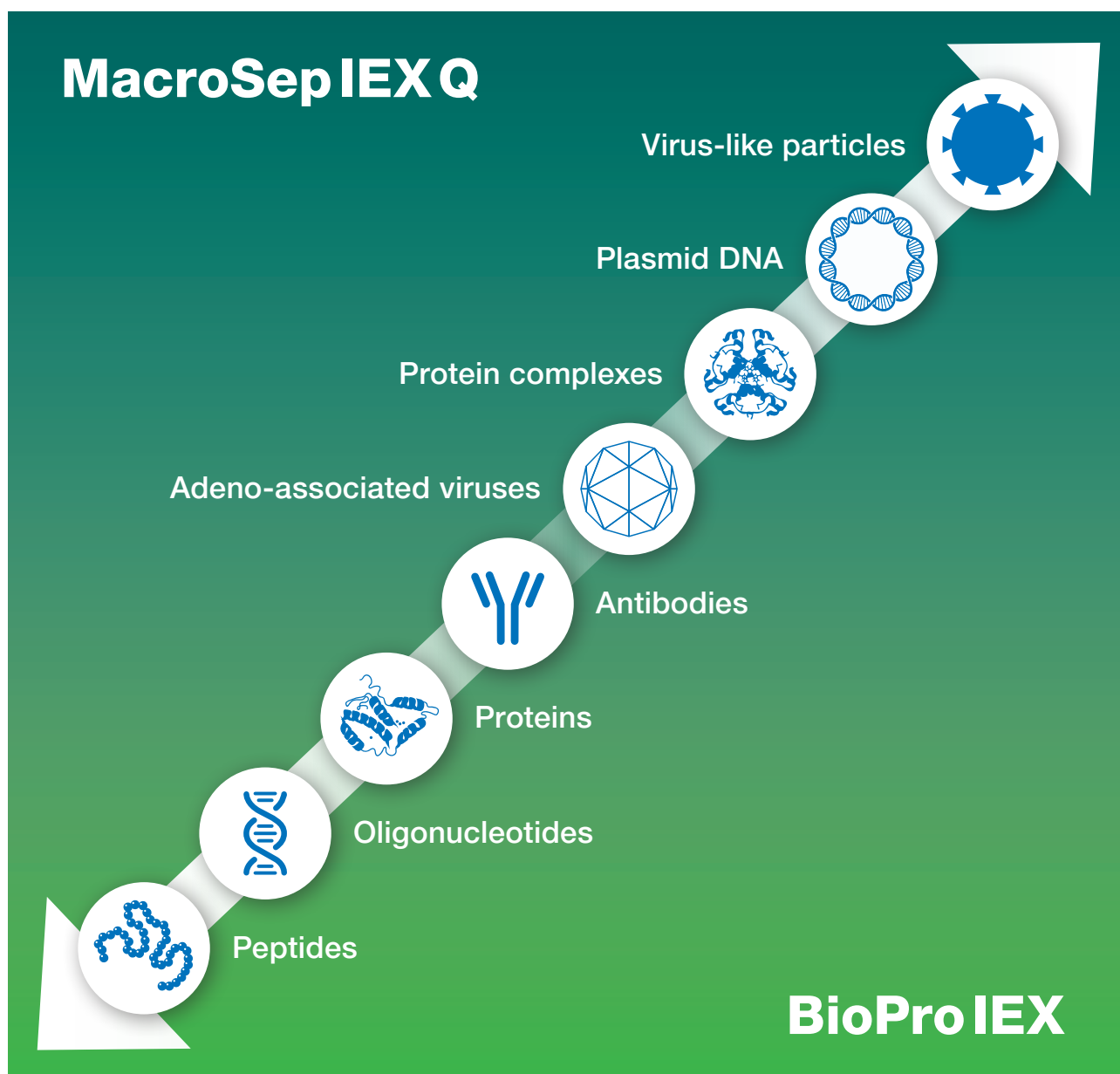
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New Targets in Downstream Processing

The purification of biomolecules requires high-quality resins that allow efficient binding and separation. For the purification of such molecules via Ion Exchange (IEX) Chromatography, YMC offers modern process resins with optimised characteristics depending on the targets' size: **BioPro IEX** and **MacroSep IEX Q**. Small and mid-sized biomolecules such as oligo-

nucleotides, proteins and antibodies require high resolution separation as well as efficient capturing purifications. Therefore, the IEX resins need an ideal pore size that provides large surface areas for high binding capacities. The **BioPro IEX** series is the versatile IEX resin family for these biomolecules.



The development of new therapeutic strategies such as gene therapy has led to an increase in the size of the target substances. For the efficient purification of larger biomolecules and particles such as viruses and protein complexes, optimised resins are needed that provide larger pores. Resins with standard pore sizes optimised for small and mid-sized biomolecules do

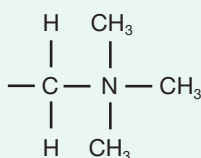
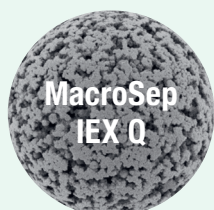
not allow efficient binding of large molecules because they cannot access the pores. This has a massive impact on their binding and separation.

With **MacroSep IEX Q**, YMC offers an improved solution for the purification of these molecules via Anion Exchange (AEX) Chromatography.

MacroSep IEX Q: Macro-Porous AEX Resin

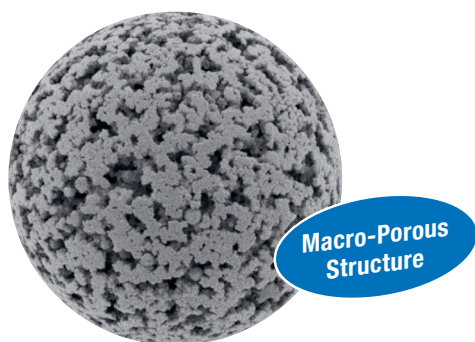
MacroSep IEX Q was especially designed for the purification of larger biomolecules such as adeno-associated viruses (AAVs), Virus-like Particles (VLPs), protein complexes and plasmid DNA (pDNA). This new strong anion exchange resin offers an optimised

macro-porous structure that ensures an efficient purification of these molecules. With its high binding capacity for large particles and molecules and high separation efficiency even at elevated flow rates, MacroSep IEX Q is a perfect addition to DSP platforms.



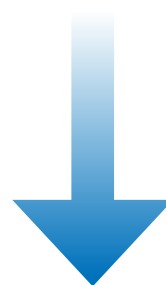
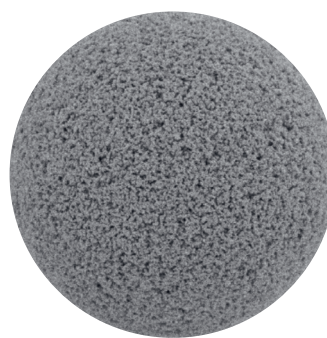
+ strong anion exchanger

MacroSep IEX Q (30 µm)



Ideal choice for the purification of **large biomolecules and particles** such as AAV, VLPs and large nucleic acids

BioPro IEX (30 µm)



Ideal choice for the purification of **smaller and mid-sized biomolecules** such as proteins, antibodies and oligonucleotides

Further Information about BioPro IEX

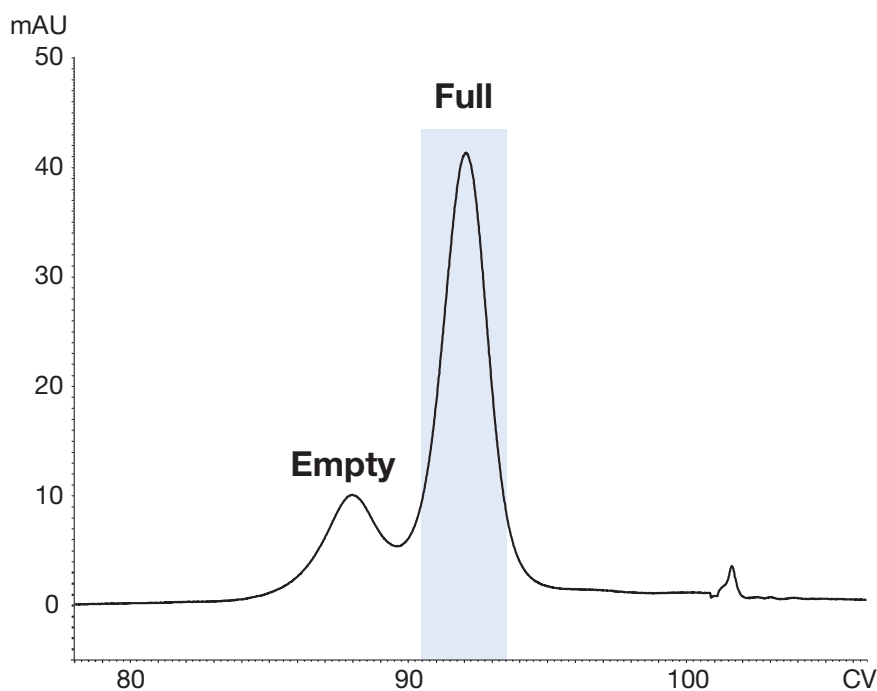


Case Study:

Highly Efficient Purification of AAV2 with MacroSep IEX Q

AAVs have become one of the main vectors of gene therapies. An efficient and safe purification is needed that removes the empty particles (non-functional, no genetic payload from the full particles that contain the genetic material required for their function. In this

real-life example, a purification process for full AAV2 was developed. The following chromatogram shows the separation of full and empty AAV capsids using MacroSep IEX Q.

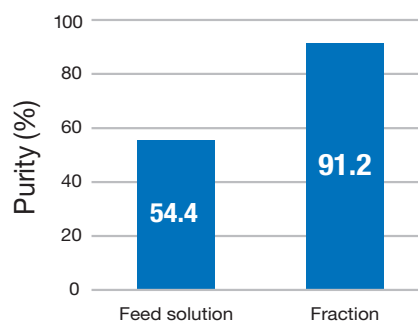


Column: MacroSep IEX Q 50x5.0 mm ID
 Eluent: A) 20 mM Bis-tris propane-HCl (pH 9.0), 1% sucrose, 0.1% poloxamer 188
 B) 20 mM Bis-tris propane-HCl containing 0.5 M choline chloride (pH 9.0), 1% sucrose, 0.1% poloxamer 188
 Flow rate: 1 mL/min
 Gradient: 10 CV equilibration 0%B, 48 CV load of sample, 20 CV wash 0%B, 28 CV 0-50%B, 10 CV strip 100%B, 10 CV CIP 1 M NaOH, 10 CV regeneration 1 M NaCl, 10 CV equilibration 0%B
 Temperature: ambient (25°C)
 Detection: UV at 280 nm
 Injection: 48 mL
 Sample: AAV2 (0.72×10^{11} vg/mL)

The purity levels for the full AAV2 species before and after the chromatographic step were verified by analytical ultracentrifugation.

The AEX purification step with MacroSep IEX Q has increased the purity level of the target immensely. Starting from a purity of 54.4% in the feed solution, the final purity after purification was 91.2%.

Therefore, MacroSep IEX Q is the ideal resin for purification of AAV with high resolution!



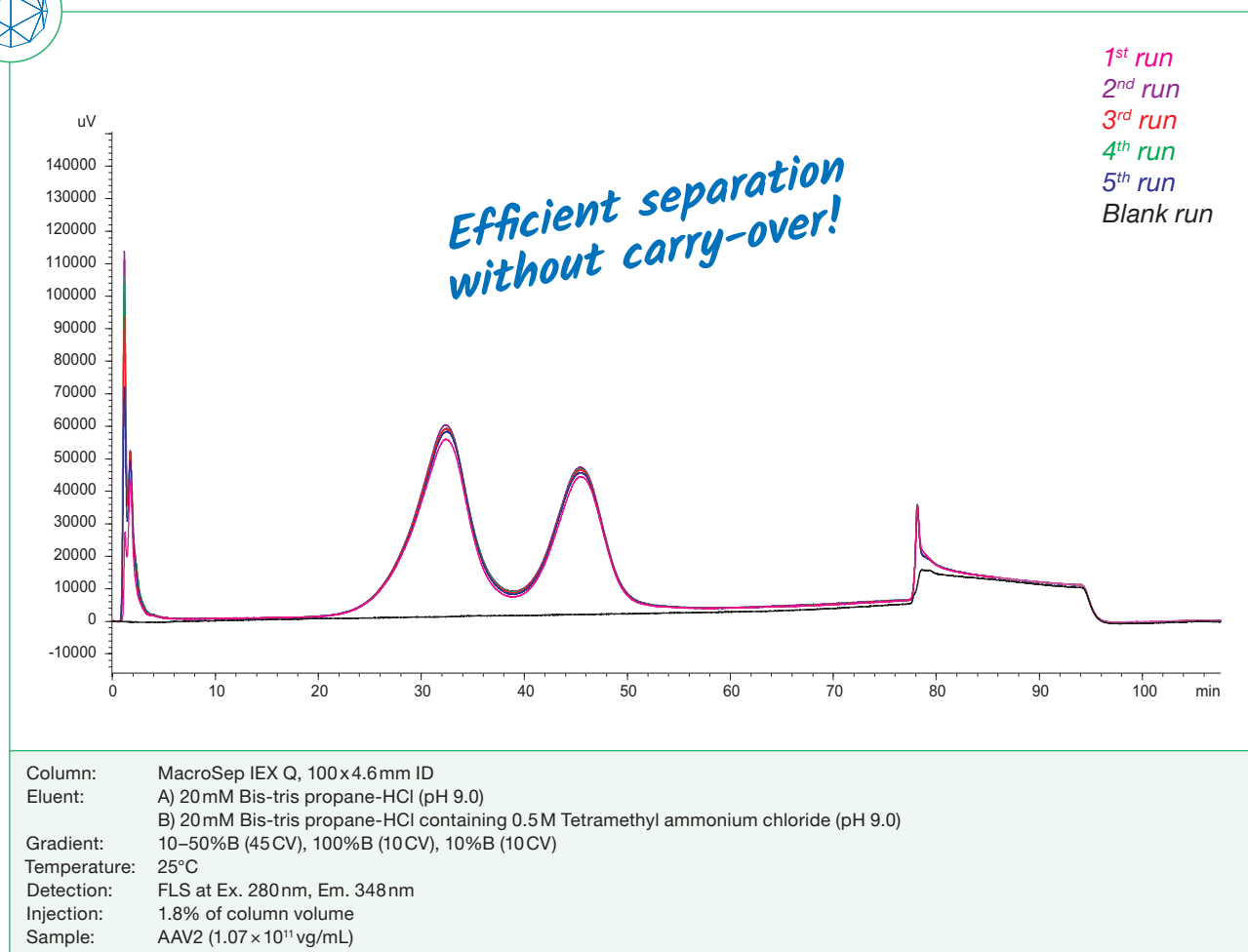
Courtesy of Prof. S. Uchiyama, Osaka University

This research was supported by AMED under Grant Number JP18ae0201001

High-Resolution Separations With Reproducible Results

The feed solution of an AAV purification is a complex mixture and the separation of full and empty capsids is challenging due to their high similarity. With MacroSep IEX Q, high resolution separation is possible. The optimised macro-porous structure ensures an optimal retention of the particles and the 30µm homogenous particles lead to increased

resolution. This results in improved chromatographic separation as shown in the following application. Additionally, high reproducibility is crucial for reliable and safe purification processes. MacroSep IEX Q gives completely reproducible results with no carry-over effects. This makes the resin the first choice for AAV purifications at any scale.



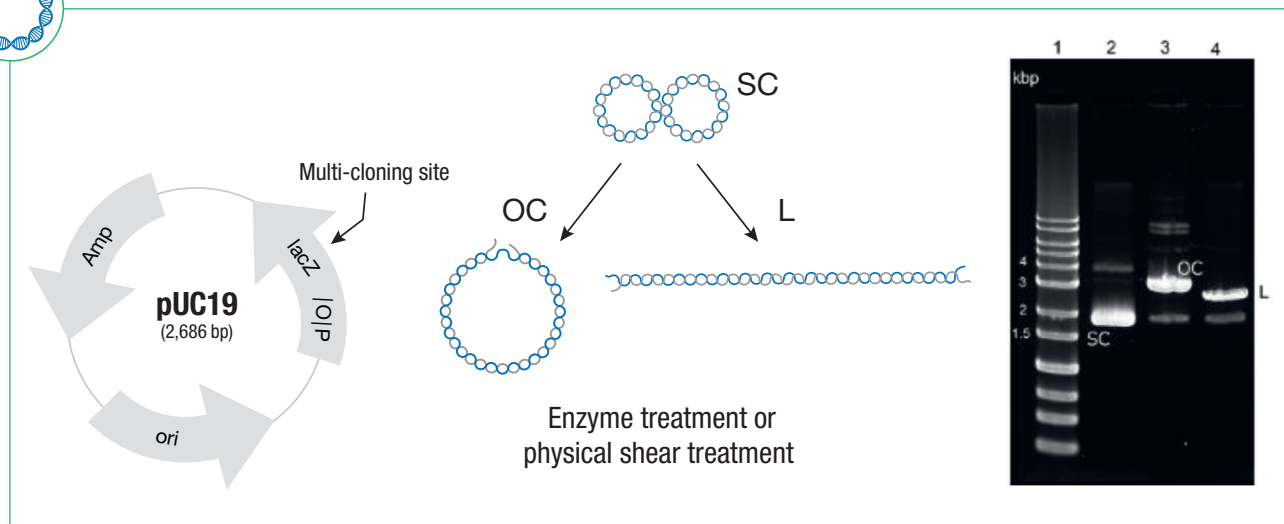
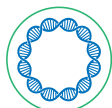
This research was supported by AMED under Grant Number JP18ae0201001

MacroSep IEX Q is the first choice for AAV purification giving reliable results!

High-Resolution Purification of Super-coiled pDNA

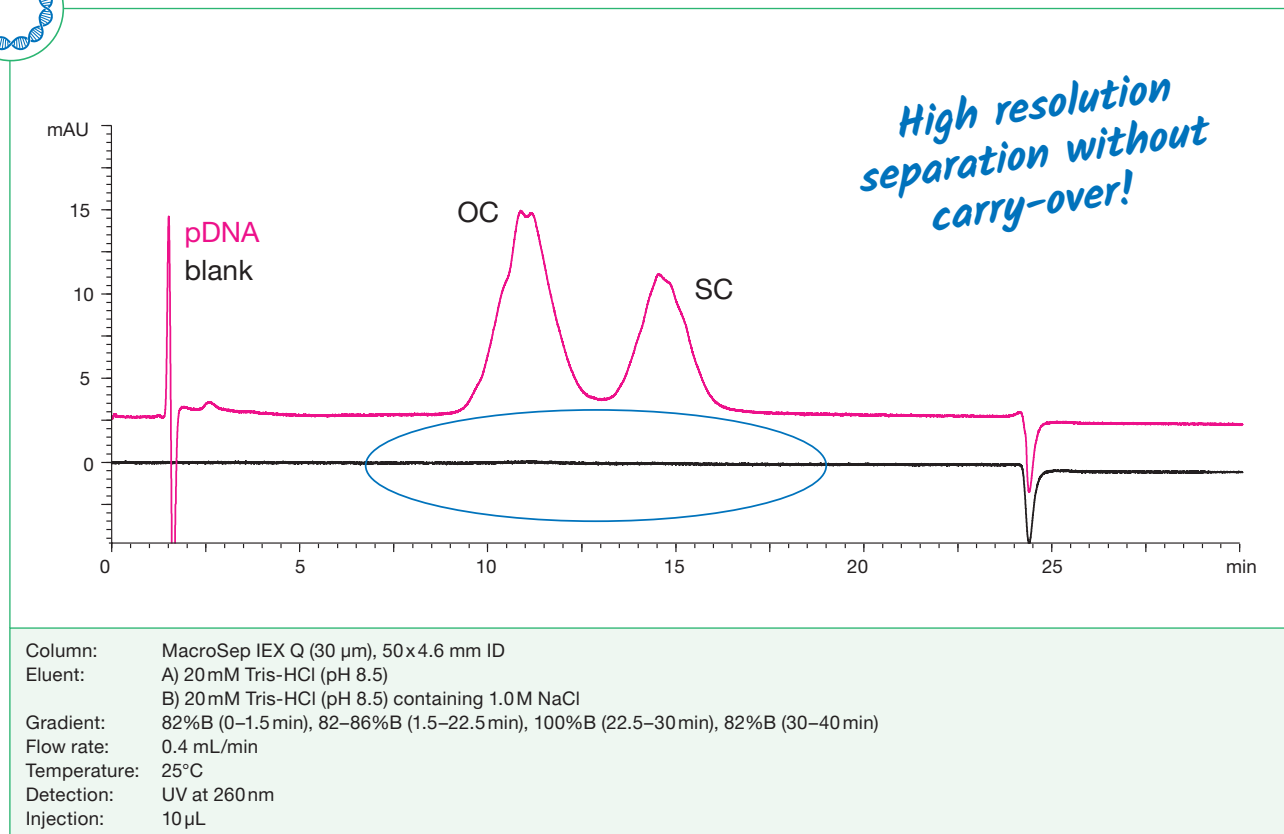
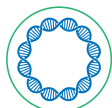
Plasmid DNA (pDNA) is crucial for the production of recombinant proteins and gene therapeutics. The separation of the super-coiled (Sc) pDNA from the non-functional species – the linearised (L) and nicked open-circular (Oc) form – is the major challenge during

the production and purification process of these complex molecules. All species are highly similar; therefore, high-resolution separation at reasonable throughput is needed.



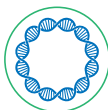
This application shows that with MacroSep IEX Q, the two highly similar pDNA species – open-circular and super-coiled – can be separated with high resolution.

This leads to a highly efficient purification process resulting in a highly pure product. The blank run verifies that no carry-over effects can be observed.

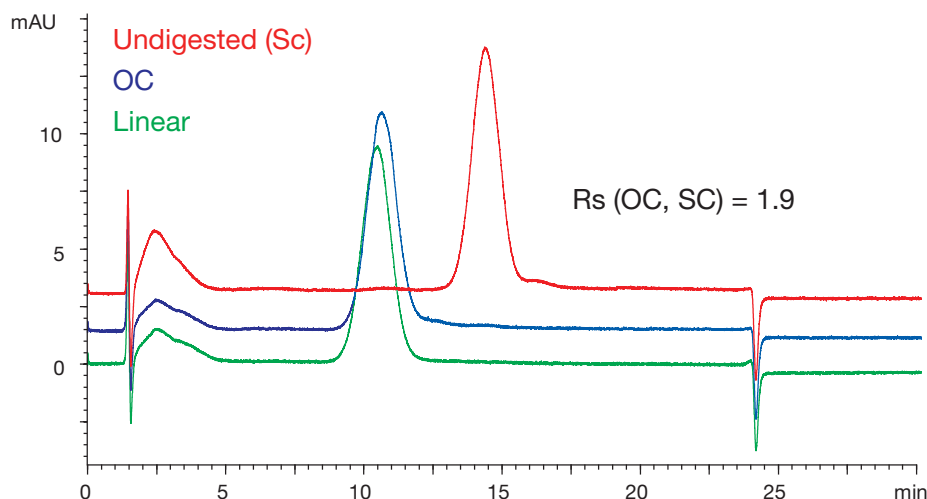


MacroSep IEX Q offers high resolution and allows an efficient separation of super-coiled DNA from the non-functional species. This leads to high purity

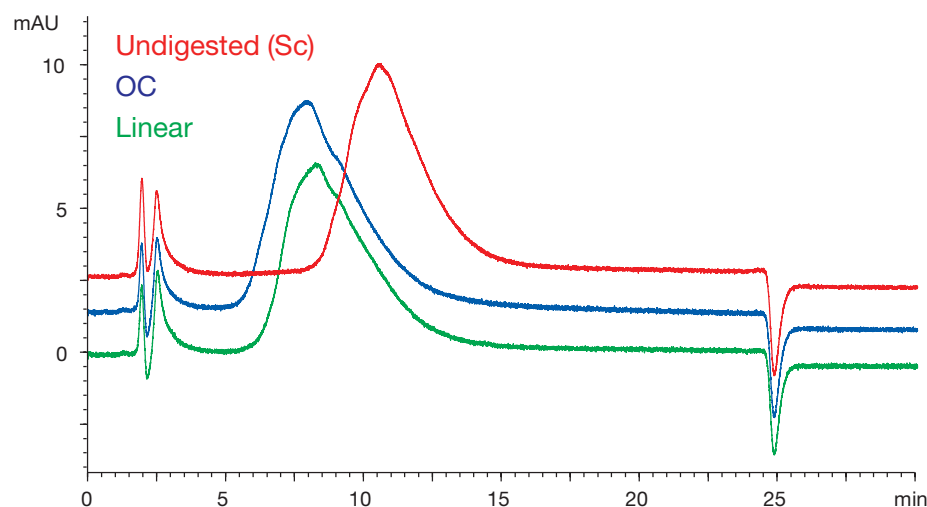
levels and increased productivity. With the alternative material, no efficient separation can be achieved for this challenging task.



MacroSep IEX Q (30 μ m) 100x4.6 mm ID



POROS 50 HQ (50 μ m) 100x4.6 mm ID



Columns: MacroSep IEX Q (30 μ m) 100x4.6 mm ID
 POROS 50 HQ (50 μ m) 100x4.6 mm ID
 Eluent: A) 20 mM Tris-HCl (pH 8.5) containing 0.7 M NaCl
 B) 20 mM Tris-HCl (pH 8.5) containing 1.0 M NaCl
 Gradient: 40%B (0–1.5 min), 40–53%B (1.5–22.5 min), 100%B (22.5–30 min), 40%B (30–40 min)
 Flow rate: 0.8 mL/min
 Temperature: 25 °C
 Detection: UV at 260 nm
 Injection: 10 μ L

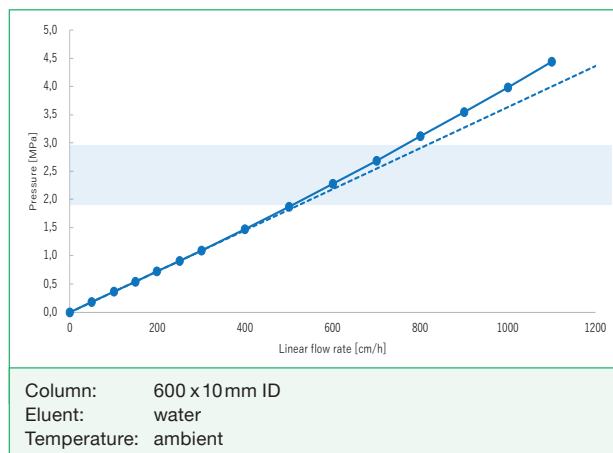
MacroSep IEX Q allows improved pDNA purification. Due to its optimal pore size, it separates the single DNA species with highest resolution.

High Flow Rates Possible with MacroSep IEX Q

The pressure-flow characteristics of a resin have a huge impact on its productivity. MacroSep IEX Q is based on hydrophilic polymer beads with excellent characteristics. The material can be used at elevated flow rates providing excellent resolution.

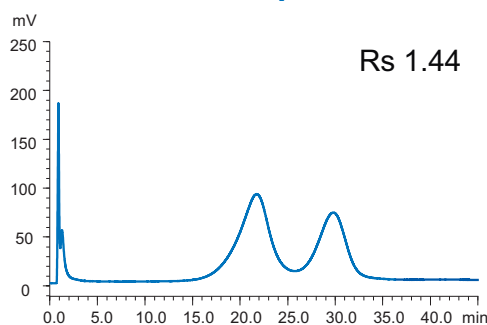
Based on the pressure-flow curve of MacroSep IEX Q, the resin shows a completely linear dependence. The typical operating pressure is about 2–3 bar.

The direct comparison of MacroSep IEX Q with an alternative material at two different flow rates clearly shows that MacroSep IEX Q provides excellent resolution, even at high flow rates. This directly leads to improved process conditions and high productivity.

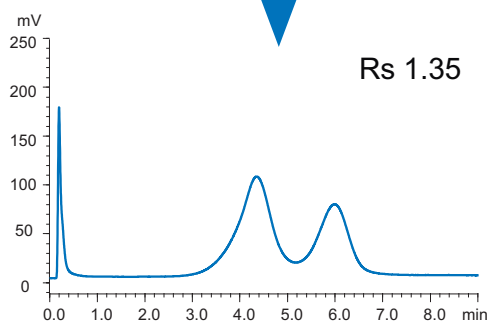


MacroSep IEX Q

Flow rate
1 mL/min
305 cm/h

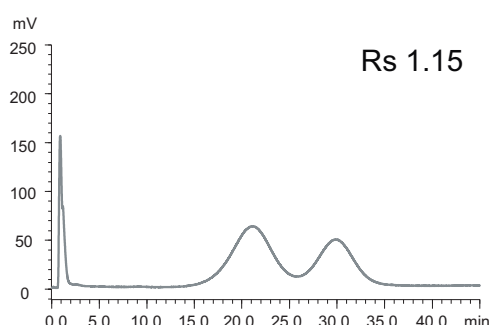


Flow rate
5 mL/min
1528 cm/h

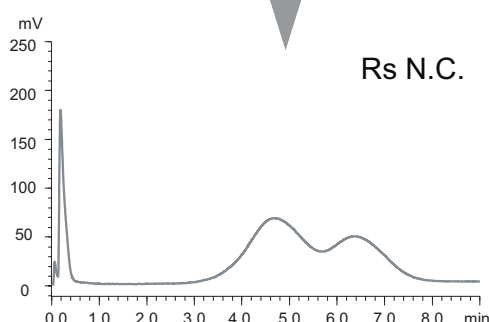


POROS 50 HQ

Rs 1.15



Rs N.C.



Columns: MacroSep IEX Q, 50x5.0 mm ID
POROS 50 HQ, 50x5.0 mm ID
Eluent: A) 20mM Bis-tris propane-HCl, (pH 9.0)
B) 20mM Bis-tris propane-HCl containing 0.5 M Tetramethyl ammonium chloride (pH 9.0)
Gradient: 10–50%B (45 CV), 100%B (10 CV), 10%B (10 CV)
Injection: 30 µL
Detection: FLS at Ex. 280nm, Em. 348nm
Temperature: 25 °C
Sample: AAV2 (1.07x10¹¹ vg/mL)

This research was supported by AMED under Grant Number JP18ae0201001

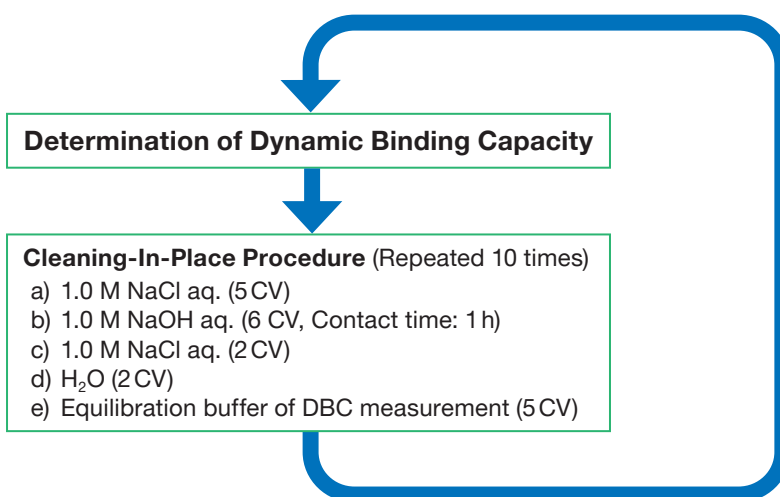
The excellent characteristics of MacroSep IEX Q lead to high productivity. Even at elevated flow rates, MacroSep IEX Q provides high resolution results.

Excellent Cleaning-in-Place Stability

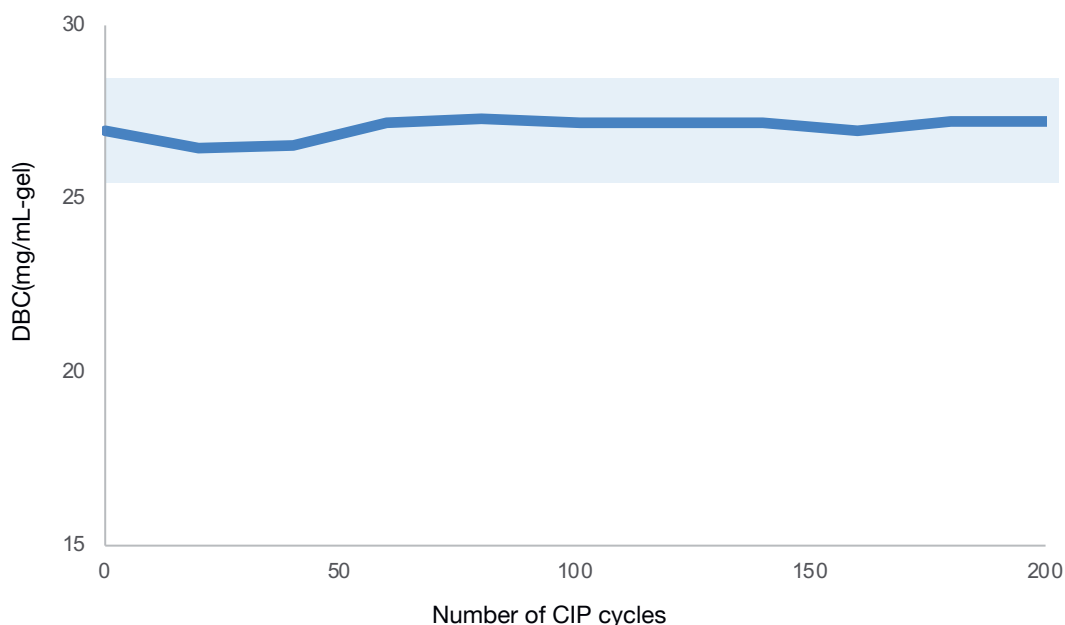
Cleaning-in-place (CIP) is an essential procedure for the economic use of packed chromatography columns. During use, nonspecific adsorption leads to a decrease in the chromatographic performance with the risk of microbial growth.

Sodium hydroxide (NaOH) solutions are well established for the removal of precipitated proteins, nucleic

acids, endotoxins and viruses. Therefore, it is the first choice for cleaning and sanitising of chromatography resins. This procedure restores the chromatographic performance and ensures a long column lifetime. To evaluate the CIP-stability of MacroSep IEX Q, the following CIP protocol was repeated multiple times.



The results of the study show that MacroSep IEX Q is completely compatible with CIP procedures using 1 M NaOH. Even after multiple treatments, the resins shows a constant dynamic binding capacity for Thyroglobulin.



MacroSep IEX Q is stable even after repetitive CIP procedures with 1 M NaOH. This enables a long life time of the packed column.

Increased Dynamic Binding Capacity with MacroSep IEX Q

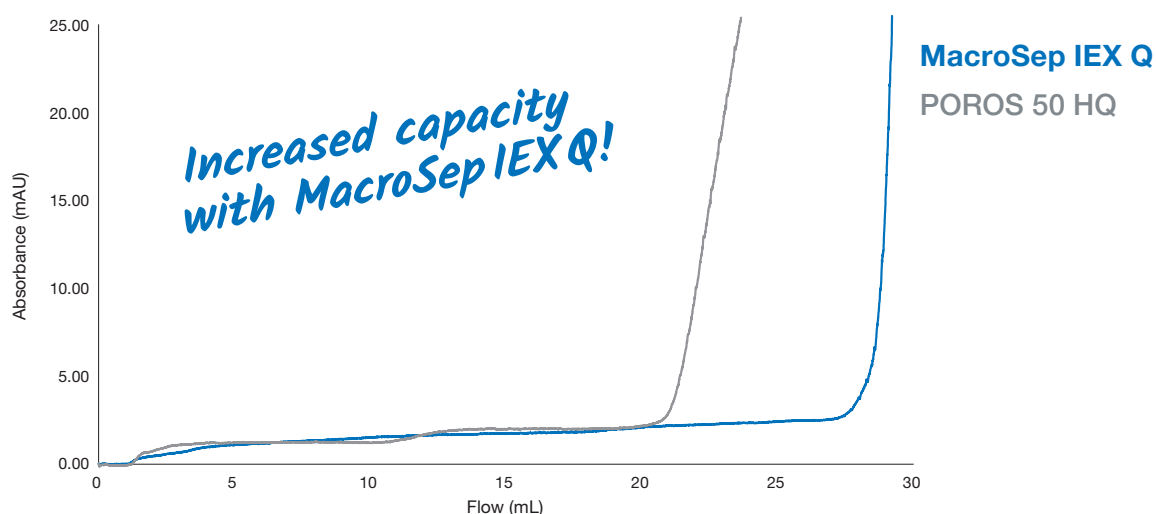
The dynamic binding capacity (DBC) of a chromatography resin is a key value of productivity. The higher the DBC, the higher the loadability of the packed column and thus the higher the throughput of the process. Large biomolecules require optimised resins with macro-porous structures for an efficient binding. Bead-based resins with large pores like MacroSep IEX Q offer an optimal binding of large molecules in combination with the advantages of chromatography

resin, such as scalability and the possibility of self-packing. Therefore, it is the optimal solution for every purification from laboratory to large scale with high productivity.

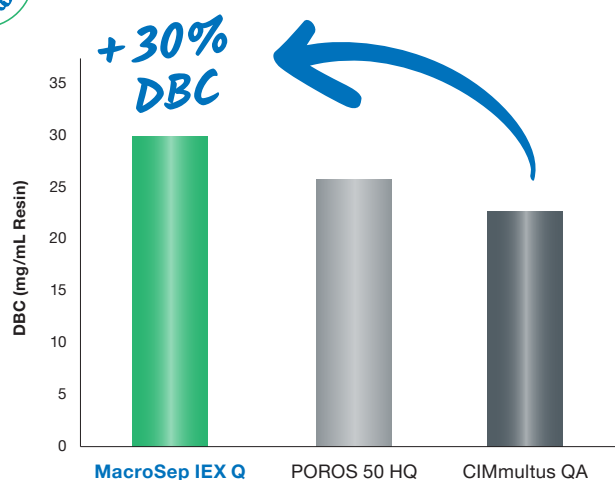
In this example, the DBC values of three different materials for Thyroglobulin, a large protein complex with 660 kDa, were determined. MacroSep IEX Q shows the highest DBC and therefore is the ideal solution for the purification of large biomolecules.



Breakthrough Experiments:



Column dimensions: 50x5.0 mm ID
Temperature: 25 °C
Detection: UV at 280nm



Resin	DBC (mg/mL Resin) Thyroglobulin MW 660 kDa
MacroSep IEX Q	30
POROS 50 HQ	26
CIMmultus QA	23

**With MacroSep IEX Q, high DBC values for large biomolecules are achieved!
This directly leads to increased productivity.**

Specifications

Specifications	MacroSep IEX Q
Matrix	methacrylate-based hydrophilic porous polymer
Charged Group	-R-N ⁺ (CH ₃) ₃
Particle Size	30 µm
Pore Size	900 nm
pH Range	2–12
Pressure Resistance	regular use: 2 MPa max: 3 MPa
Ion Exchange Capacity	min 0.08 meq/mL-resin
Compression Factor	1.05
Temperature	4–60 °C

Ordering Information and Packaging Sizes

Product	Code	Pack Sizes					
		50 mL	250 mL	1 L	5 L	10 L	20 L
MacroSep IEX Q	QM99S30	✓	✓	✓	✓	✓	✓

Screening Options

			
Bulk Packing Material	MiniChrom™ Columns	Screening Kit	Analytical Columns
Chromatography resins for self-packing	Prepacked columns with different dimensions and volumes	Prepacked columns (1 mL and 5 mL)	Prepacked bioinert columns in analytical dimensions

BioPro IEX: The Ideal Resin in DSP



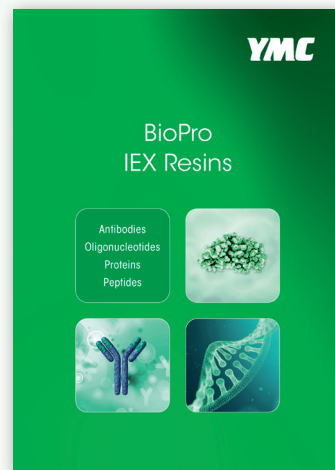
Antibodies



Proteins and peptides



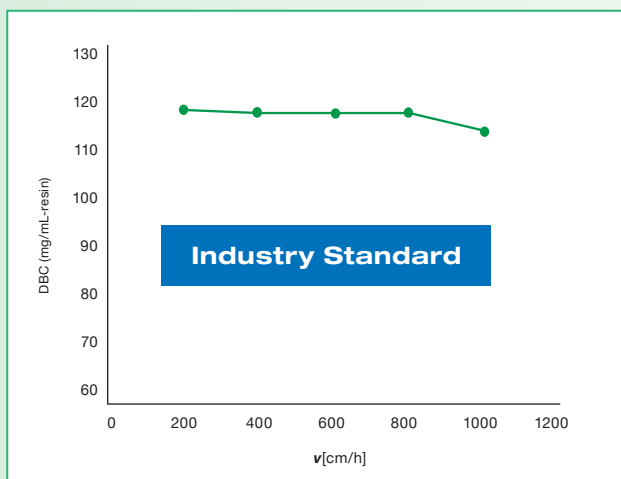
Oligonucleotides



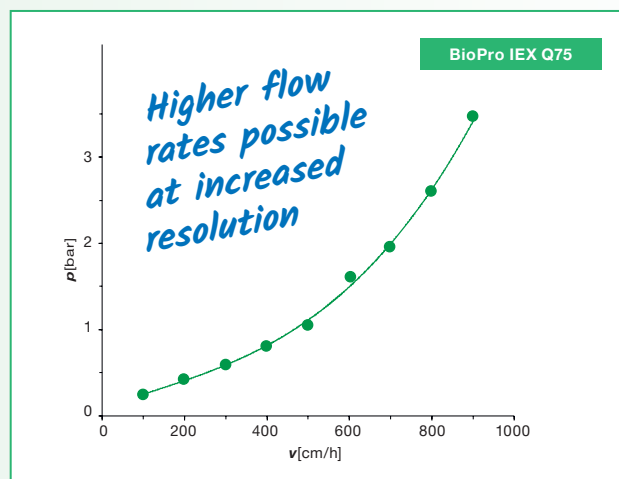
BioPro IEX Brochure

Your Advantages

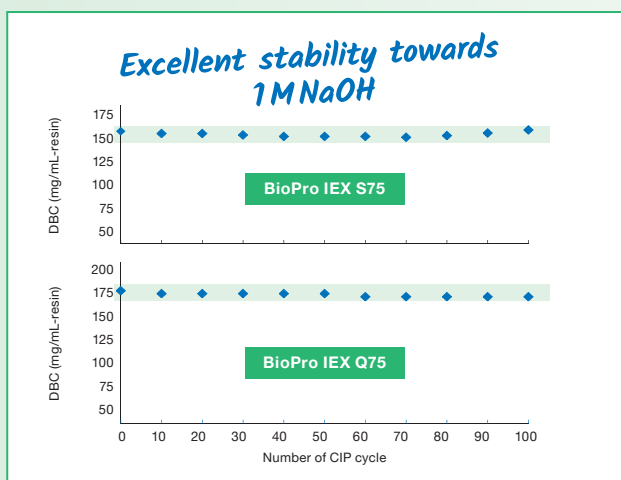
High Capacity



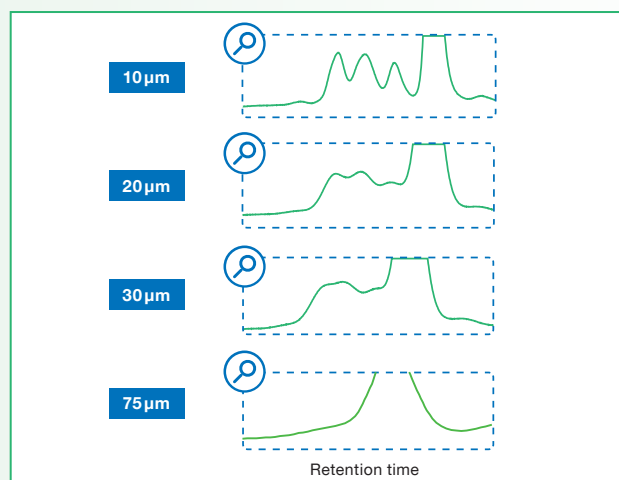
High Flow Rates Possible



Long Lifetime



Multiple Particle Sizes



Further information about BioPro IEX



Ideal Column Hardware for the YMC Resins – the YMC Glass Columns for Lab and Pilot Scale



- ✓ Inner diameter: 5–450 mm ID
- ✓ Completely biocompatible
- ✓ Easy handling
- ✓ Reliable and long-lasting



*Your
partner
in DSP!*



Further Information about Glass Columns



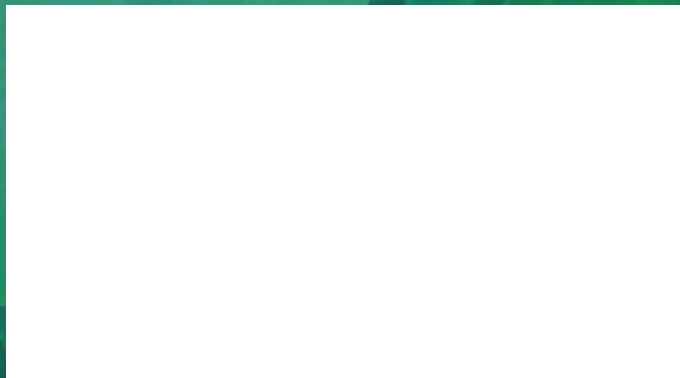
Pre-Packed Glass Columns from YMC



*Your
Ready-to-Use
MacroSep IEX Q
Columns*

- ✓ Based on your requirements
- ✓ Easy process with reliable results
- ✓ Refill service possible

Your local contact:



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