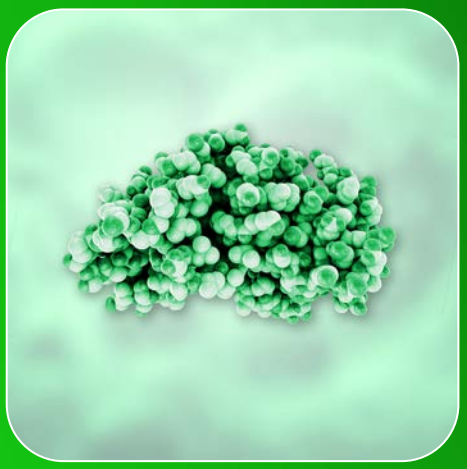
YMC

BioPro
IEX Resins

Antibodies
Oligonucleotides
Proteins
Peptides



BioPro IEX

Designed for bioseparation

Antibodies

Oligonucleotides

Proteins and peptides

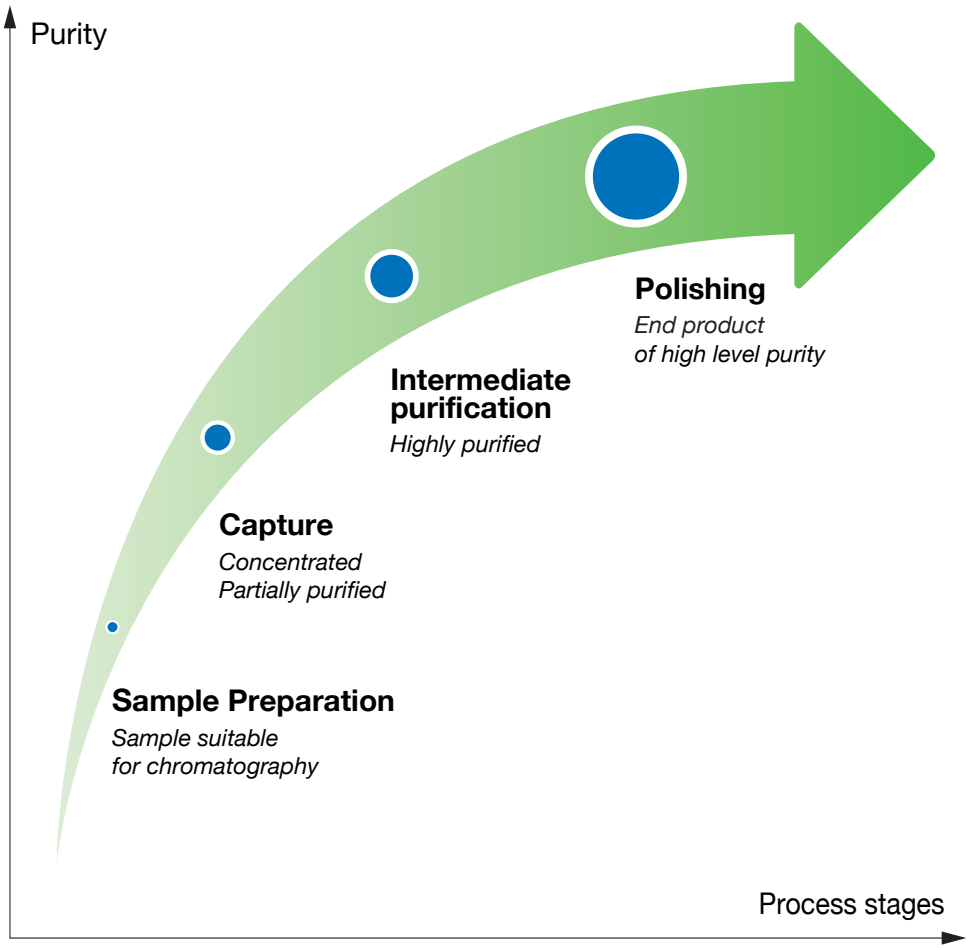
Contents

Learn more about method development and IEX

Whitepaper
Purification of Proteins and Antibodies via
Ion Exchange Chromatography
Theoretical and Practical Aspects of Method Development

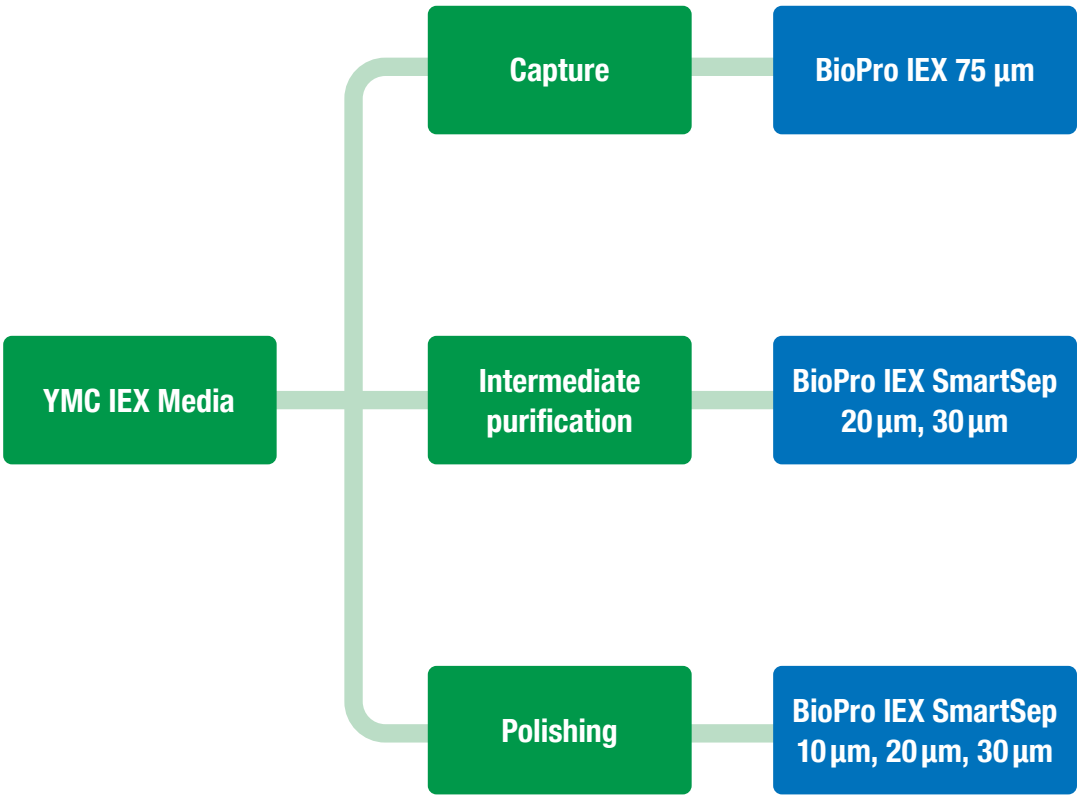
A purification strategy usually includes three parts:

- Initial product capture
- Intermediate purification stages
- The final polishing step



The capture step aims at isolating and concentrating the targets. It requires that the media has a high binding capacity even at high flow rates and easy scale-up steps. The intermediate purification is for removing the bulk impurities.

The polishing step is used for removing all traces of impurities. The corresponding media should exhibit high resolution and low non-specific adsorption. YMC´s IEX resins can be used for all stages during the whole process from the capture to the final polishing.



YMC resins can be used in:

- Bind/elute-mode
- Flow-through-mode

YMC resins are used in various applications:

- Antibodies
- Proteins
- Peptides
- Oligonucleotides

Flow-through-mode for the removal of impurities such as:

- DNA
- Viruses
- Host cell proteins
- Aggregates

Selection Tool: Target Molecules

Antibodies and Proteins

AEX & CEX

Flow-through-mode	BioPro IEX 75 µm
Capture	BioPro IEX 75 µm
Intermediate purification	BioPro IEX SmartSep 20 µm, 30 µm
Polishing	BioPro IEX SmartSep 20 µm, 30 µm

Oligonucleotides and Nucleic Acids

AEX

Intermediate purification	BioPro IEX SmartSep 20 µm, 30 µm
Polishing	BioPro IEX SmartSep 10 µm, 20 µm

Screening Guide

Bulk Packing Material

Chromatography resins for self-packing

BioPro Screening Kit

Prepacked columns (1 mL and 5 mL)

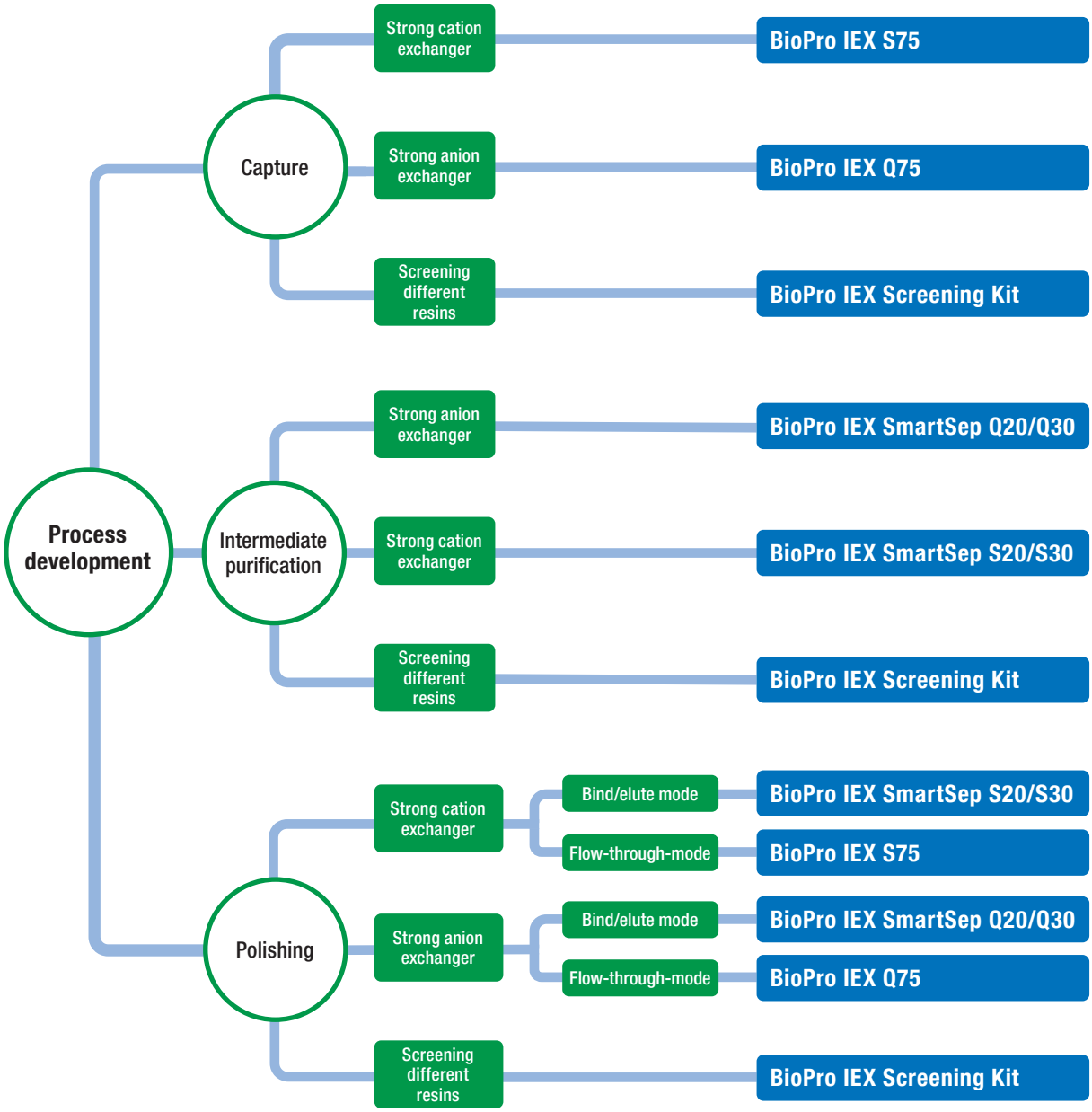
MiniChrom™ Columns

Prepacked columns with different dimensions and volumes

Analytical Columns

Prepacked bioinert columns in analytical dimensions
50 x 4.6 mm ID
100 x 4.6 mm ID

Selection Tool: Process Step



BioPro IEX Resins
Screening Kits

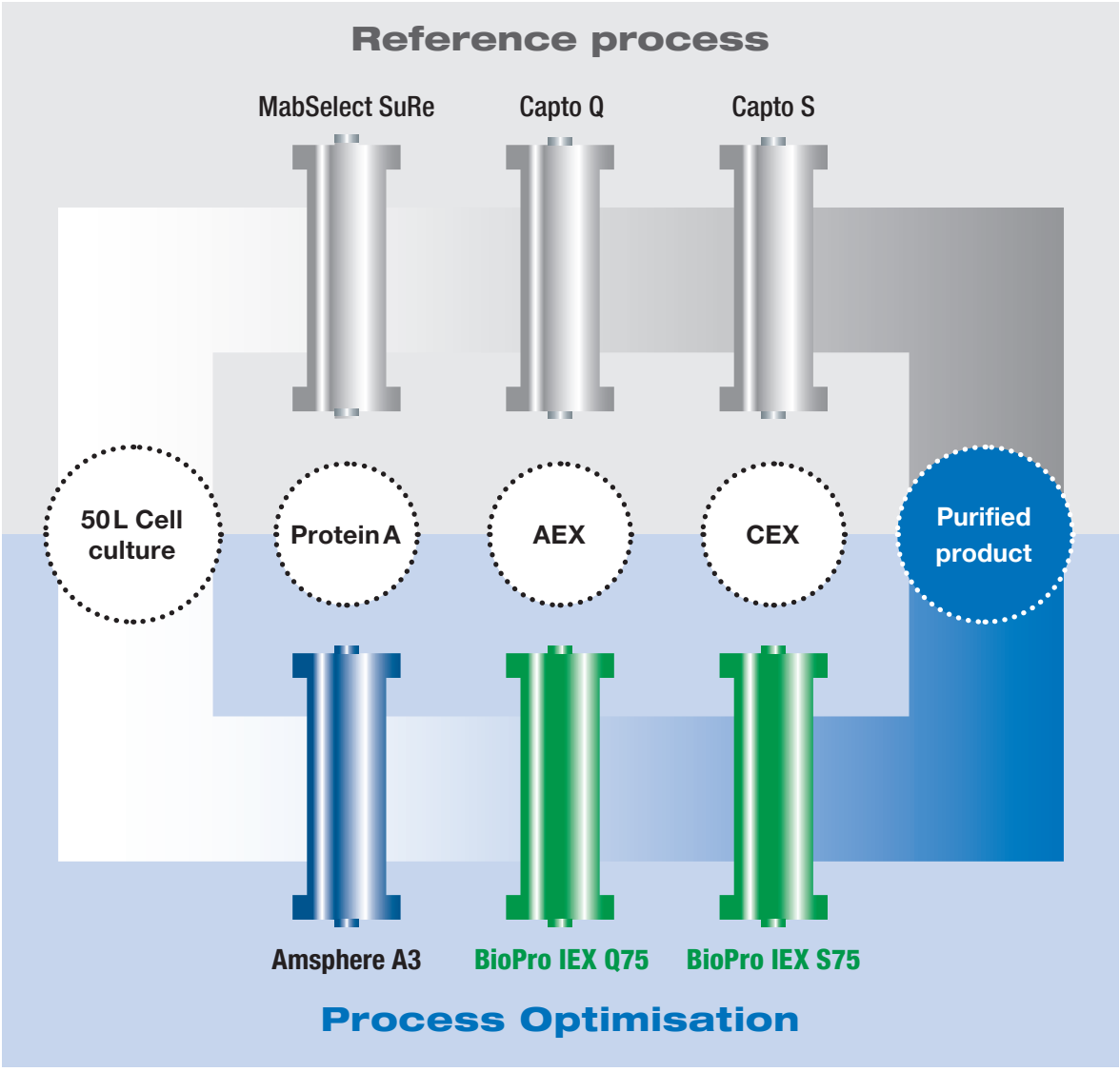
Various types of screening kits available

Please contact your YMC representative

Purification of Monoclonal Antibodies

Case Study I: Three-Step mAb Purification

The purification of a mAb from a 50 L CHO cell culture was studied under GMP conditions using BioPro IEX S75 and BioPro IEX Q75 ion exchange resins. The final three-step process succeeded in producing mAbs with high purity and efficiency. The results were directly compared with those achieved using competitive IEX resins under identical conditions.



Process flow sheet

This shows the resins used for the three-step reference and the improved process

- Step 1: Affinity chromatography using Amsphere A3 resin from JSR Life Sciences for a first clean-up of the cell culture
- Step 2: Anion exchange chromatography using YMC´s BioPro IEX Q75 resin after dilution with 25 mM Tris-HCl buffer
- Step 3: Cation exchange chromatography using YMC´s BioPro IEX S75 as the final polishing step

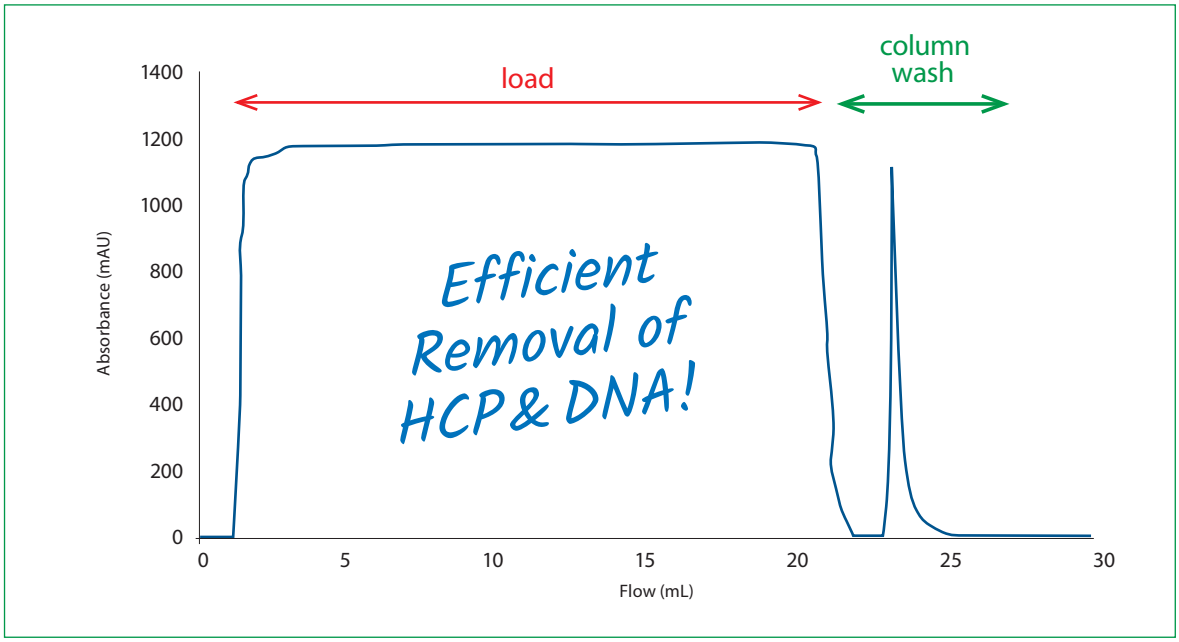
Use of an identical process sequence and identical experimental conditions ensured full comparability of the results

Case Study I: Three-Step mAb Purification

Anion exchange process conditions

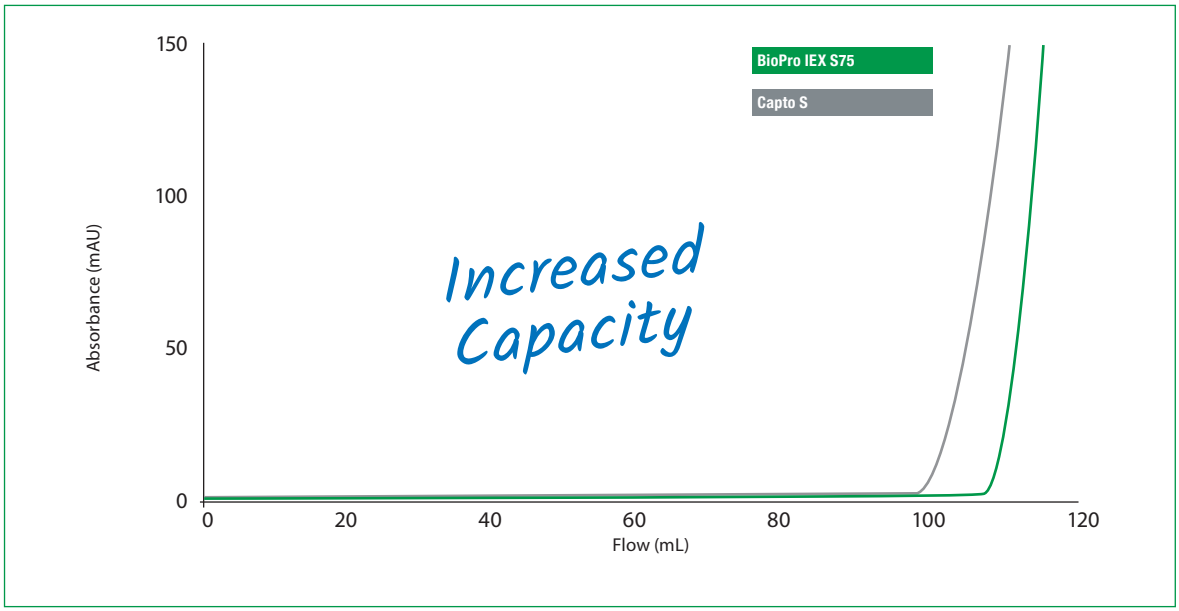
- The highly efficient removal of host cell protein (HCP) and DNA was achieved using YMC's BioPro IEX Q75.
- An optimisation study was carried out to evaluate the influence of pH on this step. Product yield and residual HCP concentration were constant between pH 8.0 and 9.0.

➜ robust & flexible process!



Cation exchange process conditions

- Comparison of the DBC breakthrough curves for BioPro IEX S75 and a competitive resin
- An increased capacity is clearly visible and this improves the efficiency of the overall process with a larger amount of product purified with each chromatographic cycle.



Case Study I: Three-Step mAb Purification

An improved purification process was successfully developed. The results shown in the table below clearly indicate the potential for process optimisation achievable using YMC resins. By addressing this potential, purities and yields can be improved to increase the overall productivity and the cost-efficiency of the related processes.

Results for improved three-step process for the purification of IgG compared to the reference process

Process step	HCP (ng/mg IgG)		DNA (pg/mg IgG)		mAb Monomer (%)	
Cell culture fluid (Ref.)	127,000		66,900,000			
	Ref.	YMC / JSR	Ref.	YMC / JSR	Ref.	YMC / JSR
Protein A capture	194	145	26,200	18,000	–	98.6
AEX	4.57	**0.64**	1.12	**< 0.44**	92.2	**98.5**
CEX	3.04	**0.46**	1.98	**< 0.12**	93.9	**98.6**

More Efficient Removal of HCP and DNA

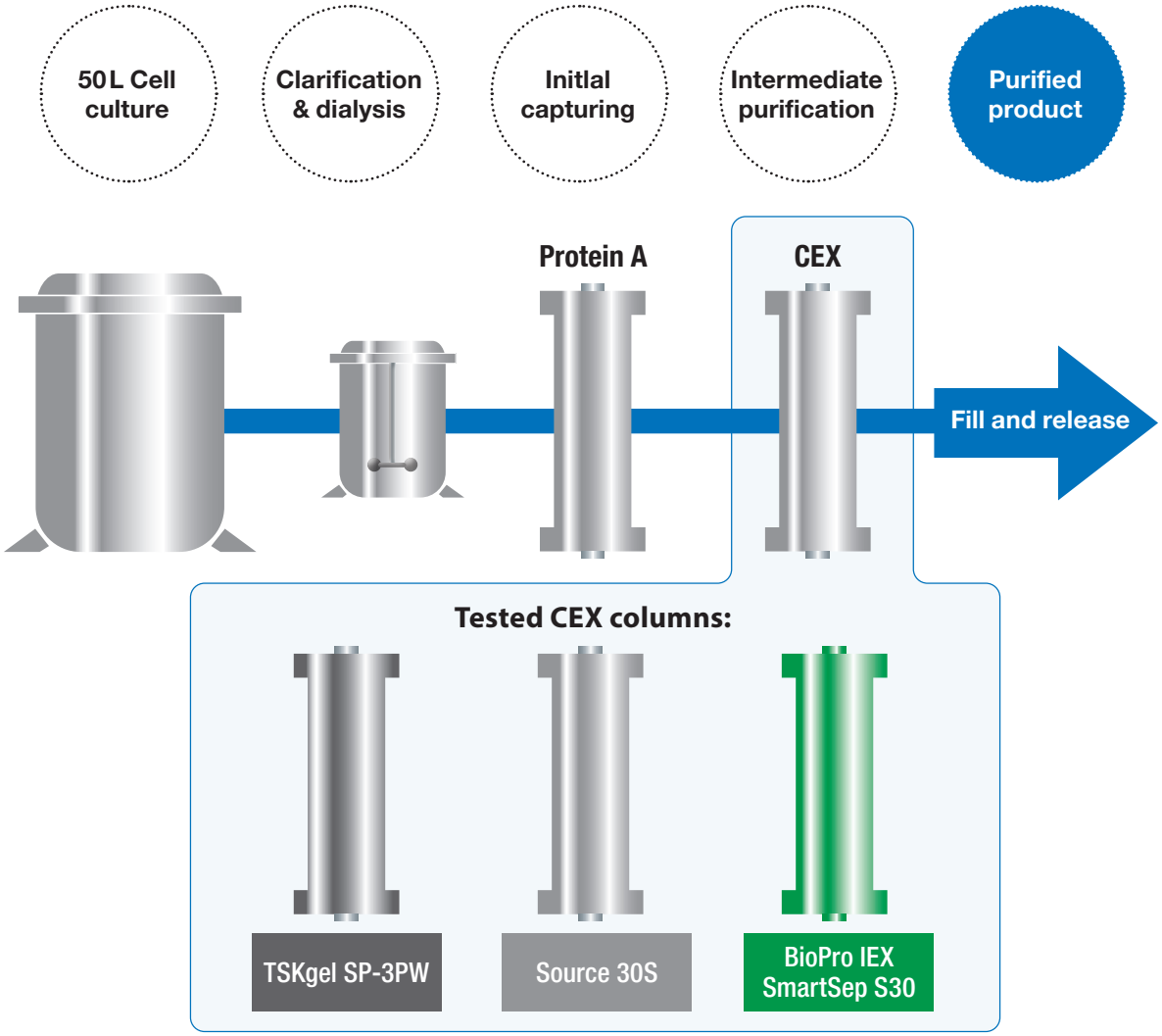
Result summary

- The highly effective purification of the developed process is apparent
- YMC´s BioPro IEX resins are the ideal choice for efficient purification of mAbs
- The AEX step was particularly effective in reducing residual impurities
- The CEX step was successful as the last step for polishing, removing the remaining trace contaminants
- With 98.6% yield the process had a very high recovery of purified mAbs

Technical Note
Efficient mAb Purification with BioPro IEX

Case Study II: Adalimumab Purification – CEX-Step Optimisation

For the purification of monoclonal antibodies high demands are required from the resin used. Factors influencing the binding characteristics of IgG are pH, linear velocity and/or salt concentration (conductivity) at the time the sample is loaded onto the column. Therefore, a resin with highly stable performance is required with regard to all those factors. In order to demonstrate the performance of BioPro IEX resins, several studies have been performed.



Study paramters:

The influence of pH, linear velocity and salt concentration on the binding capacity of IgG on different CEX resins was investigated.

Experimental conditions

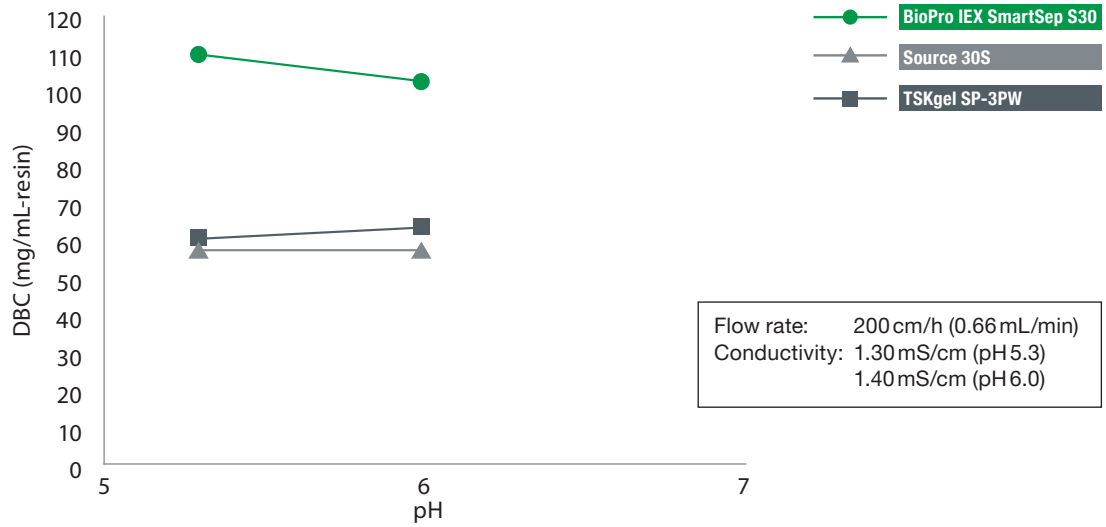
pH:	6.0 vs. 5.3
Linear velocity:	200–800 cm/h
Salt concentration:	0–50 mM NaCl

Column:	50 x 5.0 mm ID	Temperature:	ambient (25 °C)
Eluent:	A) 20 mM citric acid-NaOH buffer (pH 5.3 or 6.0)	Detection:	UV at 280 nm
		Sample:	1.5 mg/mL human polyclonal IgG in equilibration buffer
	B) Eluent A containing 0.5 M NaCl		
Flow rate:	200–800 cm/h (0.66–2.62 mL/min)		

Case Study II: Adalimumab Purification – CEX-Step Optimisation

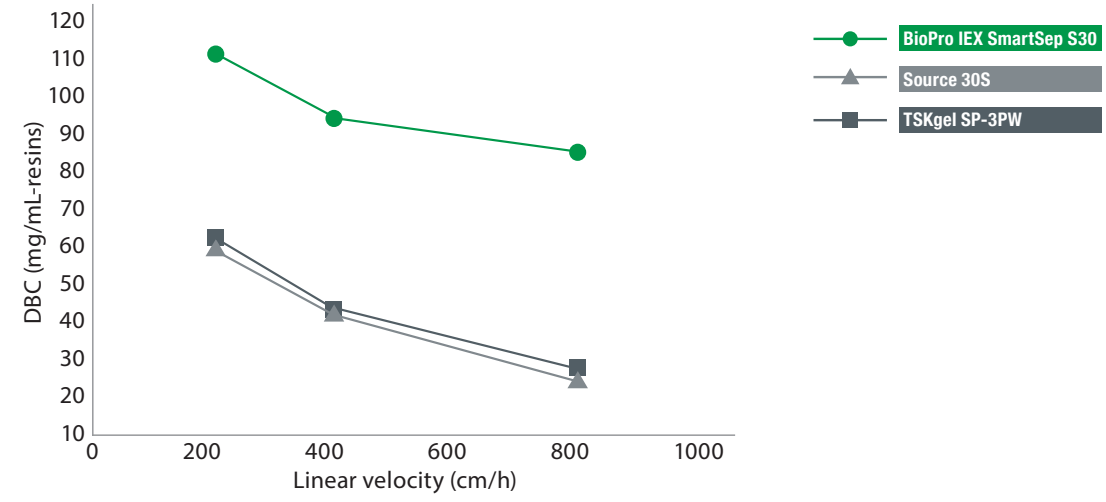
Influence of pH

pH	DBC (mg/mL-resin, 10% breakthrough)	
	pH 5.3	pH 6.0
BioPro IEX SmartSep S30	**110**	**103**
TSKgel SP-3PW (30 µm)	61	64
Source 30S (30 µm)	58	58



Influence of linear velocity

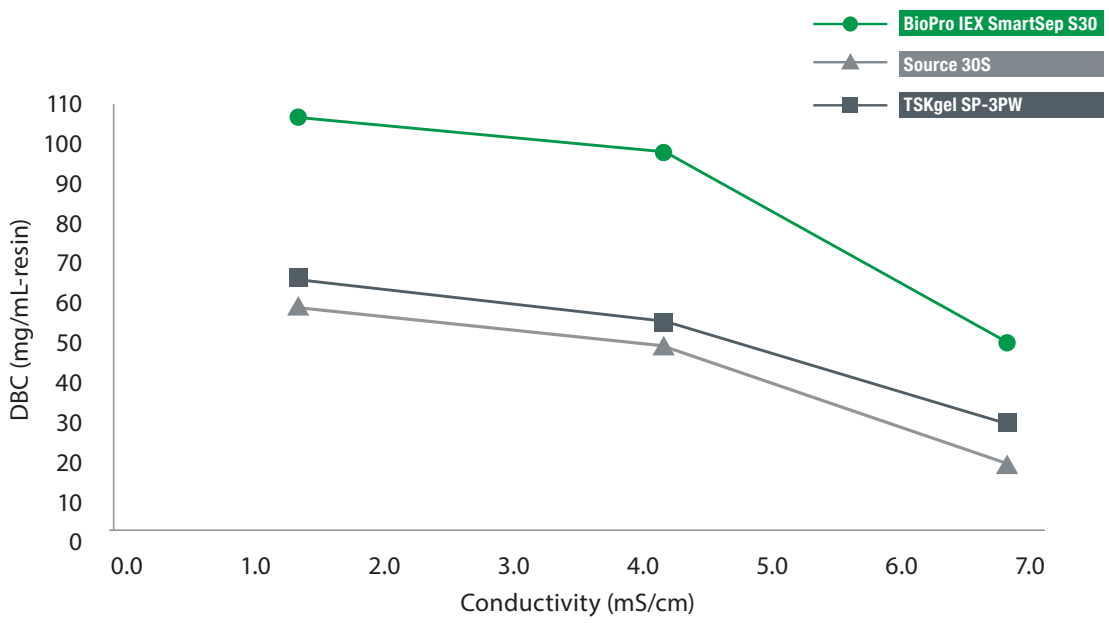
Linear velocity	DBC (mg/mL-resin, 10% breakthrough)		
	200 cm/h	400 cm/h	800 cm/h
BioPro IEX SmartSep S30	**110**	**93**	**84**
TSKgel SP-3PW (30 µm)	61	42	26
Source 30S (30 µm)	58	41	23



Case Study II: Purification of Adalimumab

Influence of salt concentration

	DBC (mg/mL-resin, 10% breakthrough)		
pH	**5.3**		
NaCl concentration	**0 mM**	**25 mM**	**50 mM**
Conductivity	**1.36 mS/cm**	**4.14 mS/cm**	**6.8 mS/cm**
BioPro IEX SmartSep S30	**107**	**97**	**50**
TSKgel SP-3PW (30 µm)	64	55	27
Source 30S (30 µm)	58	49	19



Flow rate: 200 cm/h (0.66 mL/min)
Sample: 1.5 mg/mL human polyclonal IgG in equilibration buffer containing 0, 25, 50 mM NaCl

BioPro IEX SmartSep S30 outperforms the alternative materials under all experimental conditions:

High binding capacities are achieved regardless of the pH of elution. Therefore, milder eluting conditions for IgG can be selected to protect the product purity.

BioPro IEX SmartSep S30 maintains higher binding capacity values over a wider range of linear velocities. This will increase the product throughput for the purification process.

BioPro IEX SmartSep S30 has a higher tolerance to salt concentration. This simplifies the desalting process after Protein A chromatography and will help to shorten the production process.

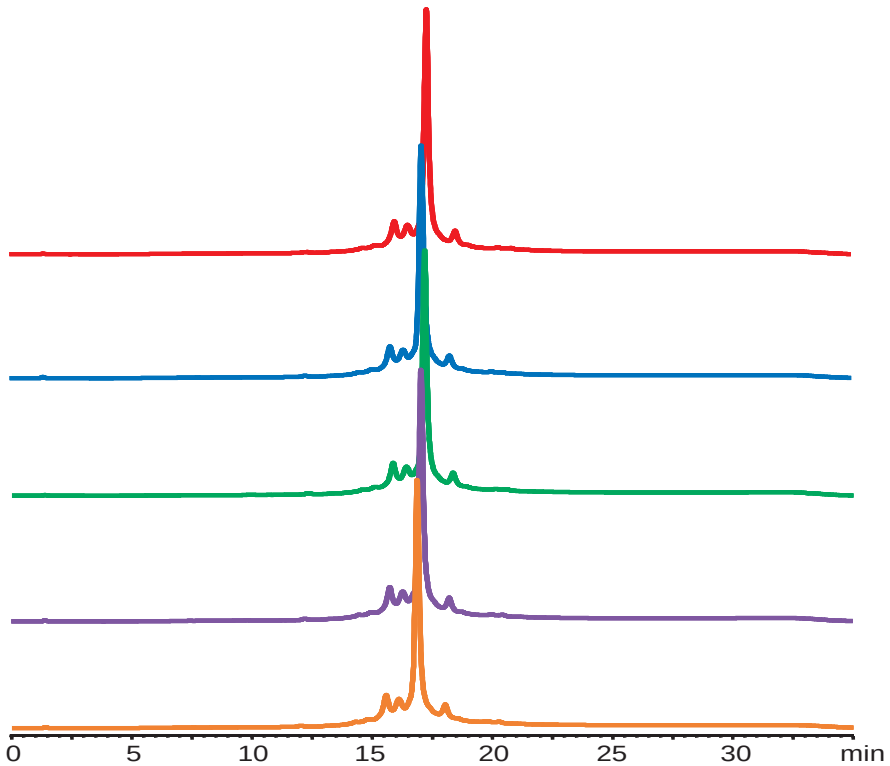
Case Study II: Purification of Adalimumab

Conclusions

BioPro IEX SmartSep resins meet the highest demands for the purification of monoclonal antibodies. High binding capacity is achieved regardless of elution of pH, linear velocity or salt concentration. This allows purification processes to be carried out more efficiently.

- **Higher throughput with no loss of efficiency**
- **Simplification of desalting processes**
- **Reduced processing costs**
- **Short delivery time for industrial-scale quantities**
- **Full compliance with GMP regulations**

Application Note
Purification of Monoclonal Antibodies with BioPro IEX SmartSep



Purified monoclonal antibody IgG1

Purification of Oligonucleotides

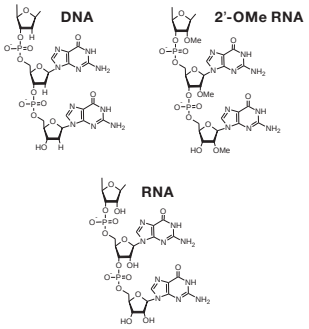
Oligonucleotide Separation with Optimised Conditions

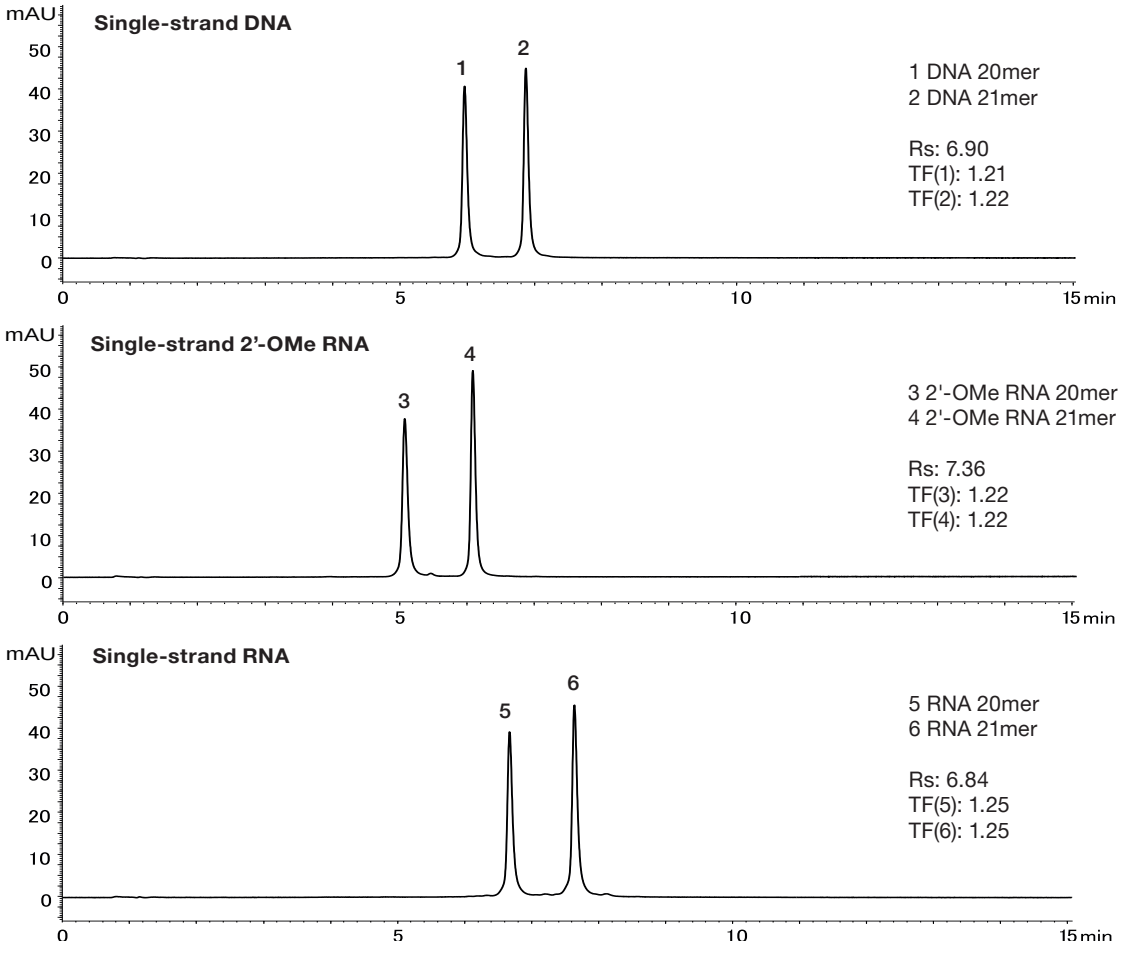
Nucleic acids such as antisense RNA (asRNA), small interfering RNA (siRNA) and aptamers are examples for the next generation of pharmaceuticals. In order to provide these drugs, purification and analytical separations that can recognize slight structural differences after synthesis are important issues.

Samples

1	Single-strand DNA	5'-TCATCACACTGAATACCAAT-3' (DNA 20mer)
2		5'-GTCATCACACTGAATACCAAT-3' (DNA 21mer)
3	Single-strand RNA	5'-U(M)C(M)A(M)U(M)C(M)A(M)C(M)A(M)C(M)U(M)G(M)A(M)A(M)U(M)A(M)C(M)C(M)A(M)A(M)U(M)-3' (2'-OMe RNA 20mer)
4		5'-G(M)U(M)C(M)A(M)U(M)C(M)A(M)C(M)A(M)C(M)U(M)G(M)A(M)A(M)U(M)A(M)C(M)C(M)A(M)A(M)U(M)-3' (2'-OMe RNA 21mer)
5		s5'-UCAUCACACUGAAUACCAAU-3' (RNA 20mer)
6		5'-GUCAUCACACUGAAUACCAAU-3' (RNA 21mer)

N(M)=2'-OMe RNA





Column: BioPro IEX QF (5 µm) 100 x 4.6 mm ID
Part No.: QF00S05-1046WP
Eluent: A) 10 mM NaOH
B) 10 mM NaOH containing 1.0 M $NaClO_4$
Gradient: 25–55%B (0–15 min), 100%B (15–20 min)

Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV at 260 nm
Injection: 4 µL (5 nmol/mL each)

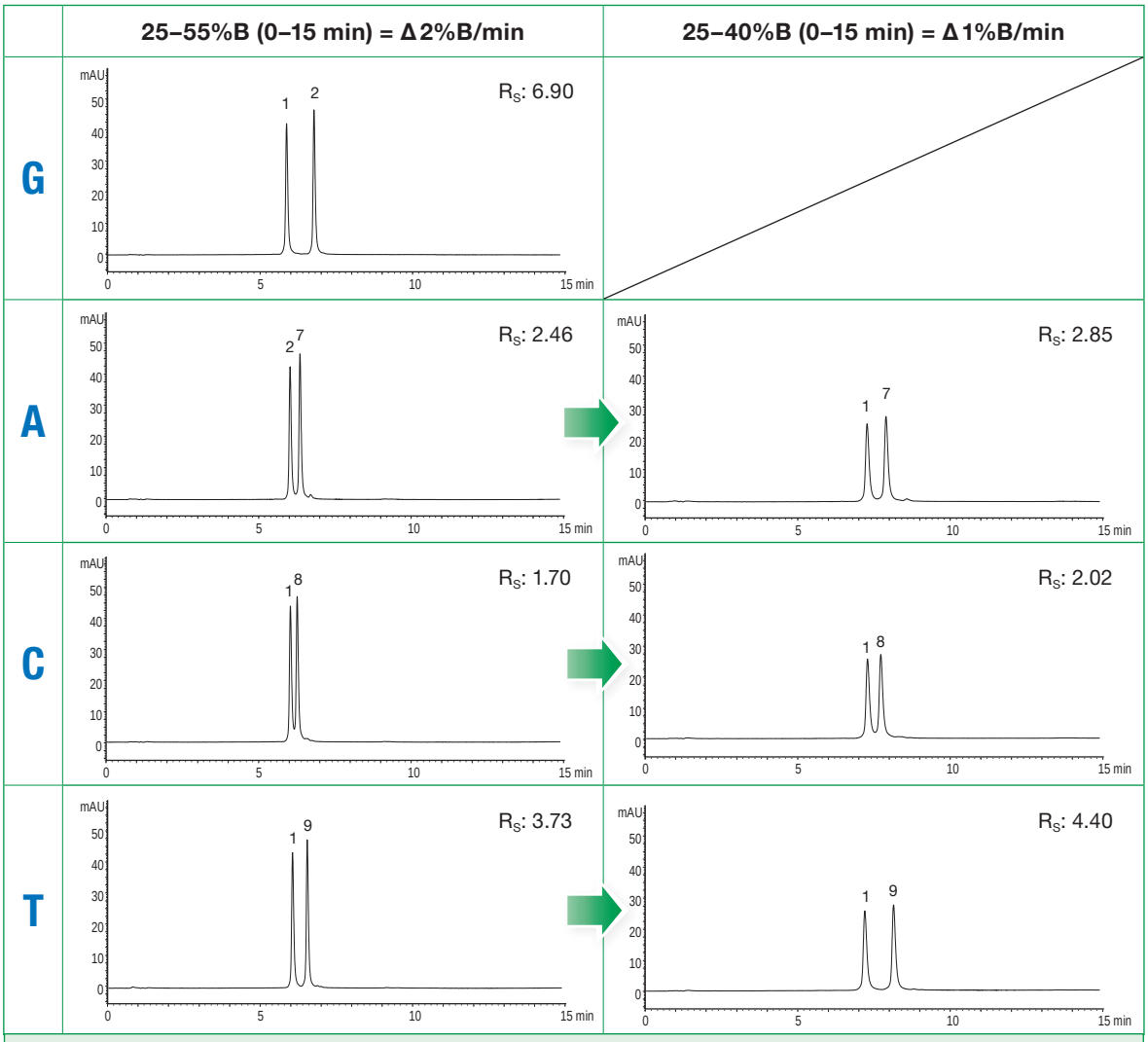
Good separation without carry over or peak tailing of oligonucleotides was achieved by optimisation of the buffer/counter ion in the mobile phase and gradient profile, and by using the non porous anion exchange column BioPro IEX QF.

Separation of ssDNAs With Single-Base Differences

Samples

1	Single-stranded DNA	5'-TCATCACACTGAATACCAAT-3' (DNA 20mer)
2		5'-**G**TCATCACACTGAATACCAAT-3' (DNA 21mer)
7		5'-**A**TCATCACACTGAATACCAAT-3' (DNA 21mer)
8		5'-**C**TCATCACACTGAATACCAAT-3' (DNA 21mer)
9		5'-**T**TCATCACACTGAATACCAAT-3' (DNA 21mer)

When ssDNAs (single-stranded DNAs) with single-base differences (differing in the type of base of 5' end of DNA 21mer) are analysed under the conditions described, all of the peak separations got worse. By using a shallower gradient, improved separations could be achieved.



Column: BioPro IEX QF 5 µm, 100 x 4.6 mm ID
Eluent: A) 10 mM NaOH
B) 10 mM NaOH containing 1.0 M $NaClO_4$
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV at 260 nm
Injection: 4 µL (each 5 nmol/mL)

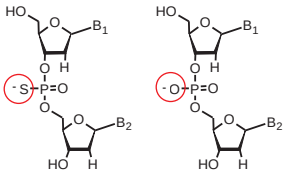
Resolution of Phosphorothioate Oligonucleotides With Different Degrees of Thiolation

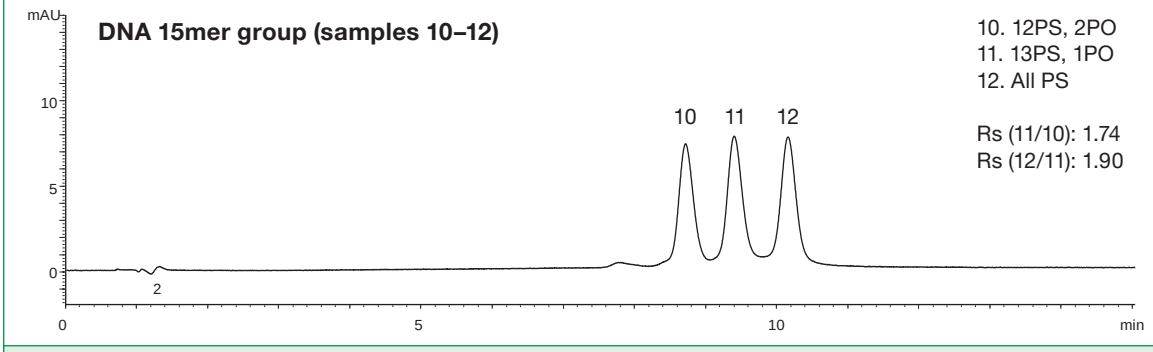
Using the optimised conditions described, [all PS], [13PS, 1PO] and [12PS, 2PO] of DNA 15mer (samples 10–12) were clearly separated by ion exchange chromatography.

Samples

10	Single-stranded DNA	5'-T^T^T^T^T^T^T^T^T^T^T^T^T^TTT-3' (DNA 15mer 12PS, 2PO)
11		5'-T^T^T^T^T^T^T^T^T^T^T^T^T^TT-3' (DNA 15mer 13PS, 1PO)
12		5'-T^T^T^T^T^T^T^T^T^T^T^T^T^T^T-3' (DNA 15mer All PS)

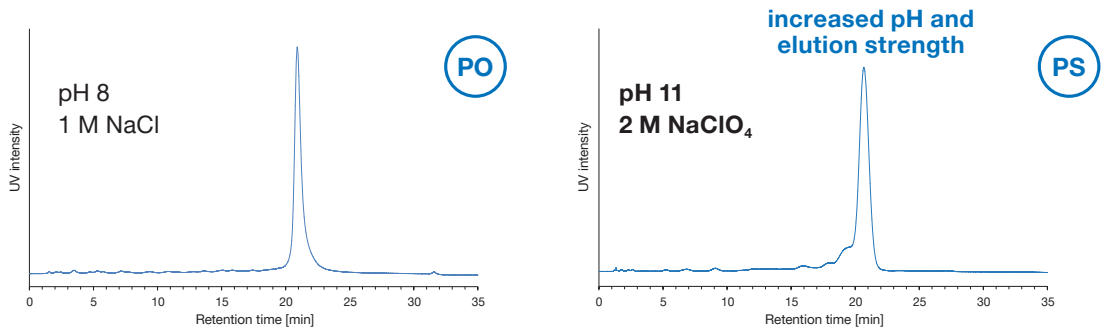
^=Phosphorothioated





Column: BioPro IEX QF 5 µm, 100 x 4.6 mm ID
Eluent: A) 10 mM NaOH
B) 10 mM NaOH containing 1.0 M $NaClO_4$
Gradient: 40–70%B (0–15 min), 100%B (15–20 min)
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV at 260 nm
Injection: 6 µL (each 3.3 nmol/mL)

Difference in required salt concentrations for eluting modified DNA (All PS) and normal DNA (All PO)



Column Dimension: 100 × 4.6 mm ID
Resin Part No.: BioPro IEX SmartSep Q10 (10 µm): QSA0S10
Eluent: A) 10 mM Tris (pH 8) or 10 mM NaOH
B) 10 mM Tris (pH 8) containing 1 M NaCl or 10 mM NaOH containing 2 M $NaClO_4$
Gradient: 20–70%B (0–30 min), 70–100%B (30–35 min) or 20–40%B (0–30 min), 40–100%B (30–35 min)
Flow rate: 0.2 mL/min
Temperature: 25 °C
Detection: UV at 260 nm
Sample: 5'-TCT CTA TCA ATA TCG TGG-3' (DNA 18mer)

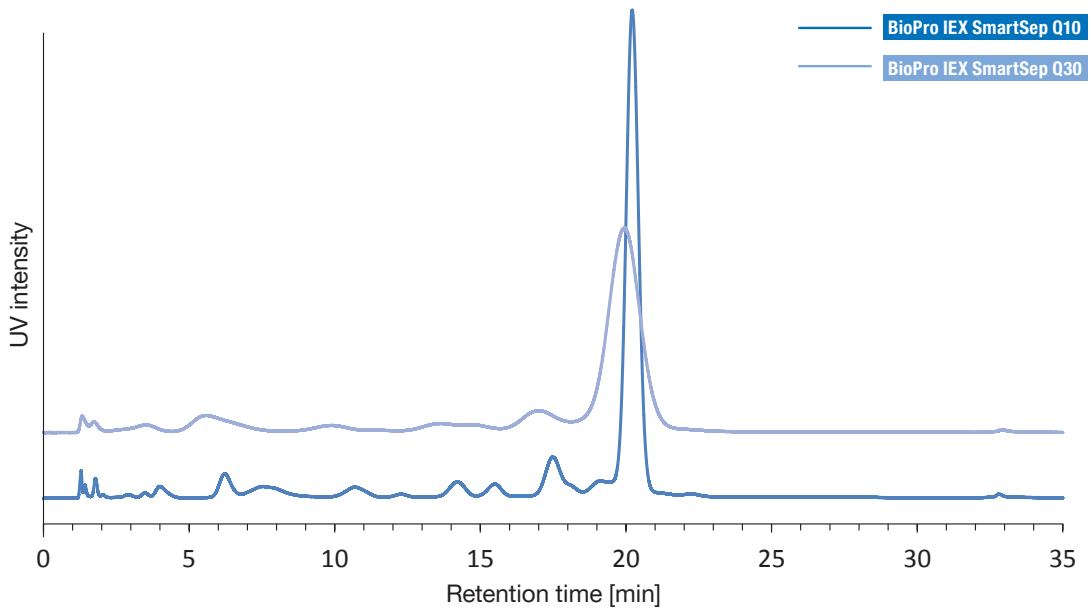
Conclusions

By using BioPro IEX:

- **Each ssDNA, ssRNA and 2'-OMe ssRNA with single-base differences in length can be successfully separated.**
- **[All PS], [13PS, 1PO] and [12PS, 2PO], which consist of 15mer ssDNA, can also be separated under the optimised conditions.**
- **Higher salt concentration is required to elute All PS compared to eluting All PO.**
- **All PS with single-base differences in length can be separated to a limited extent and for further optimisation is required.**

Oligonucleotide Purification Using Different Particle Sizes

The purification of oligonucleotides requires very high resolution. On the other hand, the process has to be productive and cost-efficient. Therefore, resolution and reasonable backpressure need to be balanced. This figure shows the separation of a DNA 20mer oligonucleotide using two different particle sizes (10 µm and 30 µm). The resolution of both traces differs significantly, whereas the retention profile of both separations remains the same.



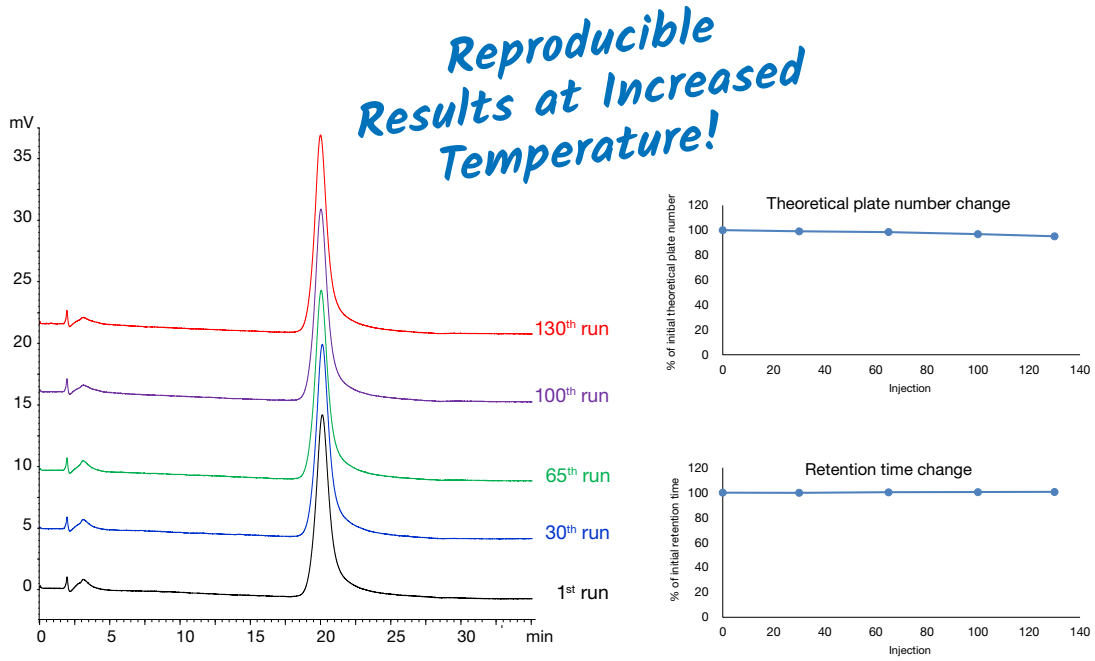
Column Dimension:	100 × 4.6 mm ID
Resin Part Nos.:	BioPro IEX SmartSep Q10 (10 µm): QSA0S10
	BioPro IEX SmartSep Q30 (30 µm): QSA0S30
Eluent:	A) 10 mM NaOH
	B) 10 mM NaOH + 1 M $NaClO_4$
Gradient:	25–40%B (0–30 min), 40–100%B (30–35 min)
Flow rate:	1 mL/min
Temperature:	25 °C
Detection:	UV at 260 nm
Injection:	5 µL
Sample:	Trityl-OFF 5'-ATA CCG ATT AAG CGA AGT TT-3' (DNA 20mer)

Resins that are available in different particle sizes allow more flexibility in process development because different particle sizes can be tested. If the particle sizes are scalable, which means they provide the same retention behaviour, a change of the particle size can easily be implemented without modifying the separation parameters.

Whitepaper
Analysis and Purification of Oligonucleotides by Anion Exchange and Ion-Pairing Reversed Phase Chromatography

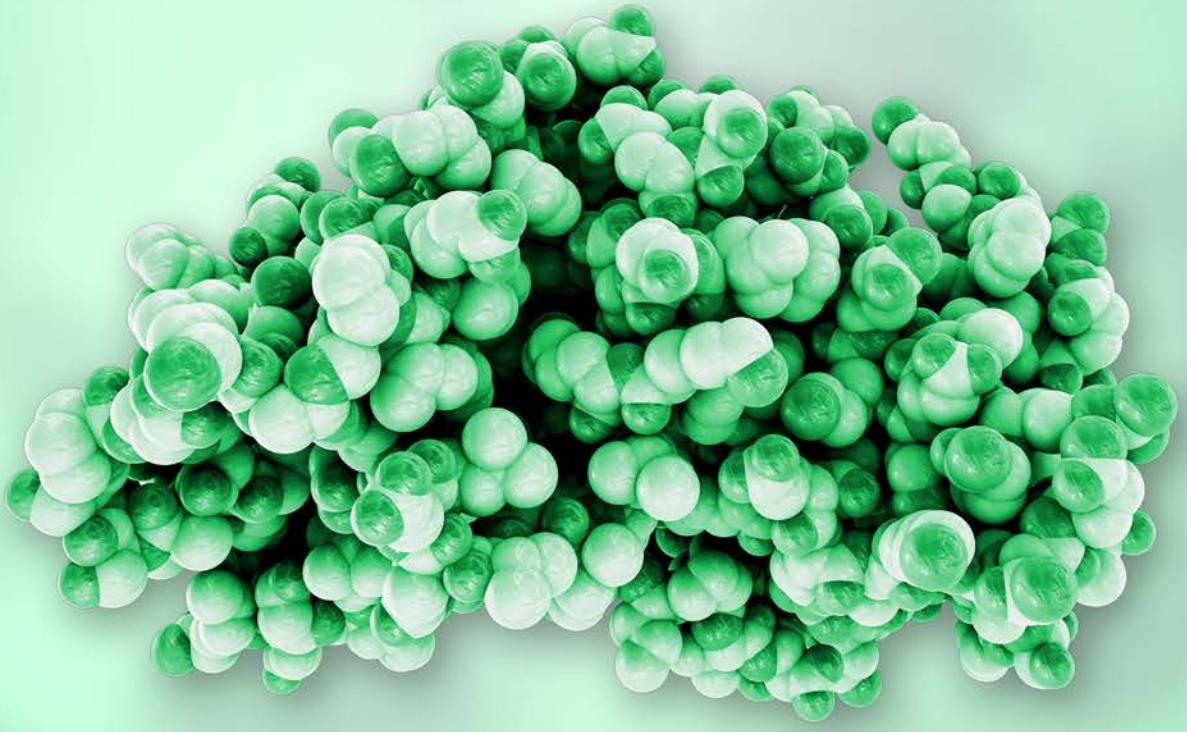
High Temperature Application for Efficient Oligonucleotide Purification

By increasing the temperature from 25 to 60 °C narrower peaks and improved resolution especially for strong-binding oligonucleotides can be obtained. The elution profile of an antisense oligonucleotide remained constant even after injecting the sample in 130 runs at 60 °C. There is no retention time shift and the column efficiency remains the same with BioPro IEX SmartSep Q30.



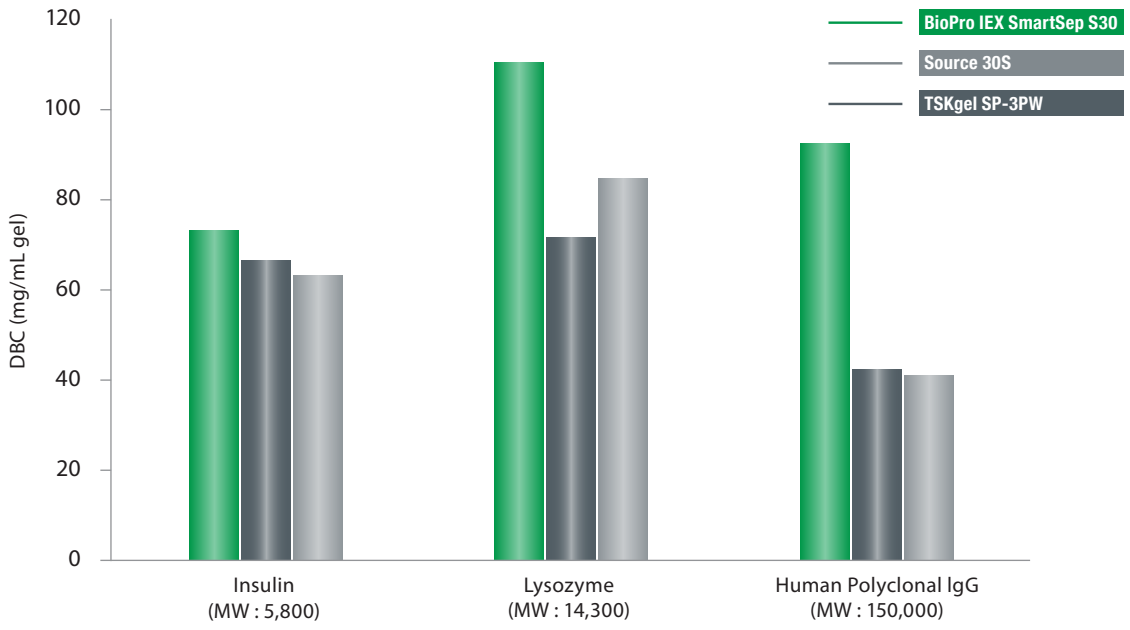
Column:	BioPro IEX SmartSep Q20, 100 x 4.6 mm ID
Part No:	QSA0S20-1046PTC
Eluent:	20 mM Tris-HCl (pH 8.6)
	20 mM Tris-HCl (pH 8.6) containing 1 M NaCl
Gradient:	40–90%B (0–25 min), 90%B (25–35 min),
	40%B (35.01–60 min)
Flow rate:	0.5 mL/min
Temperature:	60 °C
Detection:	UV at 260 nm
Injection:	12 µL
Sample:	Firefly Luciferase GL2, antisense strand (5 nmol/mL)
	5'-UCG AAG UAU UCC GCG UAC GdTdT-3

Purification of Proteins and Peptides



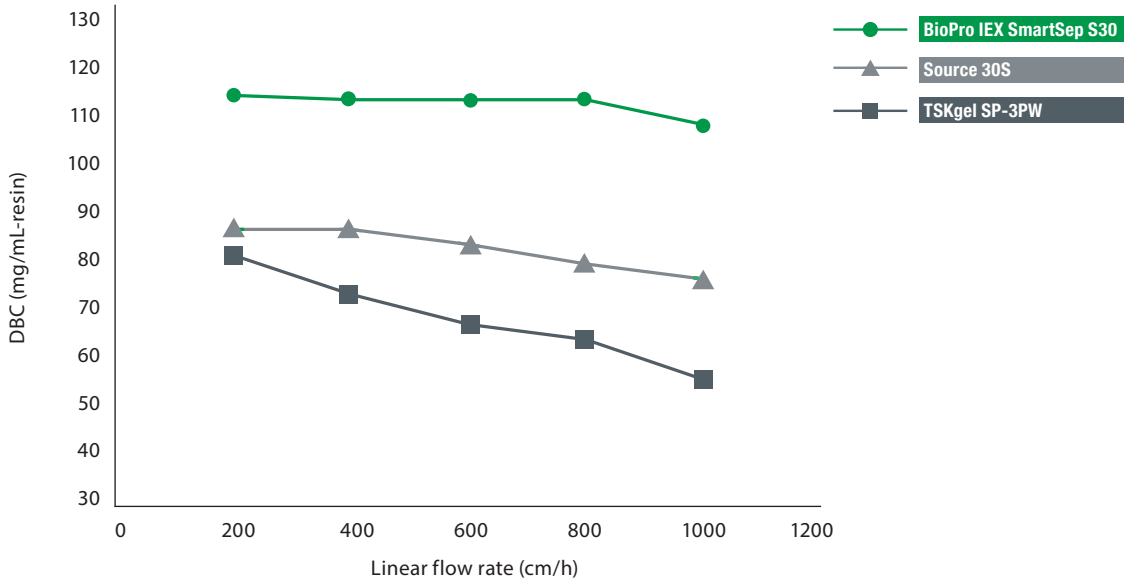
High Efficient Purification of Proteins and Peptides

Comparison of the performance of BioPro IEX SmartSep and competitor products in the purification of Lysozyme, Insulin and polyclonal IgG



Column: 50 x 5.0 mm ID
Flow rate: 400 cm/h (1.32 mL/min)
Temperature: 25 °C

BioPro IEX SmartSep shows higher dynamic binding capacity for both small peptides and large proteins.



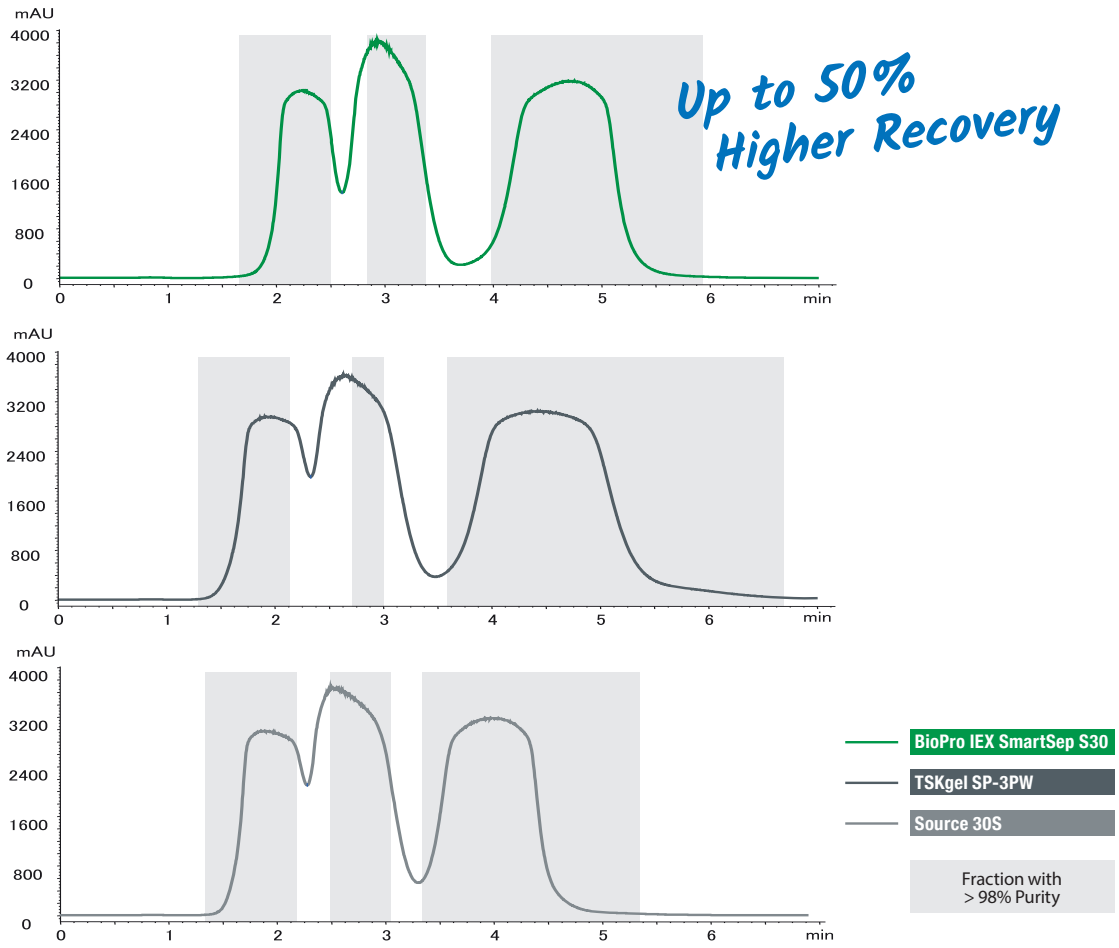
Column: 50 x 5.0 mm ID
Equilibration buffer: 20 mM Glycine-NaOH (pH 9.0)
Linear velocitiy: 200–1,000 cm/h (0.66 mL/min–3.27 mL/min)
Sample: 1.0 mg/mL Lysozyme in equilibration buffer

YMC's BioPro IEX resins show higher dynamic binding capacities over the full range of applicable flow rates.

Purification of Proteins and Peptides

BioPro IEX SmartSep resins offer the perfect solution for challenging separations. With the high binding capacity and recovery, the resins allow high-throughput purifications and increased productivity. Easy elution of target compounds improves the whole process.

Comparison of resolution with competitor materials



Column:	50 x 5.0 mm ID	Temperature:	25 °C
Eluent:	A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8)	Detection:	UV at 220 nm
	B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl	Injection:	20 mL (30 mg Proteins)
Gradient:	0–100%B, 30 column volumes	Sample:	1. Ribonuclease A (0.5 mg/mL)
Flow rate:	1600 cm/h (5.23 mL/min)		2. Cytochrome C (0.5 mg/mL)
			3. Lysozyme (0.5 mg/mL)

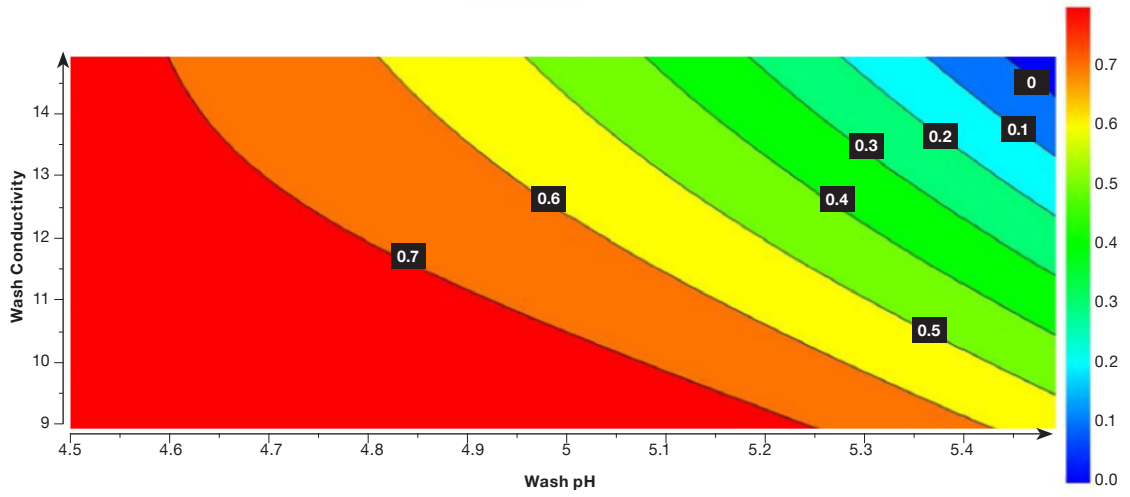
	Recovery (> 98 % Purity)			
	Ribonuclease A	Cytochrome C	Lysozyme	**Total**
BioPro IEX SmartSep S30	**90.5%**	**81.5%**	**99.3%**	**90.7%**
TSKgel SP-3PW	74.2%	54.4%	99.5%	76.9%
Source 30S	87.2%	76.0%	99.5%	87.8%

BioPro IEX SmartSep S30 maintains its high resolution and high sample loading ability even at 1600 cm/h and under high loading condition (30 mg). It allows up to 50 % higher recovery for specific target compounds compared to the competitor's materials. These features of the BioPro IEX SmartSep material indicate the possibility of cost savings for your purification.

The monoclonal antibody IgG (pI=8.9) was purified in a two-step process out of cultured medium. The two combined separation modes are affinity and ion exchange chromatography.
For the second step, the strong cation exchanger BioPro IEX S75 is used in bind-and-elute mode. In order to evaluate the optimum purification conditions, the influence of salt concentration and pH during the washing phase were analysed in a DoE (design of experiments) process.

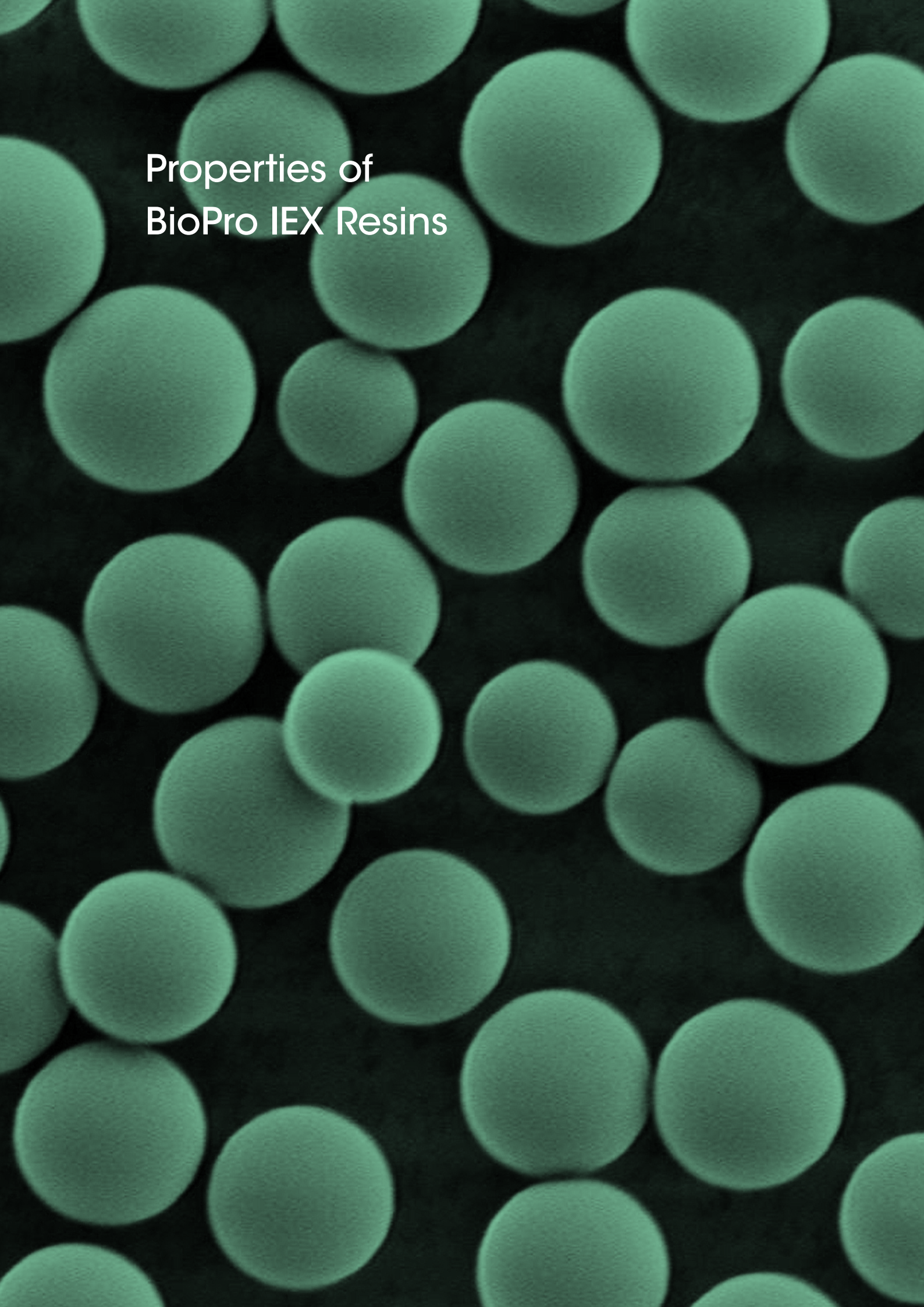
Recovery (%) at various salt concentrations and pH

Conductivity \ pH	4.5	5.0	5.5
15 mS/cm	72.2	40.1	0.0
12 mS/cm	73.4	68.2	10.1
9 mS/cm	73.1	69.5	64.0



Response surface plot (Recovery Area out/Area in)

These results show that the recovery is higher if the washing step is performed under acidic conditions. As the target mAb should not be denatured, pH 5 was chosen for the purification. A conductivity of 10 mS/cm was selected for the washing step.



Properties of BioPro IEX Resins

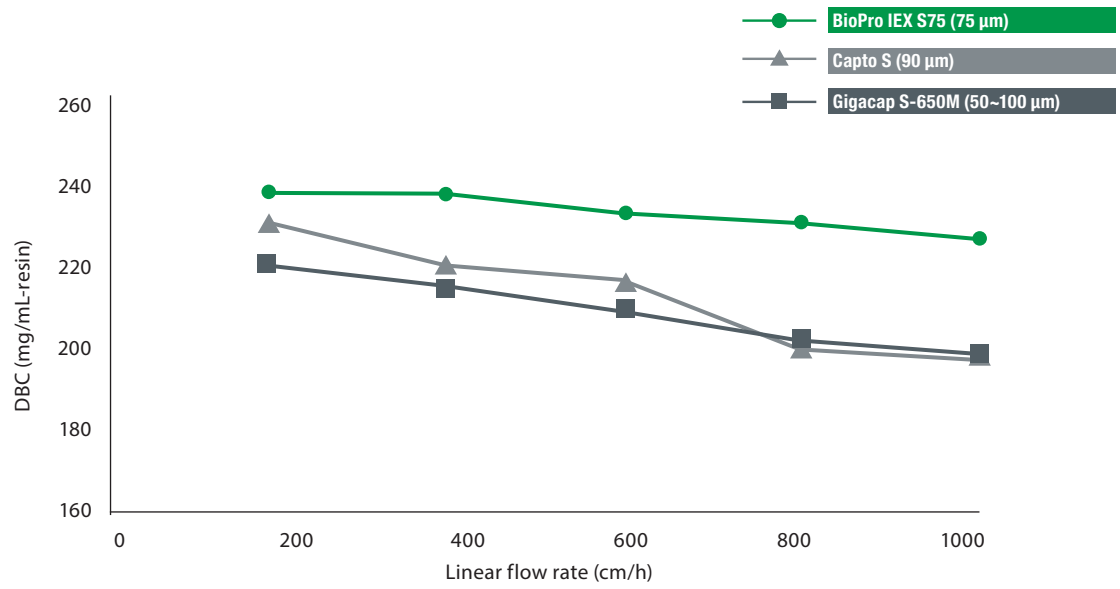
Scale-up and availability of BioPro IEX

- Preparative grade resins with particle sizes from 10 µm to 75 µm
- Full compliance with GMP requirements
- Short delivery for industrial-scale quantities
- High capacity with low operating pressures even at high flow rates
- Reduced processing costs
- Full regulatory support

High Binding Capacity and high Recovery

The BioPro IEX resins show high dynamic binding capacity (DBC) and excellent recovery, making them useful for preparative separations of proteins and antibodies.

High DBC → **High Loadability** → **High Productivity**

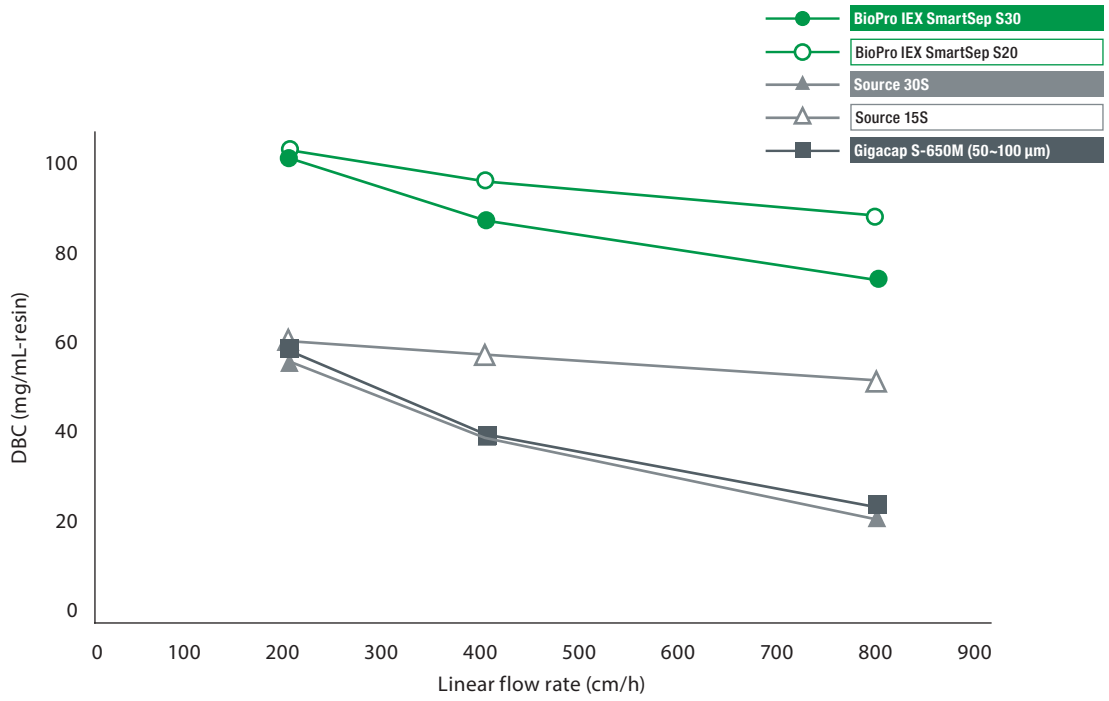


Column: BioPro IEX S75, 50 x 5.0 mm ID
Sample: 1.0 mg/mL Lysozyme in equilibration buffer
Eluent: A) 20 mM Glycine-NaOH (pH 9.0)
B) 20 mM Glycine-NaOH (pH 9.0) containing 0.5 M NaCl
Detection: UV at 300 nm

The sample loading at high flow rates is determined by the dynamic binding capacity of an ion exchange resin.
The dynamic binding capacity of BioPro IEX is excellent even at high flow rates. When compared to similar competitor products it consistently exhibits a higher dynamic binding capacity. This results in higher sample loading in preparative processes.

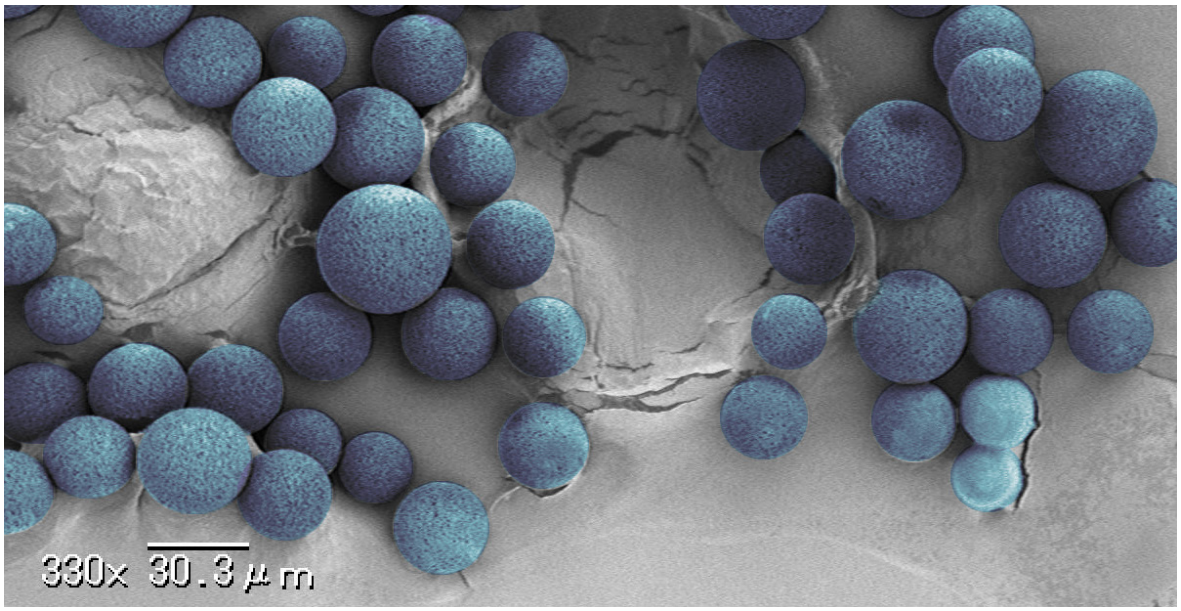
Technical Note
What makes DBC so important?
And why is it so useful to know how to determine it?

Comparison of the DBC for human polyclonal IgG at different flow rates for BioPro IEX SmartSep S30 and competitor products



Column:	50 x 5.0 mm ID
Equilibration buffer:	20 mM Glycine-NaOH (pH 9.0)
Linear velocitiy:	200–1,000 cm/h (0.66 mL/min-3.27 mL/min)

BioPro IEX SmartSep shows considerably higher DBC across a wide range of linear velocity. A high DBC at flow rates of up to 1,000 cm/h can reduce process time and significantly increase productivity.



BioPro IEX S30 Particles

Stability towards Alkaline Cleaning-in-Place

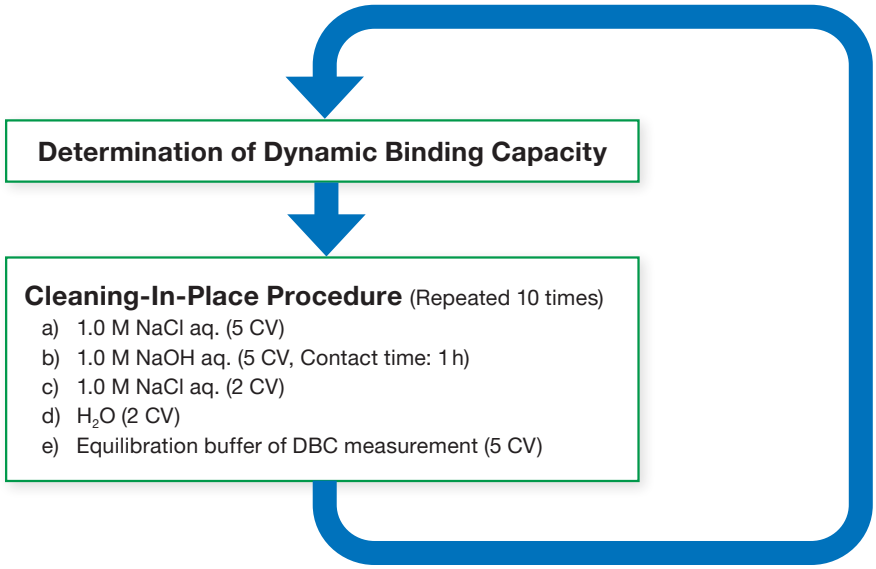
Cleaning-in-place (CIP) is essential for the economic use of packed chromatography columns. Efficient cleaning procedures increase the lifetime of the separation process and thereby contribute to the overall cost effectiveness. In addition, powerful CIP procedures strongly increase the safety and productivity of every downstream process.

Sodium hydroxide (NaOH) solutions are well established for the removal of precipitated proteins, hydrophobic proteins, nucleic acids, endotoxins and viruses and have become the first choice for cleaning and sanitising of chromatography resins. In order to optimise process development time and costs, there is an increasing demand for efficient cleaning procedures and compatible chromatography resins.

IEX resins from YMC are fully compatible with typical CIP procedures.

As an example, CIP studies have been performed using NaOH solutions with BioPro IEX S75/Q75 as well as with BioPro IEX SmartSep S30/Q30.

All YMC IEX resins maintain their performance values even after 100 CIP cycles.



DBC (IgG) (BioPro IEX SmartSep S30, BioPro IEX S75)

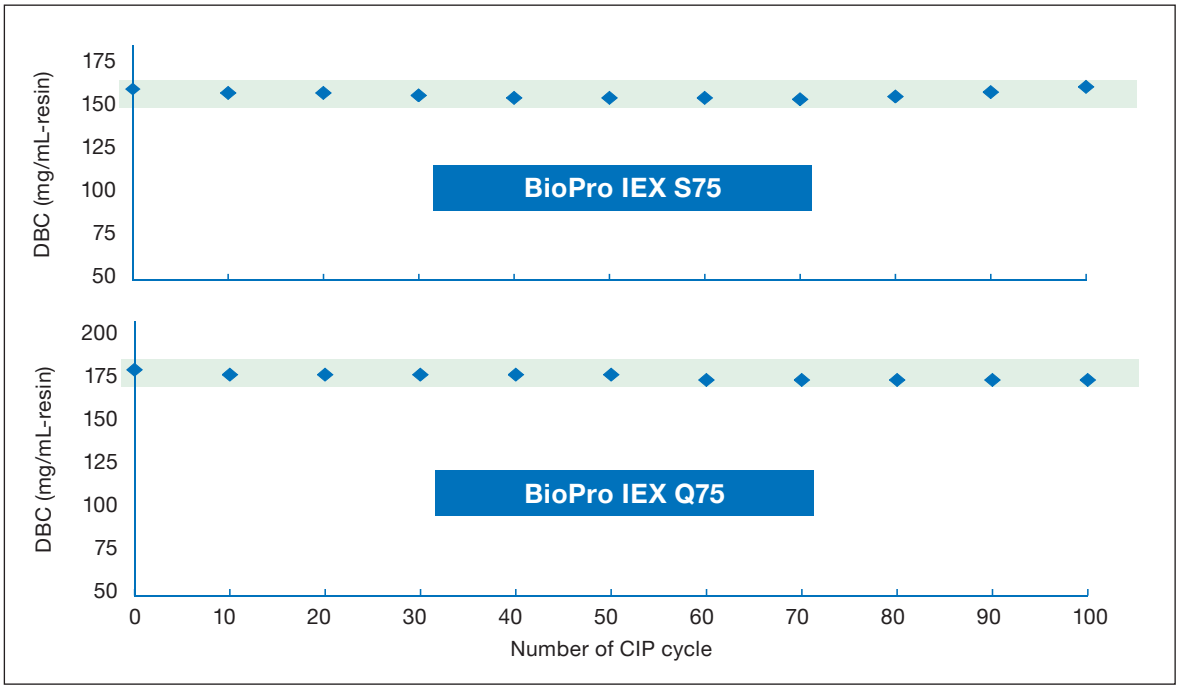
Column:	50 × 5.0 mm ID	Temperature:	25 °C
Equilibration buffer:	20 mM citric acid-NaOH (pH 5.3)	Detection:	UV at 280 nm
Elution buffer:	Equilibration buffer containing 0.5 M NaCl	Sample:	1.5 mg/mL human polyclonal IgG
Flow rate:	200 cm/h (0.66 mL/min)		in equilibration buffer

DBC (BSA) (BioPro IEX SmartSep Q30, BioPro IEX Q75)

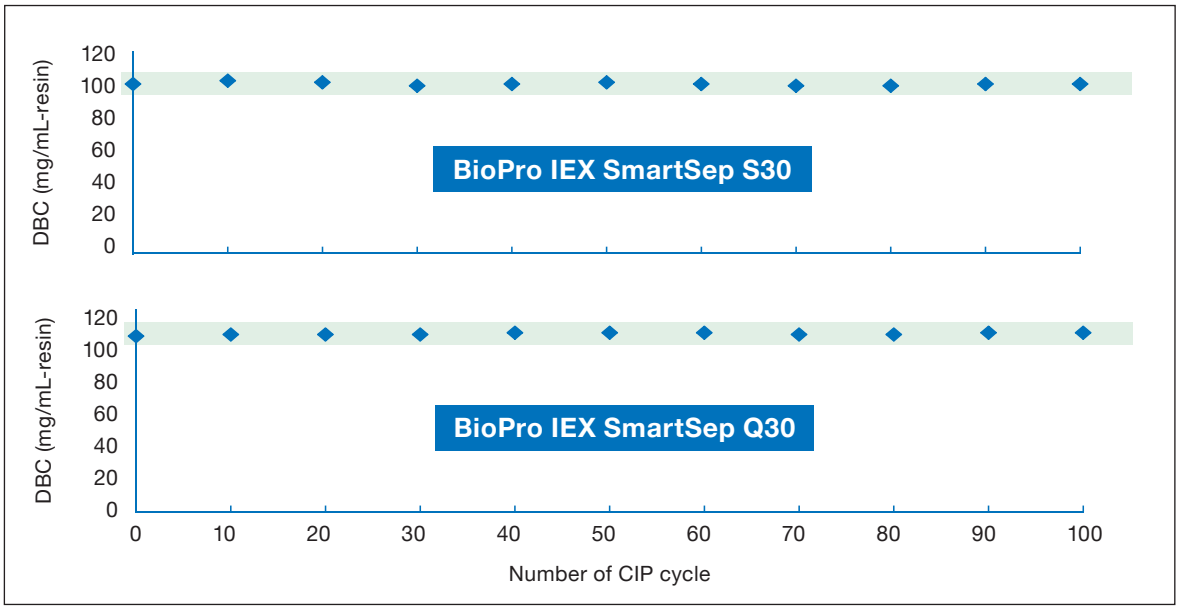
Column:	50 × 5.0 mm ID	Temperature:	25 °C
Equilibration buffer:	20 mM Tris-HCl (pH 8.6)	Detection:	UV at 280 nm
Elution buffer:	Equilibration buffer containing 0.5 M NaCl	Sample:	1.5 mg/mL BSA in equilibration buffer
Flow rate:	200 cm/h (0.66 mL/min)		

CIP cycle

Column:	50 × 5.0 mm ID
Flow rates:	200 cm/h (1.0 M NaCl, H_2O, Buffer)
	30 cm/h (1.0 M NaOH)
Temperature:	25 °C



BioPro IEX S75 and Q75 maintain their binding capacity even after 100 CIP cycles.
BioPro IEX resins show excellent alkaline CIP stability.

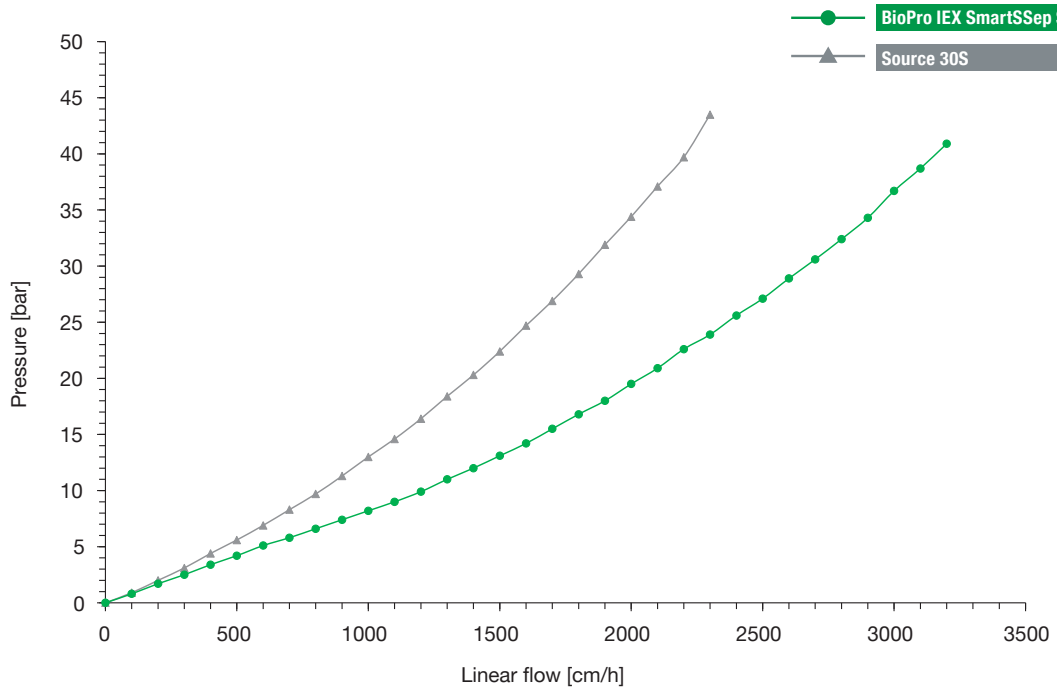


BioPro IEX SmartSep S30 and Q30 maintain their binding capacity even after 100 CIP cycles.
BioPro IEX SmartSep resins show excellent alkaline CIP stability.

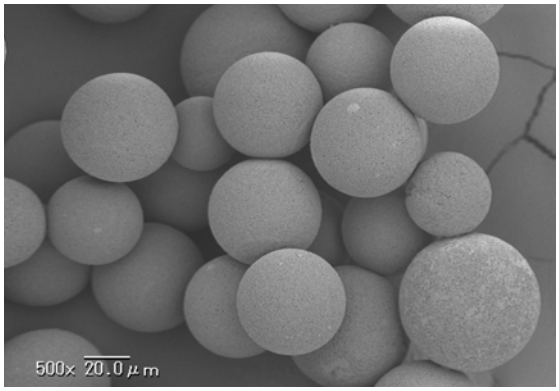
Application Note
Excellent Alkaline CIP Stability of YMC's BioPro IEX Resins

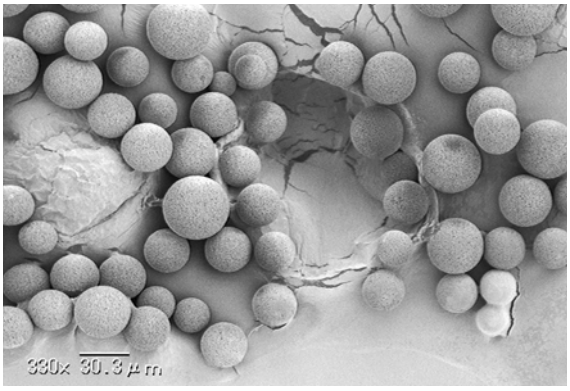
Higher Flow Rates for More Efficient Purifications

The pressure flow characteristics of a resin determine its productivity and are therefore one of the key factors in developing an efficient purification process. A high-quality resin such as BioPro IEX enables comparable low back pressure, so that the flow rate can be correspondingly higher.

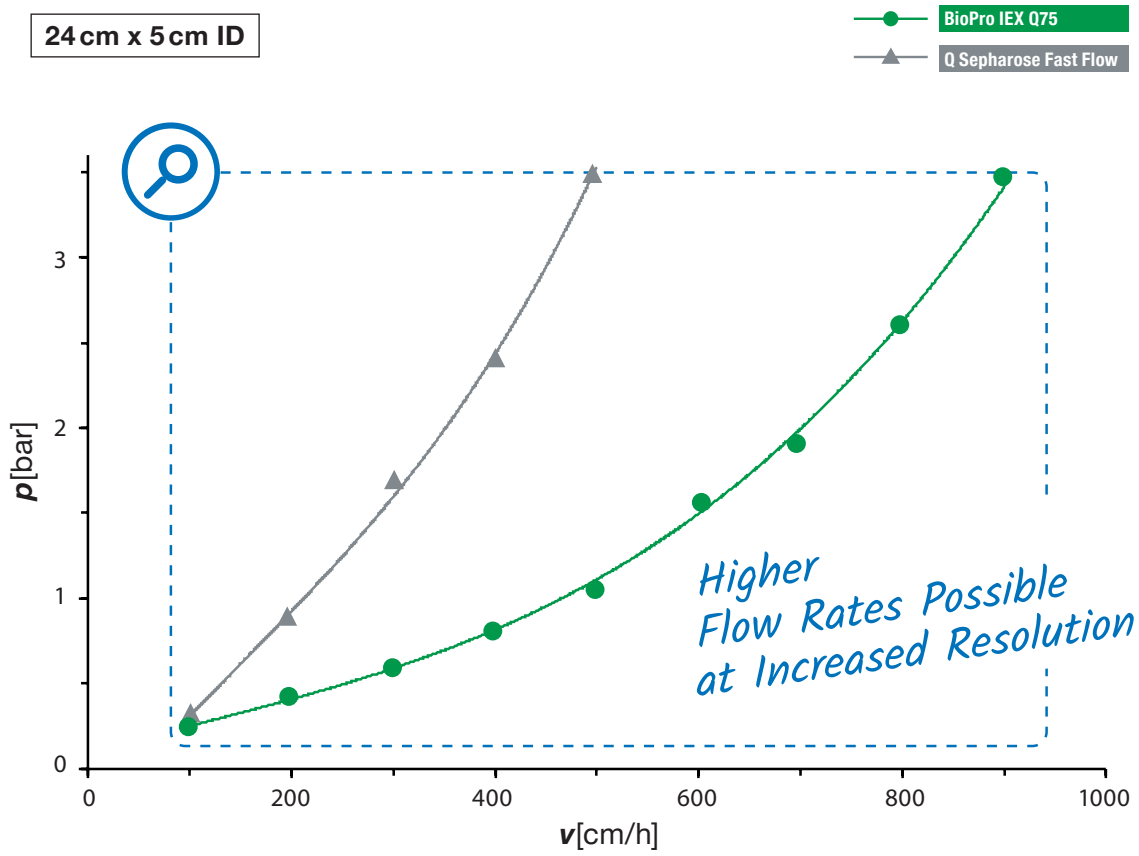


Column:	ECO^{PLUS}, 15 mm ID
Slurry concentration:	30 %
Consolidated flow velocity:	72 cm/h
Consolidated bed height:	10 cm
Mobile phase:	20 % EtOH with 0.2 M NaOAc





Technical Note
Pressure Flow Characteristics of YMC's BioPro IEX SmartSep



Column:	ECO^{PLUS}, 50 mm ID, max. bed length 250 mm, AB version
Resin amount (gravity settled in 1 M NaCl):	470 mL
Slurry concentration:	40 %
Consolidation flow velocity:	60 cm/h
Consolidated bed height:	24 cm
Mobile phase:	1 M NaCl solution

The pressure flow curve of BioPro IEX Q75 suggests reversible compression behaviour over a wide range of linear flow velocity. Despite using smaller particles (75 µm) compared to the 90 µm particle size of the competitor's resin, BioPro IEX Q75 shows much better pressure flow characteristics. Higher flow rates can be applied to increase the throughput.

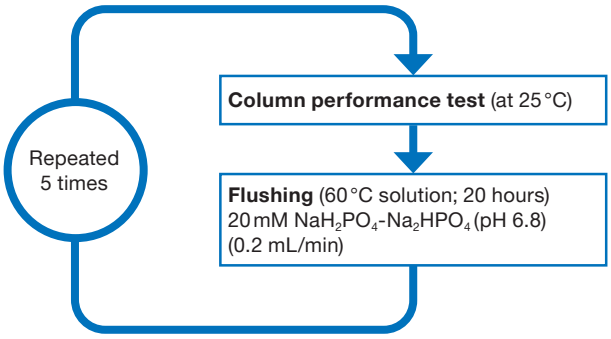
- **Improved resolution**
- **Higher flow rates possible**
- **Increased productivity**

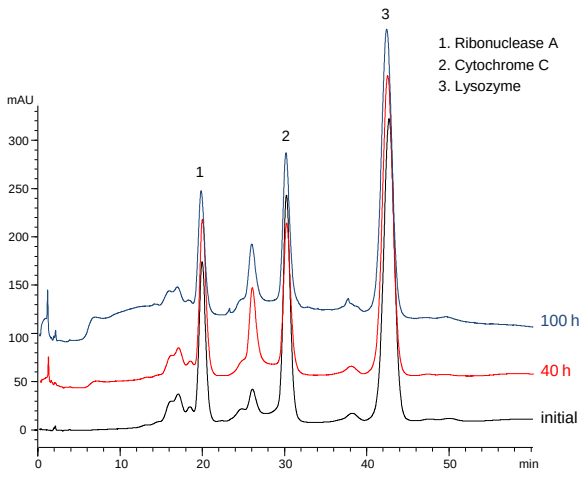
Technical Note
Pressure Flow Characteristics of YMC's BioPro IEX

High Temperature Stability of BioPro IEX SmartSep Resins

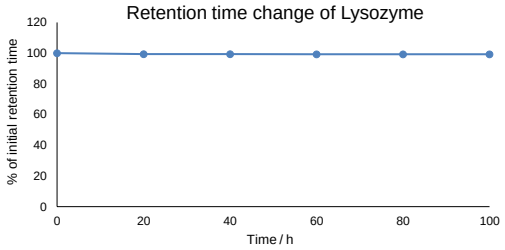
The temperature is a useful parameter to improve resolution and therefore the overall process productivity. BioPro IEX SmartSep resins can be used at temperatures up to 60 °C, offering great flexibility in method development. The following example shows the extended temperature stability of the BioPro IEX SmartSep resins.

In this example, the BioPro IEX SmartSep resins were flushed with a buffer at 60 °C for 20 hours. The column performance test at room temperature with Ribonuclease A, Cytochrome C and Lysozyme showed no retention time shift for the proteins investigated – even after repeating the procedure for 5 times!





Guaranteed Performance at Elevated Temperature!

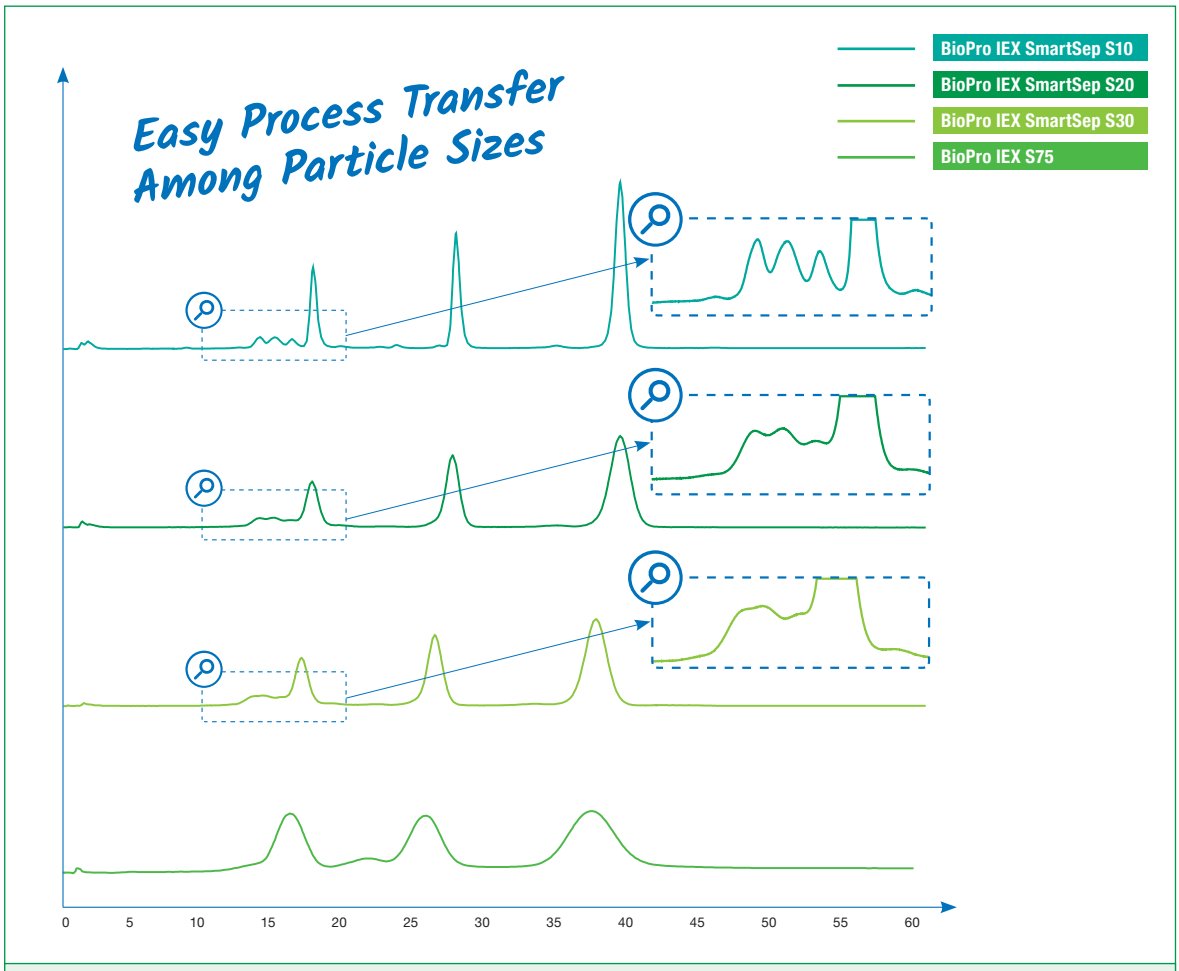


Column:	BioPro IEX SmartSep S20, 100 x 4.6 mm ID	Temperature:	25 °C
Part No:	SSA0S20-1046PTC	Detection:	UV at 220 nm
Eluent:	20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8)	Injection:	40 µL
	20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl	Sample:	Ribonuclease A (0.5 mg/mL)
Gradient:	0–100 %B (0–60 min)		Cytochrome C (0.5 mg/mL)
Flow rate:	0.5 mL/min		Lysozyme (0.5 mg/mL)

With BioPro IEX SmartSep, no change in the separation or peak distortion could be observed even after 100 hours of exposure to a 60 °C solution!

Technical Note
High Temperature Stability of BioPro IEX SmartSep Resins

Complete Scalability of BioPro IEX



Column:	50 × 5 mm ID	Temperature:	25 °C
Eluent:	A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) B) A containing 0.5 M NaCl	Sample:	1) Ribonuclease A, 0.5 mg/mL 2) Cytochrome C, 0.5 mg/mL 3) Lysozyme, 0.5 mg/mL
Gradient:	0–100%B (0–60 min)	Injection volume:	20 µL
Flow rate:	0.59 mL/min		
Detection:	UV at 220 nm		

One of the advantages of YMC's BioPro IEX resins is its full scalability. This property provides an identical chromatographic behaviour across all particle sizes. This is beneficial, as separation and fractionation can be optimised on the analytical scale. Depending on the required resolution the optimal bead size can be selected. Then, the process can be reliably transferred to the production scale. This enables highly flexible implementation of BioPro IEX resins, resulting in a perfectly tailored solution.

An illustrated example is depicted above for the three enzymes Ribonuclease A, Cytochrome C and Lysozyme. This shows that the separation of the main peaks remains stable across the four different particle sizes. If the highest resolution is required, 10 µm particles are the optimum choice. 10 µm particles allow the isolation of trace impurities.

During a capturing process the 75 µm material demonstrates adequate separation. The three main peaks are well separated.

Technical Note
Scalability of BioPro IEX Resins
BioPro IEX Q

Specification and Ordering Information

BioPro IEX for Capture

BioPro IEX Series	BioPro IEX Q75	BioPro IEX S75
Ion Exchange Type	strong anion exchanger	strong cation exchanger
Charged Group	-R-$N^+(CH_3)_3$	-R-SO_3^-
Matrix	hydrophilic polymer beads	
Pore Size	porous	
pH Range	2–12	
Compression Factor	1.05–1.15	
Particle Size	75 µm	
Pressure Resistance	0.3 MPa	
Typical Flow Rate	200–1000 cm/h max. 2000 cm/h	
Ion Exchange Capacity	min. 0.10 meq/mL-resin	
Dynamic Binding Capacity	min. 160 mg/mL-resin (BSA)	min. 160 mg/mL-resin (lysozyme)
Temperature	4–40 °C	

BioPro IEX SmartSep for Intermediate Purification and Polishing

BioPro IEX Series	BioPro IEX SmartSep Q10	BioPro IEX SmartSep Q20	BioPro IEX SmartSep Q30	BioPro IEX SmartSep S10	BioPro IEX SmartSep S20	BioPro IEX SmartSep S30
Ion Exchange Type	strong anion exchanger			strong cation exchanger		
Charged Group	-R-$N^+(CH_3)_3$			-R-SO_3^-		
Matrix	hydrophilic polymer beads					
Pore Size	porous					
pH Range	2–12					
Compression Factor	1.05–1.15					
Particle Size	10 µm	20 µm	30 µm	10 µm	20 µm	30 µm
Pressure Resistance	regular use: 3 MPa max.: 4 MPa	regular use: 2 MPa max.: 3 MPa		regular use: 3 MPa max.: 4 MPa	regular use: 2 MPa max.: 3 MPa	
Typical Flow Rate	200–1000 cm/h max. 2000 cm/h					
Ion Exchange Capacity	min. 0.08 meq/mL-resin					
Dynamic Binding Capacity	min. 100 mg/mL-resin (BSA)			min. 100 mg/mL-resin (lysozyme)		
Temperature	4–60 °C					

Regulatory support file available under non-disclosure agreement. Used in validated cGMP-manufacturing processes. Customised material available on request. DMF registered with FDA.

Screening kits and bulk samples for media selection and method development

YMC offers a number of ion exchange screening kits based on 1 mL or 5 mL columns and also bulk resin samples for testing. This provides a significant advantage and efficiency in resin screening and purification method development.

1 mL Type (26 x 7.0 mm ID)

- Resin screening
- Purification method development

5 mL Type (26 x 15.6 mm ID)

- Purification method development
- Loadability studies

Preparative screening kits

Product	Particle Size	Pack size	Column volume	Product code
BioPro IEX Q75	75 µm	5 / pack	1 mL	BPQAA0S75-01PK
			5 mL	BPQAA0S75-05PK
BioPro IEX SmartSep Q30	30 µm	5 / pack	1 mL	BPQSA0S30-01PK
			5 mL	BPQSA0S30-05PK
BioPro IEX SmartSep Q20	20 µm	5 / pack	1 mL	BPQSA0S20-01PK
			5 mL	BPQSA0S20-05PK
BioPro IEX S75	75 µm	5 / pack	1 mL	BPSPA0S75-01PK
			5 mL	BPSPA0S75-05PK
BioPro IEX SmartSep S30	30 µm	5 / pack	1 mL	BPSSA0S30-01PK
			5 mL	BPSSA0S30-05PK
BioPro IEX SmartSep S20	20 µm	5 / pack	1 mL	BPSSA0S20-01PK
			5 mL	BPSSA0S20-05PK

Strong anion exchanger: BioPro IEX Q

Product	Particle Size	Code	Pack Sizes					
			50 mL	250 mL	1 L	5 L	10 L	20 L
BioPro IEX SmartSep Q10	10 µm	QSA0S10	✔	✔	✔	✔	✔	✔
BioPro IEX SmartSep Q20	20 µm	QSA0S20	✔	✔	✔	✔	✔	✔
BioPro IEX SmartSep Q30	30 µm	QSA0S30	✔	✔	✔	✔	✔	✔
BioPro IEX Q75	75 µm	QAA0S75	✔	✔	✔	✔	✔	✔

Strong cation exchanger: BioPro IEX S

Product	Particle Size	Code	Pack Sizes					
			50 mL	250 mL	1 L	5 L	10 L	20 L
BioPro IEX SmartSep S10	10 µm	SSA0S10	✔	✔	✔	✔	✔	✔
BioPro IEX SmartSep S20	20 µm	SSA0S20	✔	✔	✔	✔	✔	✔
BioPro IEX SmartSep S30	30 µm	SSA0S30	✔	✔	✔	✔	✔	✔
BioPro IEX S75	75 µm	SPA0S75	✔	✔	✔	✔	✔	✔

Availability

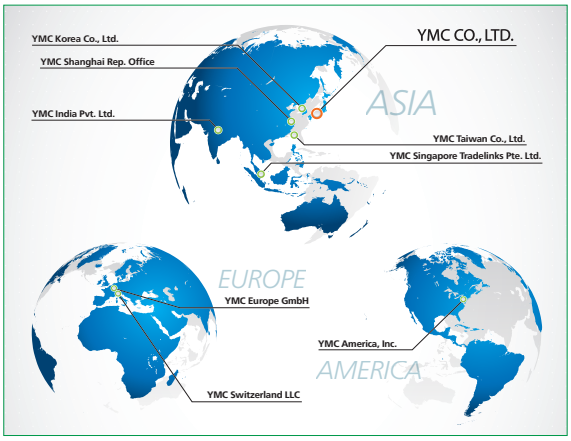
- Large production capacity for YMC's IEX resins
- Lot sizes up to 400 L available
- Short delivery time even for large quantities
- Full compliance with GMP requirements

More About YMC

Fully Integrated Manufacturing

YMC operates a fully integrated manufacturing process for the BioPro IEX resins. This process includes the manufacture of the base beads and the modification for the IEX functionality.

This gives YMC complete traceability and control over the entire manufacturing process. YMC can guarantee reliable product supplies for today and in the future.



Global Supplies

BioPro IEX resins are available worldwide through a dedicated support network headed by YMC operations in Japan, the US and in Europe to ensure easy, reliable method transfer between research and production sites across the world. Batch sizes up to 400 L are available, in many different packaging formats. Individual supply agreements are common for validated processes.

Quality Control

The rigorous quality control procedures set by YMC start with the manufacturing of the base material. Every batch is evaluated for compliant reproducibility to ensure consistent performance. The YMC facilities are certified according to ISO 9001. Quality agreements are common for validated processes. The manufacturing site is regularly audited successfully by numerous pharmaceutical companies all around the globe.

Regulatory Support

Since all YMC processes and working procedures are thoroughly monitored and documented, YMC always has been in perfect condition to prove full compliance with the requirements. The BioPro IEX resins are supplied with the full technical documentation to show compliance with all applicable regulations. The resins are registered for Drug Master Files and are in use for GMP production of biotherapeutics.

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

Lab Scale

ECO columns

Inner diameters [mm]:
10 ➜ 80

Suitable particle sizes [µm]:
75, 30, 20

Typical targets:

ECO^{PLUS} columns

Inner diameters [mm]:
5 ➜ 50

Suitable particle sizes [µm]:
30, 20, 10

Typical targets:

Your perfect screening column!

Your partner in DSP!

Pilot Scale

Pilot^{PLUS} columns

- ✔ Bubble-free column packing
- ✔ Easy handling and column unpacking
- ✔ 100% biocompatibility (metal-free)
- ✔ Complete certification available

Inner diameters [mm]:
70 ➜ 200

Suitable particle sizes [µm]:
75, 30, 20

Typical targets:

Pre-Packed Glass Columns from YMC

Your Ready-to-Use BioPro IEX Columns

As about our glass column packing service!

Your local contact:

YMC CO., LTD.
www.ymc.co.jp

YMC Europe GmbH
www.ymc.eu

YMC America, Inc.
www.ymcamerica.com

YMC Schweiz GmbH
www.ymc-schweiz.ch

YMC India Pvt. Ltd.
www.ymcindia.com

YMC Shanghai Rep. Office
www.ymcchina.com

YMC Korea Co., Ltd.
www.ymckorea.com

YMC Taiwan Co., Ltd.
www.ymctaiwan.com

YMC Singapore Tradelinks Pte. Ltd.
www.ymc.sg

BioPro IEX Resins 03/2025_Int_V1.0