SARTORIUS

Product Datasheet

Q, DEAE, CM Ceramic HyperD® F

Ion Exchange Resins

Benefits

- High dynamic binding capacity at high flow rates
- Truly rigid, non-compressible resin
- Salt tolerant CM Ceramic HyperD® F resin reduces Ultrafiltration (UF) | Diafiltration (DF) requirements

Product Information

Q, DEAE, and CM Ceramic HyperD® F ion exchangers are high capacity resins designed for efficient and scalable purification of biomolecules. They maintain high dynamic binding capacity (DBC) under conditions where conventional resins display significant capacity or productivity limitations.

Ceramic HyperD® F resins are manufactured at an ISO 9001:2008 and ISO 14001:2004 compliant manufacturing facility.

Description
Ceramic HyperD® F resins are used in a number of approved production processes for therapeutic proteins, as well as in many clinical and preclinical trials, in columns larger than 500 liters. Regulatory Support Files (RSF) and column packing support are available.

The resins are available in a 50 µm grade for pilot to full scale production. They are supplied in a variety of packagings in 1 M NaCl containing 20% ethanol | 1.2 mM EDTA.

Principles of Operating Mechanism

"Gel-In-A-Shell" Resin Design
Traditional macroporous ion exchangers operate on the basis of classical pore diffusion, characterized by rapidly decreasing binding capacity with increased flow rate. In contrast, the unique structure of Ceramic HyperD® F resin supports a more rapid mechanism of mass transfer, known as enhanced diffusion.

Ceramic HyperD® F ion exchangers employ a high capacity hydrogel polymerized within the large pores of a rigid ceramic bead. This design (Figure 1) combines the characteristics of a soft, high-capacity hydrogel with the absolute mechanical stability of a rigid ceramic bead.

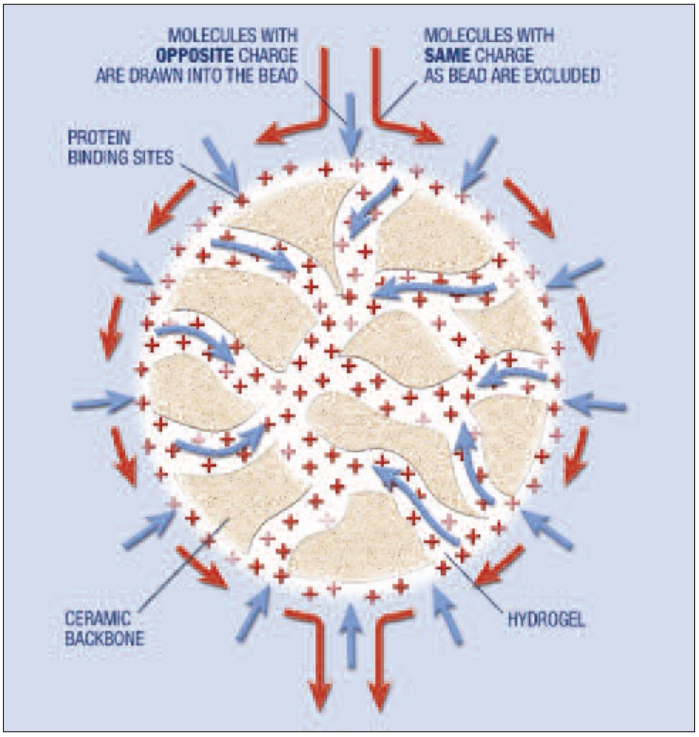

Figure 1: The "Gel-in-a-Shell" Design
Ceramic HyperD® F resins deliver high dynamic capacity and absolute mechanical stability. This translates into productivity and process economics benefits at manufacturing scale.

Ceramic HyperD® F resins do not shrink or swell with changes in pH or conductivity; columns with bed heights higher than 20 cm can be used to increase productivity and save plant space and capital investment. Because product is bound throughout the gel-filled pore – not merely at the interior surface of the pore – total binding capacity is enhanced.

Binding of protein within the hydrogel is illustrated by the electron micrograph in Figure 2. Abundant ion exchange sites in the hydrogel are highly accessible to proteins. Biomolecules diffuse rapidly within the hydrogel, facilitating rapid uptake of product. This mechanism of mass-transfer – known as enhanced diffusion – allows the resin to operate free of the operational constraints typically encountered with conventional ion exchange resins.

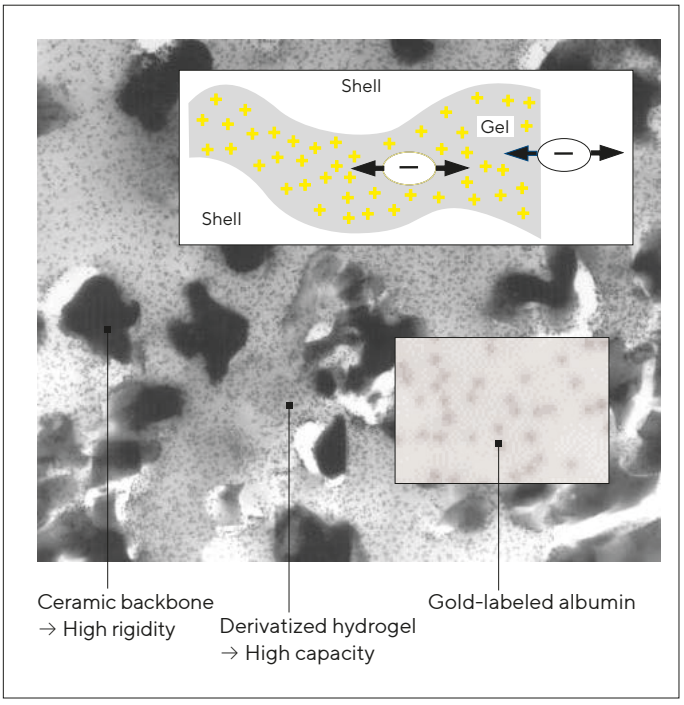

Figure 2: Structure of Ceramic HyperD® F Ion Exchange Resins
Cross section through the bead showing binding of gold-labeled albumin. The hydrogel completely fills the pores within the ceramic shell, and that gold-labeled albumin – visible as dense black dots – is distributed homogeneously throughout the hydrogel.

For Fast Selectivity Screening

Ceramic HyperD® F resins offer a different selectivity than other new generation of ion exchangers. To allow a convenient screening, Ceramic HyperD® resins are supplied in easy-to-use prepacked columns.

Prepacked PRC Columns for Screening and Process Development: Q and CM Ceramic HyperD® F resins are available in 1 mL (5 mm ID × 50 mm) prepacked PRC columns for rapid selectivity screening under reliable and reproducible conditions. PRC columns can be easily connected to standard chromatography systems, and their typical backpressure is < 2.0 barg at 600 cm/hr in 0.1 M NaCl buffer.

Technical Data

Table 1: Ceramic HyperD® F Ion Exchangers Main Properties

	Type of Ceramic HyperD® F Resin		
	Q	DEAE	CM
Average particle size (µm)	50	50	50
Dynamic binding capacity (mg/mL) 10% breakthrough at 200 cm/hr	BSA* ≥ 85[1]	BSA* ≥ 85[1]	IgG ≥ 110g/L
Amount of ionic groups (µeq/mL)	≥ 250	≥ 200	250 – 400
Pressure resistance	70 barg (1,000 psi)		
Working pH	2 – 12		
Cleaning	pH 1 – 14		
Volumes changes due to pH and ionic strength	Non compressible		

1. Sample: 5 mg/mL BSA in 50 mM Tris-HCl buffer, pH 8.6
2. Sample: 5 mg/mL hu IgG in 50 mM sodium acetate, 100 mM NaCl, pH 4.7
* BSA = Bovine Serum Albumin

Operating Flow Rates

The rigid ceramic skeleton of Ceramic HyperD® F resin allows work at high linear velocities (typically over 300 cm/hr) with low or moderate backpressures (typically less than 3 barg) and without compression or shrinkage. Standard low pressure chromatography pumps and columns can be used. Figure 3 shows pressure vs. flow rates curves for Q Ceramic HyperD® F resin. Column packing is accomplished quickly and easily owing to the dense nature of the Ceramic HyperD® F beads.

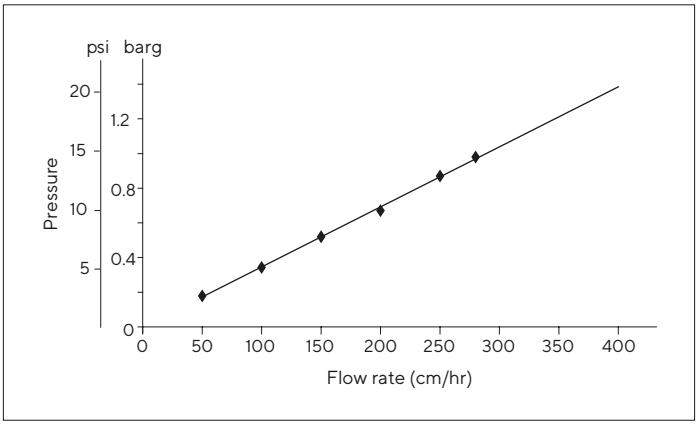

Figure 3: Pressure vs. Flow Rate Curve on Q Ceramic HyperD® F Resin
Column: 9 cm ID × 16 cm; Buffer: 50 mM Tris-HCl, 0.5 M NaCl, pH 8.6

Dynamic Binding Capacity (DBC) and Residence Time (RT)

Ceramic HyperD® F ion exchangers can be operated at a high linear velocity or short RT. There is only a modest decline in DBC for bovine serum albumin (BSA) as linear velocity is increased from 50 cm/hr to more than 650 cm/hr (see Figure 4). At a RT of only 0.4 minute, DBC for BSA is over 85 mg/mL at 10% breakthrough for Q Ceramic HyperD® F resin. As shown in Figure 5, there is only modest reduction in DBC as RT is reduced from 3 to 0.4 minute. DBC values ranging from ~85 to 120 mg BSA/mL were achieved. The high DBC of Ceramic HyperD® F resins permits operation using columns of moderate volume and reduces buffer volume requirements, resulting in process productivity benefits.

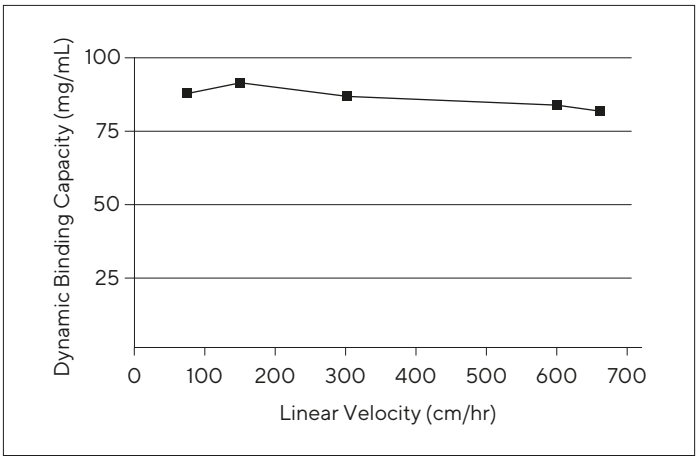

Figure 4: DBC vs. Flow Rate on Q Ceramic HyperD® F Resin

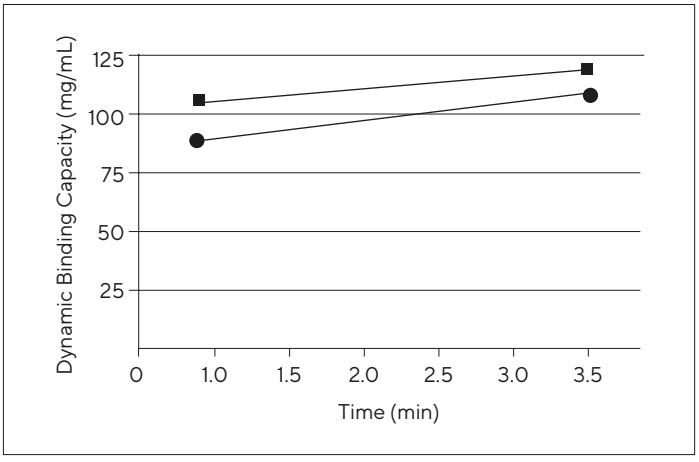

Figure 5: DBC vs. RT of Q Ceramic HyperD® F Resin

DBC at 10% (●) and 50% (■) breakthrough for BSA (0.5 mg/mL) in 50 mM Tris-HCl, pH 8.6

Dynamic Binding Capacity and Sample Concentration

Ceramic HyperD® F resins provide higher DBC with dilute feedstock. This behavior is independent of protein concentration in the feedstock. Over a broad range of linear velocity values, higher DBC values are observed for feedstocks containing 0.5 mg hu IgG/mL than for those containing 10 mg hu IgG/mL. Use of Ceramic HyperD® F resin at capture step reduces or eliminates the need for preliminary concentration of feedstock.

Chemical Stability and Cleaning in Place (CIP)

Ceramic HyperD® F ion exchangers can be sanitized using NaOH (i.e., 5 column volumes of 0.5 M NaOH for 1 hour contact time at room temperature). Data from Regulatory Support Files demonstrate long-term resistance (over 200 cycles) and no significant modification of the resin performance. Other chemical agents such as 20% ethanol/1 M acetic acid mixtures can also be used.

Virus clearance data have shown that viral clearance performance of Q Ceramic HyperD® F resin was not affected after more than 200 cycles of CIP with 0.5 M NaOH.[8]

Application Examples

Example 1. Direct one-step capture of an IgG1 from diluted cell culture supernatant (CCS) on CM Ceramic HyperD® F resin

CM Ceramic HyperD® F resin can be applied for a direct, one-step capture of monoclonal antibody from CCS. Prior to loading, the pH of the CCS was adjusted to pH 4.7 at a conductivity of 19 mS/cm (equivalent to about 180 mM NaCl). The concentration of IgG in the feedstock was low: 150 µg/mL. IgG was purified (>90%) at only 1 minute RT (260 cm/hr).

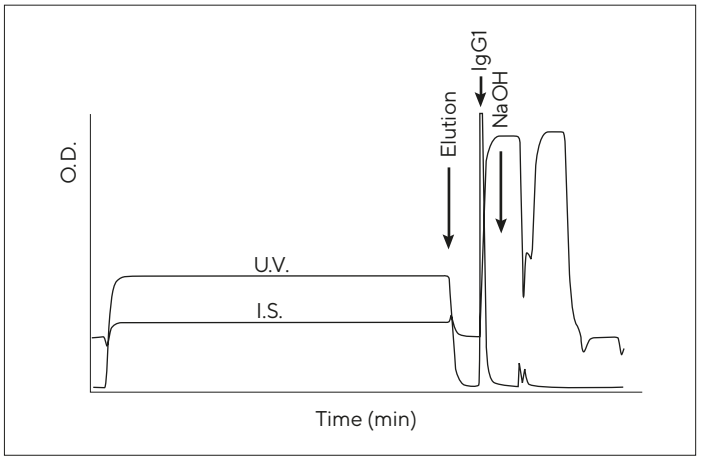

Figure 6: One-step Capture of Mouse IgG1 from CCS on CM Ceramic HyperD® F Resin

IgG1 purity: 90%; Column: 9 cm ID x 5.2 cm (330 mL); Load: 31 L CCS 100-150 µg/mL adjusted to pH 4.7; Equilibration and postload wash: 50 mM sodium acetate, 0.1 M NaCl, pH 4.7; Elution: same buffer + 1.5 M NaCl; Duration: 164 min; Residence time: 1 min; Linear velocity: 260 cm/hr.

Example 2. Purification of mouse IgM from cell culture supernatant on CM Ceramic HyperD® F resin

IgM are relatively difficult molecules to purify. Figure 7 shows the application of the purification of a concentrated mouse IgM CCS on CM Ceramic HyperD® F resin, resulting in 77% step purity (analysis by SEC HPLC).

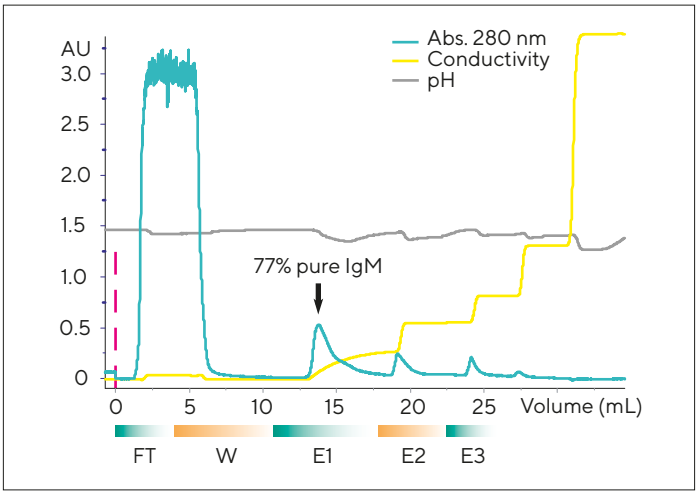

Figure 7: Purification of a Concentrated Mouse IgM CCS on CM Ceramic HyperD® F Resin

Load at pH 5.5 : 4 mL after a 4-fold dilution. Equilibration + Wash: 100 mM sodium acetate, pH 5.5.

Elution by steps: Equilibration buffer + 0.1 M NaCl (E1); + 0.2 M NaCl (E2); + 0.3 M NaCl.(E3); Flow rate: 43 cm/hr (RT: 7 min.)

Example 3. Polishing step on DEAE Ceramic HyperD® F ion exchanger after monoclonal antibody capture on MEP HyperCel mixed-mode resin

DEAE Ceramic HyperD® F resin was used in a two step process for a polishing step to purify a mouse IgG1 from ascites fluid. The first step was a capture of the IgG1 on a mixed-mode MEP HyperCel column, which resulted in a good initial capture of the IgG1 (93%). A purity of 98% for the IgG1 was achieved in two steps.

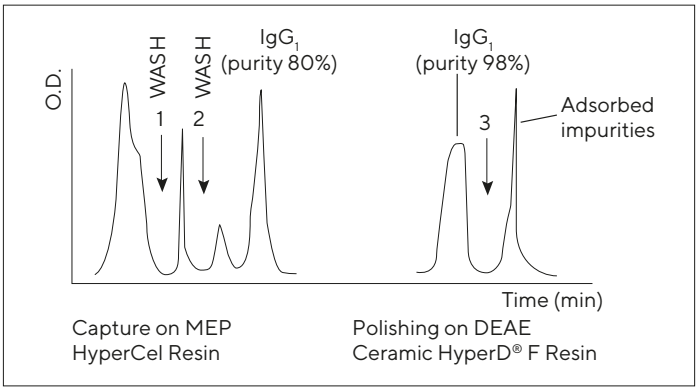

Figure 8: Two-step Purification of IgG1 from Ascites Fluid on MEP HyperCel Resin Followed by DEAE Ceramic HyperD® F Resin

MEP HyperCel column: Wash 1 with 50 mM Tris-HCl buffer, pH 8, Wash 2 with 25 mM sodium caprylate in same buffer (arrow 1), followed by a water wash (arrow 2), to remove albumin. Elution with 50 mM sodium acetate, pH 4.0. The IgG1 enriched fraction is added with Tris base up to pH 8.8 and ionic strength of 7.4 mS/cm, and injected onto the DEAE Ceramic HyperD® F column. Wash with same buffer to collect the antibody. DEAE Ceramic HyperD® F column: 0.6 cm ID × 10 cm; Equilibration: 50 mM Tris-HCl, pH 8.8; Linear velocity: 160 cm/hr. IgG does not bind, adsorbed impurities are eluted by 1 M NaCl (arrow 3).

References

1. Duval, M., et al., Job Life Sciences 316 (1993) 1463.
2. Boschetti, E., et al., J. Biochem. Biophys. Meth. 32 (1996) 15.
3. Necina, R., Amatschek, K., Jungbauer, A., Biotechnology and Bioengineering Vol. 60/6 (1998) 689.
4. Moure, F., Rendueles, M., Diaz, M., ECCE2 (Second European Congres of Chemical Engineering) (1999) Montpellier.
5. Riedel, K.-U., et al., Eur. J. Biochem. 231 (1995) 742.
6. Jouanneau, Y., et al., Eur. J. Biochem. 267 (2000) 780.
7. Sookkheo, B., et al., Protein Expression and Purification 20 (2000) 142.
8. Norling L. et al., J.Chrom. A, 1069 (2005) 79-89
9. Bengio, S. et al. BioProcess International, (May 2010), 64.

Ordering Information

Description	Part Number			Pack Size
	Q	DEAE	CM	
Ceramic HyperD® F Resin	20066-031	20067-039	20050-035	25 mL
Ceramic HyperD® F Resin	20066-023	20067-021	20050-027	100 mL
Ceramic HyperD® F Resin	20066-015	20067-013	20050-019	1 L
Ceramic HyperD® F Resin	20066-064	20067-054	20050-050	5 L
Ceramic HyperD® F Resin	20066-056	20067-047	20050-043	10 L

PRC Prepacked Columns

Part Number	Description	Pkg
PRC05X050QCHDF01	Q Ceramic HyperD® F 5x50, 1 mL	1/pkg
PRC05X050CMCHDF	CM Ceramic HyperD® F 5x50, 1 mL	1/pkg

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