Packing MabSelect™ and MabSelect SuRe™ resins using verified methods

Good column packing is essential for any chromatographic process and plays a key role in the large-scale commercial manufacture of biopharmaceuticals. A bed packed too densely might crack, which can lead to channeling and early breakthrough. A bed packed too loosely can further compress, causing a liquid gap where mixing can occur. Either instance will lead to costly process disruptions and loss of valuable product. Proper packing eliminates such concerns and ensures a stable bed that performs according to expectations over many processing cycles.

This procedure describes packing of MabSelect and MabSelect SuRe resins in large-scale chromatography columns including AxiChrom™, BPG, and Chromaflow™ columns. The procedures include robust and verified packing and testing methods that help eliminate concerns and risks associated with poorly packed beds.

Fig 1. AxiChrom columns provide excellent packing control.

Product characteristics

MabSelect, MabSelect SuRe, and MabSelect SuRe LX

MabSelect resin is a recombinant protein A-based affinity resin. The optimized cross-linked agarose matrix of the resin gives at least five times higher fluid velocities compared with conventional cross-linking. In addition, the recombinant protein A ligand of this resin is engineered to include a C-terminal cysteine and coupling conditions are designed to favor single-point attachment of the ligand, both of which enhance the binding capacity for IgG. MabSelect SuRe and MabSelect SuRe LX resins are designed with the same base matrix as MabSelect resin, but have an alkali-stabilized protein A ligand that allows the use of 0.1 to 0.5 M sodium hydroxide for cleaning-in-place (CIP) procedures. MabSelect SuRe LX has been further developed from MabSelect SuRe resin to give even higher binding capacities.

AxiChrom columns

AxiChrom columns are low-pressure, mechanical axial compression chromatography columns designed for process development and biopharmaceutical manufacturing environments (Fig 1). Mechanical axial compression enables accurate and reproducible control of the packing, even with large-diameter columns.

The columns are available in many different configurations and materials (see Data file 28929041 for more details). AxiChrom columns are designed to be scalable and will give predictable results over the entire range of scales by enabling a uniform plug flow through the bed, irrespective of column size. The columns feature Intelligent Packing with preprogrammed methods that support all column sizes. Intelligent Packing enables straightforward operation and high packing success rates. The packing methods described here apply to bed heights up to 40 cm in AxiChrom columns up to 1600 mm in diameter.

BPG columns

BPG columns are glass columns for process development and manufacturing. The single-screw adapter allows easy and efficient packing and running. The columns have diameters from 100 to 450 mm. The packing methods described here apply to all BPG columns, except for BPG 450 (due to its lower pressure rating).

Chromaflow columns

Chromaflow columns are acrylic or stainless steel, pack-in-place columns for biopharmaceuticals manufacturing. The columns have diameters ranging from 400 to 2000 mm. The packing method described here applies to Chromaflow columns up to 800 mm. A short guideline for larger columns is also provided.

Packing

Definitions

The bed height of a gravity-settled bed differs from the bed height of a bed settled at low flow (consolidated). Therefore, the compression factor (*CF*) has to be separated from the packing factor (*PF*). In water, for example, where the consolidated bed height (at 60 cm/h) is higher than the gravity settled bed height, the *CF* is 1.1 and *PF*, when consolidating at 60 cm/h, is 1.15 for MabSelect, MabSelect SuRe, and MabSelect SuRe LX resins.

Equations to calculate *CF, PF,* and column volume (V_c) are shown below:

$$\text{Compression factor, } CF = \frac{L_{settled}}{L_{packed}}$$

$$\text{Packing factor, } PF = \frac{L_{cons}}{L_{packed}}$$

where

$L_{settled}$ = bed height measured after settling by gravity (cm)

L_{cons} = consolidated bed height, that is, bed height measured after settling the resin at a given flow velocity (cm)

L_{packed} = packed bed height (cm)

$$\text{Column volume, } V_C = L_{packed} \times A_C$$

where

A_C = cross-sectional area of the column (cm^2)

When packing BPG and AxiChrom columns, PF is used in the packing procedure to calculate the packed bed height after the consolidation step. *CF* is used in the resin preparation step to calculate the resin volume needed to pack a desired bed height. Because Chromaflow columns are pack-in-place columns, they have no registered consolidated bed heights and the *CF* is used throughout the packing process.

Properties of MabSelect affinity resins in various packing solutions

MabSelect resins settle differently in different solutions. Adding NaCl to the packing slows the settling of the resin beads and also allows them to settle less tightly. As little as 1 mM NaCl changes the consolidated and gravity settled bed height more than 10%. It is important to measure the resins in correct solutions to minimize the effect on settling. In pilot-scale columns, NaCl is used as packing buffer to minimize wall effects on the packing result and bed stability.

Table 1 shows typical packing factors for MabSelect, MabSelect SuRe, and MabSelect SuRe LX resins in different solutions.

Table 1. Typical packing factors for MabSelect, MabSelect SuRe, and MabSelect SuRe LX resins in different solutions for optimal bed performance where the bed is consolidated at 30 to 60 cm/h

Solution	Packing factor
Water	1.15
20% ethanol	1.15
0.4 M NaCl	1.19

Slurry preparation

Start by calculating the resin volume (*V*) needed to pack the desired bed height. In this step, use CF 1.1, which is the *CF* in 20% EtOH for the gravity-settled resins. This *CF* corresponds to the right packing factor in the method.

Measuring slurry concentration

In order to achieve the correct amount of chromatography resin for packing to target bed height or compression, it is important to measure the slurry concentration correctly. Measuring slurry concentration can be performed with a Tricorn™ 10/100 column. GE Healthcare offers a Slurry Concentration Kit (see Ordering information) with all of the materials required for determination of slurry concentration.

Packing MabSelect, MabSelect SuRe, and MabSelect SuRe LX resins in AxiChrom columns

When packing AxiChrom 50 to 200 columns for use with ÄKTA™ systems, Intelligent Packing control is managed by the UNICORN™ system control software. For AxiChrom 300 to 1600 columns, Intelligent Packing is performed by the AxiChrom Master, a separate unit that comprises a touchscreen-operated user interface, or from the UNICORN software on the ÄKTAprocess™ system.

Intelligent packing in AxiChrom columns—general considerations

Packing methods are created by entering values for the packing variables (e.g., column, resin, slurry concentration, target bed height) in the Intelligent Packing wizard. The *PF* given in the Intelligent packing wizard is dependent of entered packing variables and the packing solution. To pack the column, start the chosen method in the UNICORN software and follow the instructions.

When packing AxiChrom 50 to 200 columns, the slurry is introduced into the column by hand and adapter movement is driven by internal hydraulics. After the wizard method has been created and the resin has been equilibrated in packing solution, the column is primed and filled with slurry. The method controls the flow rate of hydraulic fluid to drive the adapter and packing of the bed (Fig 2).

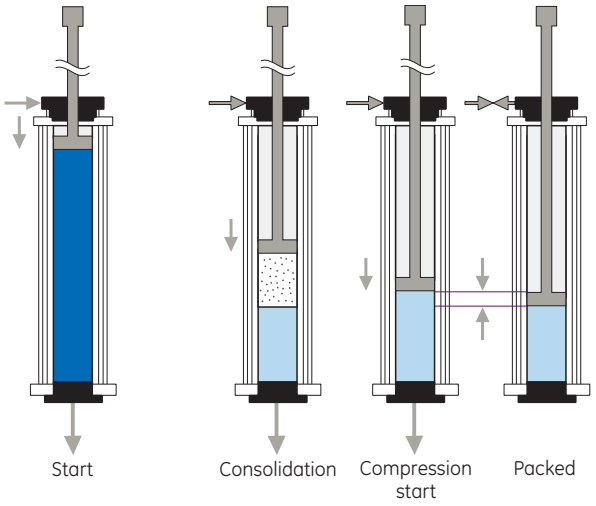

Fig 2. Intelligent Packing in small AxiChrom columns. The adapter is mounted to the column tube and the wizard is started **(Start)**. The adapter moves down, forcing packing liquid out through the bottom bed support. The resin forms a consolidated bed **(Consolidation)**. When the adapter comes into contact with the consolidated bed surface, the operator initiates bed compression in the UNICORN wizard **(Compression start)**. Compression occurs according to a predetermined PF The target bed height is attained **(Packed)**.

In AxiChrom 300 to 1600 columns, slurry is introduced via a resin valve in the center of the bottom bed support and the adapter is driven by an electric servomotor. The two-position resin valve enables filling, packing, and unpacking without adjusting the assembled column.

After the column is primed, the adapter rises from its lowest position and the column fills with slurry via the resin valve. The slurry volume is calculated automatically from the target bed height, slurry concentration, and *PF*. As an electric servomotor controls the movement of the adapter, its position is monitored with millimeter accuracy.

When the correct slurry volume has been drawn into the column, the adapter starts to move downwards and packing buffer is forced out through the bottom bed support and bed consolidation starts. The time to complete consolidation (i.e., when the adapter reaches the bed) is automatically calculated (as for the AxiChrom 50 to 200 columns), allowing the operator to carry out other tasks in the meantime. As the adapter contacts the consolidated bed, it is detected by the Intelligent Packing wizard. When this occurs, the operator confirms that the adapter has contacted the bed.

The compression of the resin starts and a graphical interface is shown on the control screen of the UNICORN software or AxiChrom Master. This graphical interface assists the operator in finishing the packing, giving a well-packed bed. When the adapter symbol is within the range of approved packing factors and bed height limits, the operator can end the packing.

If selected in the UNICORN wizard, Intelligent Packing will automatically run a packed bed evaluation test after the packing. For large AxiChrom columns, automatic methods for priming and unpacking can also be created with the Intelligent Packing wizard.

Packing MabSelect SuRe in BPG columns

Column and system preparation

A detailed description of column preparation is available in the BPG instructions (18117070). The packing pump should be as pulsation-free as possible. Screw or rotary lobe pumps are the most suitable for this task and multi-headed diaphragm pumps are satisfactory.

Caution! Ensure that the column has no visible scratches in the glass tube and that the adapter moves smoothly in both upward and downward directions before packing. In addition, there should be no difficulty in tightening the adapter O-ring to the column inner wall.

Follow the steps below to prepare the BPG column:

1. Place a new 23 µm net on both adapter and bottom end piece.
2. Level the column with the aid of a spirit level.
3. A pressure relief valve should be used for safety reasons, especially against pressure spikes. Position this valve on the pump outlet and add a pressure gauge on the adapter.
4. Mount one 4-port-2-way valve on bottom inlet and one on top of the pressure gauge, 10 mm i.d. for BPG 300 and 6 mm i.d. for BPG 100 and 200.

Resin preparation

Equilibration on the resin in packing solution can be performed by using the BPG column as a "filter". Pour the resin into the column (amount calculated above), mount the adapter, tighten the adapter O-ring, move the adapter down and compress the bed slightly, connect the pump and wash the resin with the packing solution for at least 3 column volumes. For details, use steps 1 to 6 in the packing instruction below but continue with step 6 until 10 cm bed has built up against the adapter net. Unpack and re-suspend the slurry and pack according to the method. MabSelect SuRe resin is packed with water at diameters above 140 mm i.d. Below that diameter, the packing solution shall be 0.4 M NaCl.

Packing the column

1. Set the pressure alarm or pressure relief valve according to the pressure specification (4 bar). Purge the system and tubing from air.
2. Purge the net of trapped air by draining packing solution through the column outlet until about 2 cm of solution remains in the column. Close the bottom valve. If air is still trapped under the end-piece net, add more packing solution and connect a tube to the suction side of a pump. Start the pump and place the pump inlet tube on the bottom net and extract the remaining air.
3. Add the slurry to the column and, if needed, additional packing solution to about 40 cm. Mix the resin and the packing solution to a homogeneous slurry.

Note! The available height to allow the adapter to be inserted into a 50 cm column tube (for filling slurry) is 40 cm. Use a longer column tube when packing beds higher than 20 cm (75 cm and 95 cm tubes are available).

4. Rinse the wall from particles and let the resin settle until there is about 1 cm clear liquid on top of the slurry. This reduces the risk of particles sticking between the O-ring and the column wall, which can cause the column to leak.
5. Insert the adapter and secure it to the column tube. Lower the adapter to the surface of the slurry, allow some clear liquid to pass the O-ring. Tighten the adapter O-ring.
6. Make sure the column top valve is open. Slowly move the adapter down until no air bubbles can be seen leaving the top valve.
7. Start the pump and adjust the settling velocity to 60 cm/h. Shift the top valve into the column and immediately open the bottom valve and lead the liquid to waste.
8. Run the settling flow until the bed is completely consolidated. Note the consolidated bed height and calculate the packed bed height using the *PF* 1.15 in water and *PF* 1.19 in 0.4 M NaCl. The packed bed height is the ratio between the consolidated bed height and the packing factor. Use a marker pen to indicate the packed bed height on the column.
9. Stop the flow and close the bottom valve. Loosen the O-ring and lower the adapter down to 1 cm above the settled bed and seal the adapter O-ring. Shift the top valve to waste and use the adapter to mechanically compress the bed to the mark on the column (step 8). Excessive packing solution is removed through the adapter tube.

The column is now ready for use.

Packing MabSelect resin in Chromaflow columns

The scaled-up method used to pack Chromaflow 600 is based on a standard Chromaflow procedure (i.e., via nozzles in the top and bottom bed supports, and without removing the lid or adaptor). This method makes use of the optional Chromaflow Packing Station, which includes a control panel with pneumatically-actuated diaphragm pumps and valves, and a tank to hold the slurry.

The recommendation for packing Chromaflow columns is to use the solution in which the resin is delivered or a decanted solution, as 10% to 20% ethanol in the slurry gives a good packing result. If the delivery solution is decanted, replace it with water.

To avoid introducing air to the column when packing, additional slurry is required for the extra volumes in tank and tubing. Add the slurry to the slurry tank and stir the resin. Dilute the suspension to about 50% slurry concentration.

Column preparation

For a more detailed description about the column and pack station preparation, see Chromaflow columns Operating instruction (28962232) and Chromaflow Packing stations Operating instruction (29046228). In this procedure, standard Chromaflow nomenclature is used for connections on the column and packing station.

Note: It is important that the supply air flow rate follows the specification of the Chromaflow Packing station (1000 L/min for Pack 100) and that the supply air pressure into the packing station is 6 to 7 bar.

1. Set up the column according to the Chromaflow columns Operating Instructions (28962232).
2. A pressure relief valve (adjusted to the operating pressure limit of the column) should be used for safety reasons. Position this valve on the slurry inlet top (SIT), with the waste tubing connected to the slurry tank. Place a pressure gauge on the mobile phase top (MPT) to record the pressure during packing. Mount one 3-port, 2-way valve on top of the pressure gauge and one on the mobile phase bottom (MPB). The top valve should lead in two directions: one side into the system and one to waste for purging the tubing. On the bottom valve, one side leads to the system and a 1.5" to 2" tubing leads to waste (for packing). Part of the MPB waste tubing should be placed above the outlet valve to prevent air from entering throught the MPB.
3. Connect appropriate tubing (i.d. 1" or 1.5") and tanks to the column and packing station. If a flow meter is used, place it between the SIT and the packing station.
4. Level the adapter to the desired bed height. Remember to loosen the nuts on the adapter rods to allow the adapter to be raised or lowered. Flush the adapter rods with 20% ethanol as lubrication.
5. Prime the column, packing station, and tubing with water according to the Chromaflow columns Operating instruction.

Column packing

Note: Packing Chromaflow columns is a rapid procedure compared with other packing procedures and it is therefore important to thoroughly read the packing instructions and practice the packing steps in advance of the packing.

1. Mount a flow meter on the tubing leading to the top slurry inlet.
2. Set both nozzles in run position to prime the tubing with slurry. Lead the slurry outlet top (SOT) tubing back to the slurry tank and secure it. Stir the slurry to keep it homogeneous, select slurry and SIT on the packing station, open the slurry tank, and start the packing pump.
3. As the aim of this procedure is to prime the tubing and allow the pump speed to be set, the column is bypassed at this stage. Increase the pump flow to the packing flow rate of about 1500 cm/h (or about 70.5 L/min).
4. When the tubing is primed and the flow rate set, set the SIT/slurry inlet bottom (SIB) to the position between SIT and SIB to block the flow during step 4 while maintaining the correct flow rate for the next step.
5. Move the top nozzle down into the packing position.
6. Two operators should simultaneously open the bottom mobile phase valve to waste and turn the SIT/SIB valve to SIT on the packing station. The column then starts to fill with slurry and the bed builds up slowly from the bottom as excess liquid exits via the MPB.

Note! Column pressure should not exceed the operating pressure limit of the column (i.e., 3 bar). If this pressure is reached, gently decrease the packing flow so that the pressure remains just below 3 bar. Typically, the final pressure in the column is 2 to 3 bar depending on the viscosity of the packing solution, column diameter, and bed height.

7. Stop the packing pump when the bed is 0.5 cm from the top bed support by setting the SIT/SIB to the position between SIT and SIB, as described in step 4. Once the flow is stopped, the bed will expand to meet the adapter.

Note! If a non-transparent (e.g., stainless steel) column tube is used, stop the packing flow when the calculated volume of slurry has been introduced into the column. Check the volume in the slurry tank or use a volume totalizator.

8. Immediately move the top nozzle back to the run position.
9. Close the MPB valve when the pressure in the column is between 0.3 and 0.1 bar.
10. Use packing solution to rinse residual resin from the tubing and the top nozzle. Pump the packing solution through the top nozzle back into the slurry tank.
11. Close the slurry tank and empty the tubing between the tank and packing station.
12. Pump liquid upflow through the column until the air is expelled.

Testing the performance of the packed column

Process-scale packed columns must perform with a high degree of efficiency over many processing cycles (i.e., display high stability). The efficiency of a packed column can be expressed in terms of height equivalent to a theoretical plate (HETP) and asymmetry factor (A_S). This test should be repeated regularly to monitor the state of the bed throughout the working life of the column. If the test results are to be comparable over time, conditions such as fluid velocity (cm/h), liquid pathway, sample composition, and elution buffer should be kept constant. The requirements for the test have to be set in accordance with test conditions and the goal of the purification. The test is further described in Application note 28937207.

Test conditions used in this study

Sample:	2% v/v acetone or 0.8 M NaCl (AxiChrom 50 to 200)
Sample volume:	1% of the column volume (V_c)
Test velocity:	30 cm/h for AxiChrom and BPG, 20 and 30 cm/h for Chromaflow
Eluent:	water or 0.4 M NaCl (AxiChrom 50 to 200)

To compare the performance of columns packed with chromatography resin of different particle diameters, the reduced plate height (h = HETP/average bead diameter [dp]) is typically used. As a guideline, a value of h < 3 is considered good at optimal test conditions.

Examples of results

Columns packed with the methods outlined above were tested for plate number, asymmetry, pressure-flow properties, and stability.

AxiChrom columns

Table 2 provides examples of efficiency and stability results for MabSelect SuRe and MabSelect SuRe LX resins packed in AxiChrom columns (results for MabSelect resin are similar). The results for column sizes ranging from 100 to 300 mm were almost identical, and mirrored the results for MabSelect SuRe resin in larger AxiChrom 400 to 1600 mm columns. Changes in bed height (see MabSelect SuRe resin in 300 and 400 mm AxiChrom columns) also showed little effect on the efficiency data. These results show that the verified packing methods available in Intelligent Packing in UNICORN Master wizard give similar results independent of column size and bed height. The stability test showed that the beds were stable when running in water at velocities given in Table 2.

Pressure-flow curves provide a simple, yet effective illustration of column performance in terms of the maximum operating velocity at which the purification process can be run. These curves also show the magnitude of the back pressure in the system at a certain liquid velocity. AxiChrom columns can utilize the full liquid velocity of MabSelect SuRe resin, even at large column diameters (Fig 3). MabSelect SuRe LX shows similar pressure-flow characteristics (Fig 4).

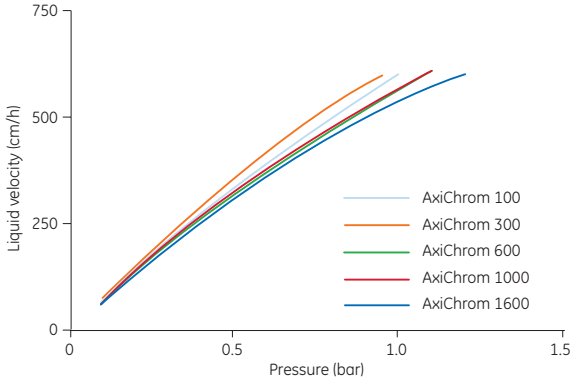

Fig 3. Regression curves of pressure-flow tests for MabSelect Sure resin in 20°C water at 20 cm packed bed height in AxiChrom 100, 300, 600, 1000, and 1600 equipped with stainless steel bed supports. MabSelect SuRe resin can be run at 500 cm/h with a back pressure of less than 2.0 bar. System/tubing pressure is excluded.

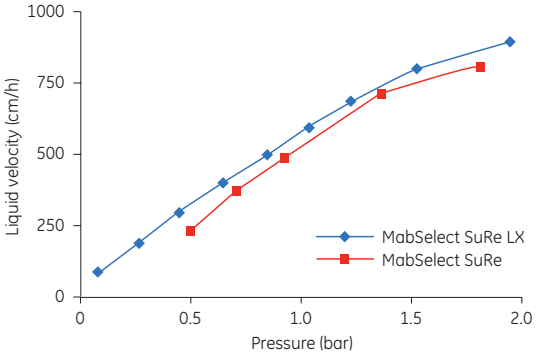

Fig 4. Pressure-flow curve for MabSelect Sure resin in 20°C water, and MabSelect SuRe LX at a 20 cm packed bed height in AxiChrom 300 equipped with stainless steel bed supports. System/tubing pressure is excluded.

Table 2. Column efficiency data for different packings of MabSelect SuRe and MabSelect SuRe LX in different AxiChrom columns

Resin	AxiChrom column	Bed height (cm)	Average plates/m*	Reduced plates height (h) range*	Asymmetry factor A_s range*	Flow velocity for stability test (cm/h)†	Change after stability test (%)†	
							h	A_s
MabSelect	100	20	8200	1.4–1.5	1.0–1.0	500	3	8
MabSelect	140	20	7900	1.4–1.6	1.1–1.2	500	11	11
MabSelect SuRe	300	20	8100	1.4–1.5	1.1–1.1	500	2	4
MabSelect SuRe	300	40	8000	1.4–1.5	1.1–1.1	300	0	3
MabSelect SuRe	400	20	8300	1.4–1.5	1.1–1.3	500	6	10
MabSelect SuRe	400	35	8100	1.4–1.6	1.1–1.1	300	1	5
MabSelect SuRe	600	20	8500	1.3–1.5	1.1–1.2	500	8	5
MabSelect SuRe	1000	20	7300	1.4–1.9	1.1–1.3	500	1	5
MabSelect SuRe	1600§	20	6200	1.4–2.0	1.1–1.3	500	-5	8
MabSelect SuRe	1600‡	20	7800	1.0–1.6	1.1–1.2	500	na	na
MabSelect SuRe LX	100	20	8400	1.3–1.4	1.0–1.0	500	-5	8
MabSelect SuRe LX	300	20	7900	1.4–1.5	1.1–1.2	500	3	4

* Test performed at optimal test conditions. Average and ranges of up-flow and down-flow tests for at least three packings.
† Stability tests were run once for each bed height/resin/column combination in water for 16 h at given velocity.
§ Stainless steel bed support.
‡ Polyethylene bed support.

BPG columns

Examples of efficiency and stability results for MabSelect and MabSelect SuRe resins are shown in Table 3.

The pressure-flow curves for MabSelect resin in BPG 100 and 300 columns are shown in Figure 5. The pressure-flow profile for MabSelect Sure resin in BPG 300 shows that the resin can be run at 500 cm/h with a back pressure of less than 2.0 bar.

Figure 6 displays the pressure-flow curves for MabSelect SuRe in BPG 300 columns. MabSelect SuRe can be run at 500 cm/h with a back pressure of less than 2.0 bar.

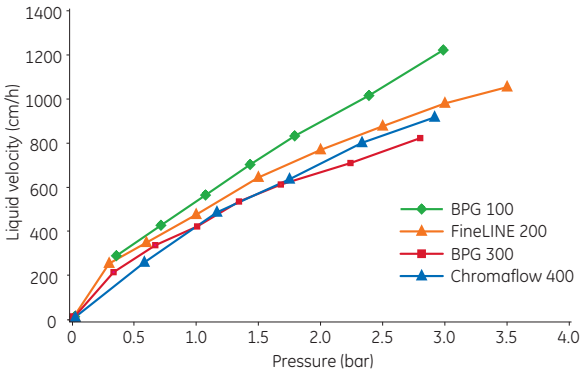

Fig 5. Pressure/flow rate studies on MabSelect resin packed at 20 cm bed height in BPG, Chromaflow, and FineLINE™ columns.

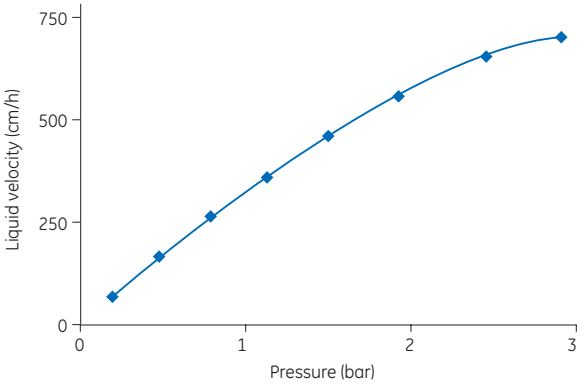

Fig 6. Pressure-flow curve in water at 20°C for MabSelect SuRe resin at a 20 cm packed bed height in BPG 300/500. MabSelect SuRe resin can be run at 500 cm/h with a back pressure of less than 2.0 bar. System/tubing pressure is excluded.

Table 3. Column efficiency data for different packings of MabSelect SuRe resin in BPG columns

Resin	BPG	Bed height (cm)	Average plates/m*	Reduced plate height (h) range*	Asymmetry factor A_s range*	Flow velocity for stability test (cm/h)	Change after stability test (%)†	
							h	A_s
MabSelect SuRe	BPG 300	20	6200	1.7–2.6	1.12–1.15	500	5	8

* Test performed at optimal test conditions. Average and ranges of up-flow and down-flow tests for at least three packings.
† Stability tests were run once for each bed height/resin/column combination in water for 16 h at given velocity.

Chromaflow columns

The efficiency results for MabSelect and MabSelect SuRe resins packed in Chromaflow 600 and 1000 are shown in Table 4. Good plate numbers and asymmetry factors were achieved when using both 600 and 1000 mm columns.

The pressure-flow curves for Chromaflow columns are shown in Figure 7. For MabSelect SuRe resin, stability test flows performed on the different columns reveal that the flow performance and bed stability are lower when packed in the 1000 column, despite the same calculated compression. The stability test flow reached for the 1000 cm column was 280 cm/h, compared with a flow of 500 cm/h in the 600 column (Table 4). One reason for the difference in flow performance can be the higher packing flow possible in the 600 column.

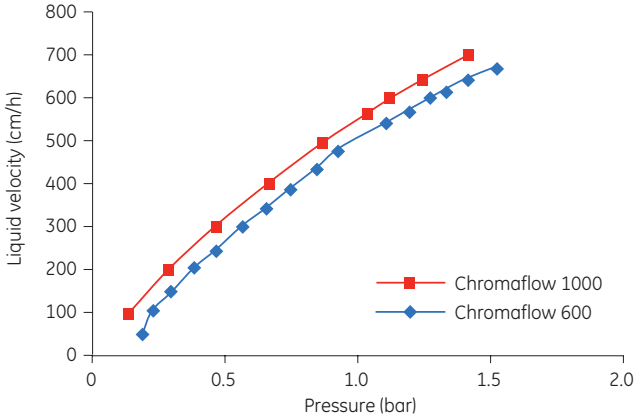

Fig 7. Pressure-flow curve in water at 20°C for MabSelect Sure resin at a 20 cm packed bed height in Chromaflow 600 and 1000. The packed bed compression is 1.08. The presented curve is the sum of bed and column pressure drop. MabSelect SuRe resin can be run at 500 cm/h with a back pressure of less than 2.0 bar in the 600 column. System/tubing pressure is excluded.

A Pack Station 200 was used to pack the Chromaflow 1000 column and this allowed a packing flow velocity of (max.) 1100 cm/h compared with the recommended flow velocity of 1500 cm/h. The wall support in the 600 column also helps to keep the bed stable to a higher degree than in the 1000 column. Due to column design, large (> 800 mm) Chromaflow columns cannot be packed with MabSelect SuRe resin at recommended packing velocities due to flow restrictions. For columns larger than 800 mm id, AxiChrom columns are recommended.

Conclusions

This procedure describes packing of MabSelect, MabSelect SuRe, and MabSelect SuRe LX resins in AxiChrom columns, utilizing the easy-to-use and verified Intelligent Packing wizard. Methods for packing these resins in BPG and Chromaflow columns are also described.

AxiChrom columns enable the full utilization of the MabSelect resin family's high fluid velocity capabilities. In addition, AxiChrom columns are available in a range of diameters and bed heights, allowing for more flexible and rapid processes. It is important to remember that each packing method is related to a specific packing solution. Changes in packing solution can have a significant impact on the *PF* and subsequently on the packing results. To utilize the full flow potential of the MabSelect resin family, AxiChrom columns are recommended.

Table 4. Column efficiency data for different packings of MabSelect and MabSelect SuRe resins in different Chromaflow columns

Resin	Chromaflow	Bed height (cm)	Average plates/m*	Reduced plate height (h) range*	Asymmetry factor A_s range*	Flow velocity for stability test (cm/h)	Change after stability test (%)†	
							h	A_s
MabSelect‡	600	20	6100	1.9–2.4	1.0–1.1	500	14	21
MabSelect SuRe	600	20	5300	2.1–2.3	1.1–1.2	500	18	4
MabSelect SuRe	1000	20	5500	1.9–2.3	0.8–1.1	280	8	13

* Test performed at optimal test conditions. Average and ranges of up-flow and down-flow tests for at least three packings.
† Stability tests were run once for each bed height/resin/column combination in water for 16 h at given velocity.
‡ Test performed at 20 cm/h.

Ordering information

Products	Quantity	Product code
MabSelect	25 mL	17519901
	200 mL	17519902
	1 L	17519903
	5 L	17519904
MabSelect SuRe	25 mL	17543801
	200 mL	17543802
	1 L	17543803
	5 L	17543804
	10 L	17543805
MabSelect SuRe LX	25 mL	17547401
	200 mL	17547402
	1 L	17547403
	5 L	17547404
	10 L	17547405
Media Wand™	1	28922767
Media Handling Unit	1	28922769
Slurry Concentration Kit	1	29096100

Related literature

Products	Product code
Data files	
MabSelect	18114994
MabSelect SuRe	11001165
MabSelect SuRe LX	28987062
AxiChrom columns	28929041
BPG columns	18111523
Chromaflow columns	18113892
Media Wand	28923101
Application notes	
Column efficiency testing	28937207
Packing MabSelect Xtra™ chromatography resins	11001156
Instructions	
MabSelect	71502091
MabSelect SuRe	11002601
MabSelect SuRe LX	28976500
Instructions for use/Operating instructions/User manuals	
AxiChrom 50, 70, and 100 columns	28933108
AxiChrom 140 and 200 columns	28943123
AxiChrom 300–1600 columns	29065430
BPG Columns	18117070
Chromaflow columns	28962232
Chromaflow Packing Station 50, 100, 200, and 400	29046228

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