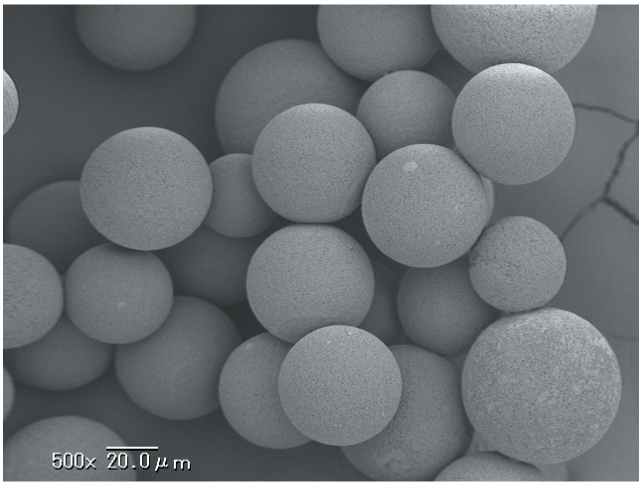
Pressure flow characteristics of YMC's BioPro IEX

The pressure flow characteristics of IEX resins are mainly based on the physical properties of the base beads used for the resin. In general, the particle size of the resin is the overriding parameter responsible for the separation efficiency according to the diffusion processes and for the inherent backpressures during the chromatographic processes.

In this technical note, the pressure flow characteristics of BioPro IEX Q75 from YMC and Q Sepharose FF from Cytiva are compared. Even though the base beads are completely different, the intended use in the downstream processing of biomolecules is the same for both resins. The BioPro IEX Q75 resin is based on polymethacrylate beads whereas the Q Sepharose FF is based on crosslinked 6% agarose beads.



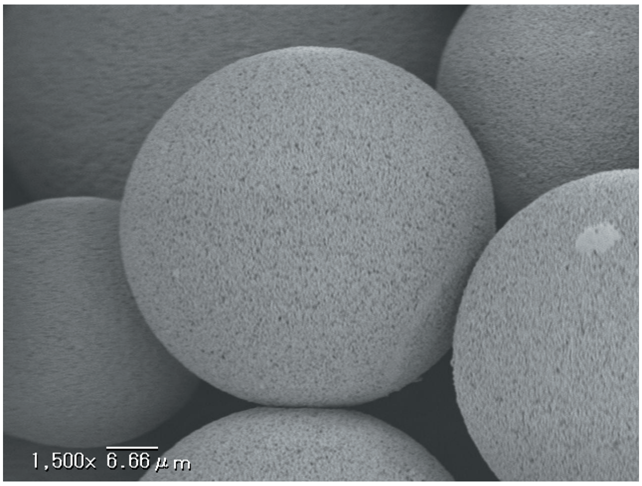


Fig. 1: Microscopic images of BioPro IEX Q75 particles

Pressure drop

The backpressure within a chromatography system depends essentially on the pressure drop of the column which in turn is dependent on the particle size of the resin used.
The theoretical pressure increase is 44% for a change from 90 µm particles to 75 µm particles.

f	Proportionality factor
F	Flow rate
η	Viscosity (cP)
L	Column length (cm)
r	Column radius (cm)
d_p	Particle size (µm)

$$\Delta p = f \, x \, \frac{F \, x \, \eta \, x \, L}{\pi \, x \, r^2 \, x \, d_p^2}$$

Comparison study

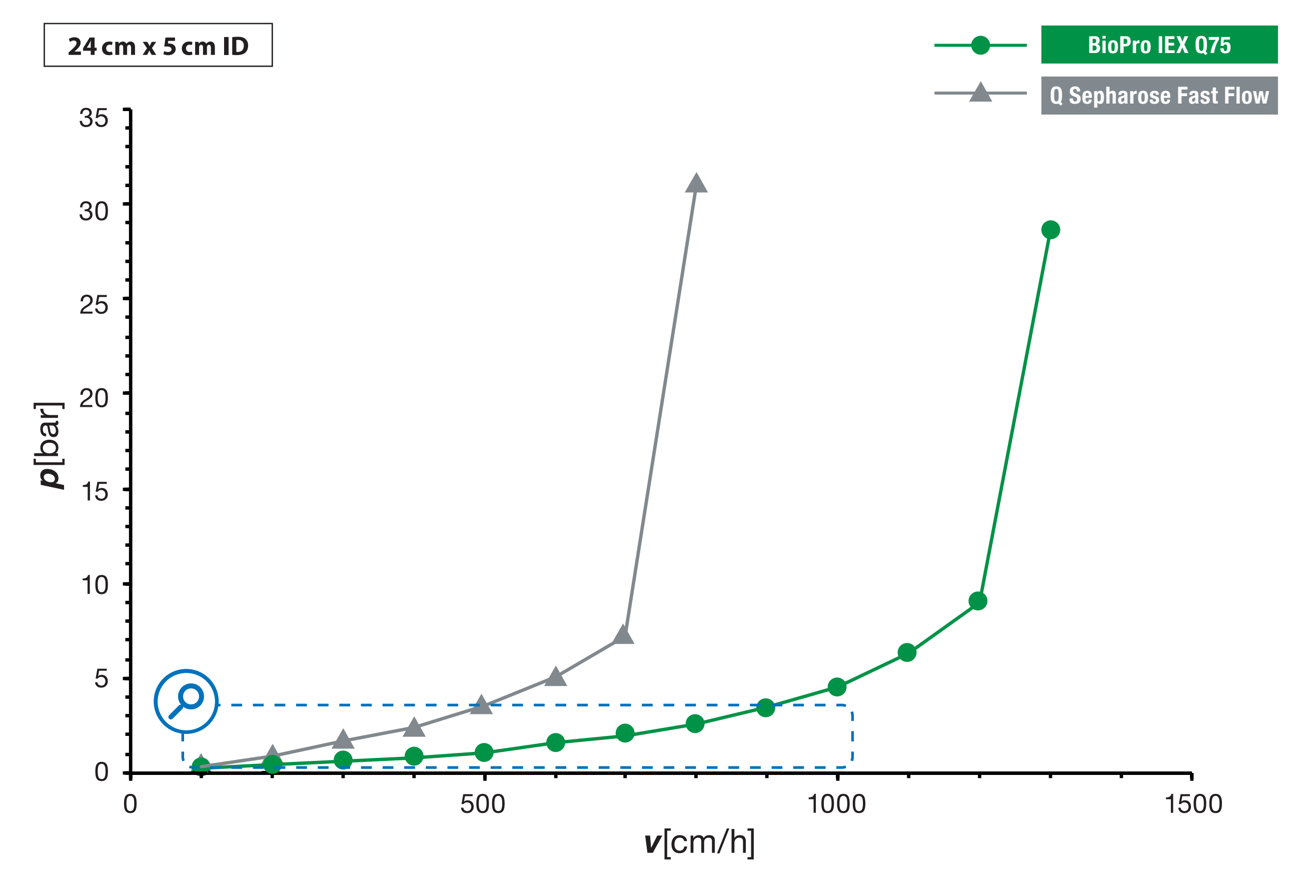
YMC investigated the pressure flow characteristics of YMC's BioPro IEX Q75 and Q Sepharose FF from Cytiva using the following procedure:

- The fines were removed from the resin and the remaining resin washed with 1 M NaCl.
- Then a 40% slurry in 1 M NaCl was poured into a YMC ECO^{PLUS} laboratory scale glass column (inner diameter = 50 mm).
- The resin was consolidated at a linear flow velocity of 60 cm/h.
  The consolidated bed height was adjusted to 24 cm and marked on the glass column.
- The piston was placed approx. 1 cm above the resin surface.
- The flow was increased in steps of 100 cm/h up to the point where the resulting pressure becomes infinite (= critical velocity). The stabilised pressure at each increment was noted.

Results

The resulting pressure flow curves are shown in Figure 1. In contrast to the theoretical expectations, the pressures observed for the 75 µm resin from YMC are about 1/3 that of the pressures observed for the 90 µm based resin from Cytiva in the typical flow rate range of 200–600 cm/hr.

The critical flow rate for the YMC resin is at 1,200 cm/h whereas the Cytiva resin already reaches the maximum flow rate at 700 cm/h.



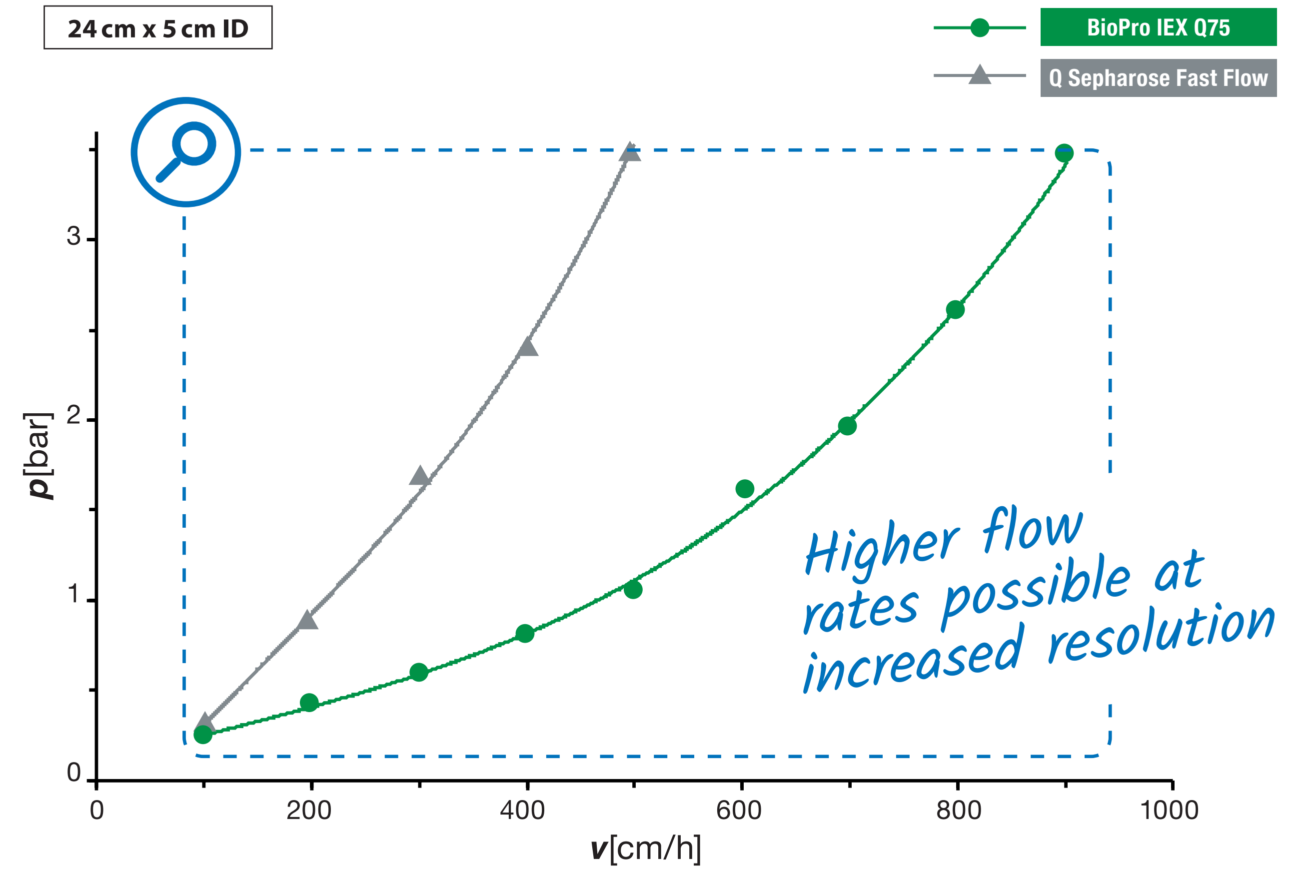
Column:	ECO[PLUS], 50 mm ID, max. bed length 250 mm, AB version
Resin amount (gravity settled in 1 M NaCl):	470 mL
Slurry concentration:	40 %
Consolidation flow velocity:	60 cm/h
Consolidated bed height:	24 cm
Mobile phase:	1 M NaCl solution

Fig. 3: Pressure flow curves for YMC's BioPro IEX Q75 and the Cytiva resin

The pressure flow curve of BioPro IEX Q75 suggests reversible compression behaviour over a wide range of linear flow velocities. Despite using smaller particles (75 µm) compared to the 90 µm particle size of the Cytiva resin, BioPro IEX Q75 shows much better pressure flow characteristics.

Conclusions

The YMC resin shows much better pressure flow characteristics. This may be related to the rigidity of the base beads used.
As a result, the YMC resin can be used over a greater flow rate range and with higher flow rates. For a pressure range of up to 3 bar, the YMC resin can be used with flow rates of up to 800 cm/hr for a bed length of 24 cm.



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

Fig. 4: Pressure flow curves for YMC's BioPro IEX Q75 and the Cytiva resin for a pressure range up to 3.5 bar.