



Application Note



A HIGH CAPACITY PROTEIN A RESIN DESIGNED TO REDUCE PRODUCTION COSTS

TAKING ADVANTAGE OF HIGH CAPACITY PROTEIN A: AN ECONOMIC COMPARISON OF THE RESIN COST PER GRAM OF ANTIBODY PRODUCED

With pressures mounting to reduce production costs at many companies, and protein A being the most expensive resin used in mAb purification, the use of a high capacity protein A resin can significantly impact the overall cost of doing business. This report details how using a high capacity protein A resin will reduce production costs, on a per-gram produced basis, for companies that implement its use in their chromatography platform.

TOYOPEARL AF-rProtein A HC-650F and two other commercially available protein A resins, one of them also a “high capacity” resin, were compared on a cost-per-gram of mAb produced basis at multiple resin prices from \$7,000 to \$17,000 per liter as well as three different column configurations. For in-depth comparison, the median resin price of \$12,000 per liter was used as a basis to determine comparative production costs between the three resins tested.

Three configurations were examined to model what the resin costs would be in columns that were packed to have equal capacity, equal resin volume, and equal column dimensions. These three configurations were chosen to reflect the ways high capacity protein A resins could be instituted by individual companies, and also allows for a more complete look at the effects of resin capacity than just a single column configuration.

COLUMNS OF EQUAL CAPACITY

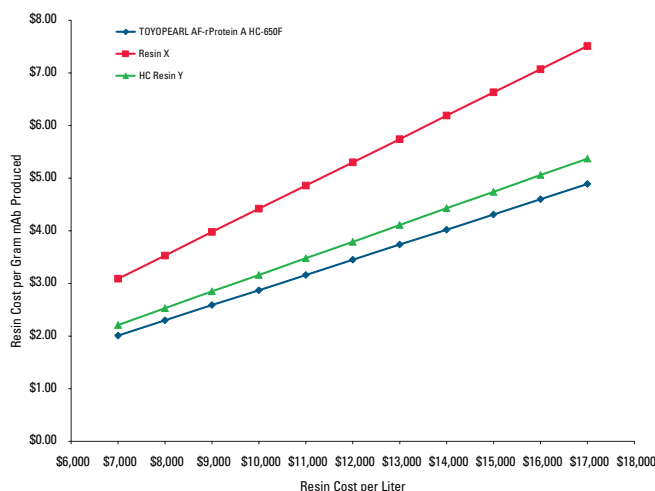


Figure 1 At a column capacity of approximately 735 grams per load, the TOYOPEARL AF-rProtein A HC-650F had the lowest cost per gram of antibody purified at every similar price point.

For this evaluation, the variables examined are the resin cost per liter and the column configuration. The following values were held constant:

- Residence time: 3 minutes
- DBC: 3 minute residence time (from product literature)
- Column load: 80% of stated dynamic binding capacity
- Harvest titer: 3 g/L
- Harvest volume: 2000 L
- Column lifetime: 100 cycles
- Column yield: 95%

Resin	Packed bed height (cm)	Column diameter (cm)	Column volume (L)	Resin compression	Resin volume to pack column	Resin cost per liter	Packed column cost	DBC at residence time (g/L)	Column capacity 80% DBC (g)	Residence time (min)
TOYOPEARL AF-rProtein A HC-650F	15	36	15	1.25	20	\$12,000	\$240,000	60	732	3
Resin X	21	40	26	1.16	31	\$12,000	\$372,000	35	739	3
High capacity resin Y	18	36	18	1.16	22	\$12,000	\$264,000	50	732	3

Table 1

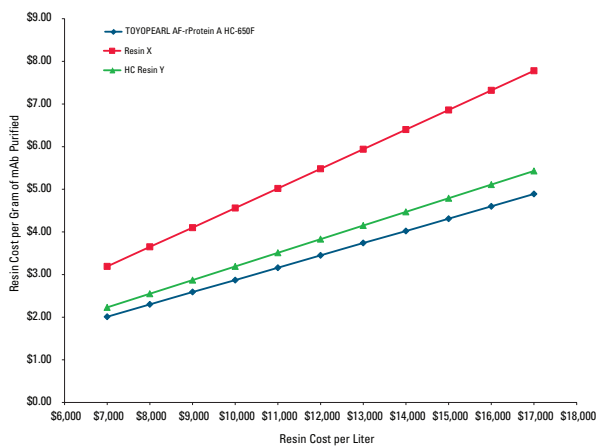
Resin	Flow rate (cm/hr)	Harvest titer (g/L)	Harvest volume (L)	Column cycles per harvest	Column lifetime (cycles)	Column lifetime (harvests)	Yield	Column lifetime productivity (g)	Resin cost per gram
TOYOPEARL AF-rProtein A HC-650F	300	3	2000	9	100	11	95%	69,587	\$3.45
Resin X	420	3	2000	9	100	11	95%	70,160	\$5.30
High capacity resin Y	360	3	2000	9	100	11	95%	69,587	\$3.79

Table 2

Resin	Resin Cost Per Gram at Median Resin Price (\$12,000)	Competitor Resin Price per Liter Needed to Equal Tosoh
TOYOPEARL AF-rProtein A HC-650F	\$3.45	
Resin X	\$5.30	\$7,500
High capacity resin Y	\$3.79	\$11,000

Table 3

COLUMNS OF EQUAL VOLUME



At a column capacity of appr. 732 grams per load, the TOYOPEARL AF-rProtein A HC-650F had the highest load capacity of the three resins packed at an equal column volume of 15 L.

The cost per gram of antibody purified was also lower than the other two resins at every similar price point.

Figure 2

Resin	Packed bed height (cm)	Column diameter (cm)	Column volume (L)	Resin compression	Resin volume to pack column	Resin cost per liter	Packed column cost	DBC at residence time (g/L)	Column capacity 80% DBC (g)	Residence time (min)
TOYOPEARL AF-rProtein A HC-650F	15	36	15	1.25	20	\$12,000	\$240,000	60	732	3
Resin X	21	30	15	1.16	18	\$12,000	\$216,000	35	415	3
High capacity resin Y	21	30	18	1.16	18	\$12,000	\$216,000	50	593	3

Table 4

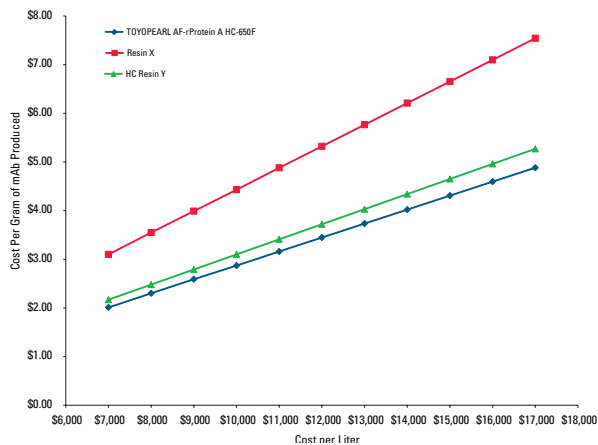
Resin	Flow rate (cm/hr)	Harvest titer (g/L)	Harvest volume (L)	Column cycles per harvest	Column lifetime (cycles)	Column lifetime (harvests)	Yield	Column lifetime productivity (g)	Resin cost per gram
TOYOPEARL AF-rProtein A HC-650F	300	3	2000	9	100	11	95%	69,587	\$3.45
Resin X	420	3	2000	15	100	6	95%	39,465	\$5.47
High capacity resin Y	420	3	2000	11	100	9	95%	56,379	\$3.83

Table 5

Resin	Resin Cost Per Gram at Median Resin Price (\$12,000)	Competitor Resin Price per Liter Needed to Equal Tosoh
TOYOPEARL AF-rProtein A HC-650F	\$3.45	
Resin X	\$5.47	\$7,300
High capacity resin Y	\$3.83	\$10,600

Table 6

COLUMNS OF EQUAL DIMENSIONS



At a column capacity of approximately 732 grams per load, the TOYOPEARL AF-rProtein A HC-650F had the highest load capacity of the three resins packed at equal column dimensions of 36 cm ID x 15 cm.

The cost per gram of antibody purified was also lower than the other two resins at every similar price point.

Figure 3

Resin	Packed bed height (cm)	Column diameter (cm)	Column volume (L)	Resin compression	Resin volume to pack column	Resin cost per liter	Packed column cost	DBC at residence time (g/L)	Column capacity 80% DBC (g)	Residence time (min)
TOYOPEARL AF-rProtein A HC-650F	15	36	15	1.25	20	\$12,000	\$240,000	60	732	3
Resin X	15	36	15	1.16	18	\$12,000	\$216,000	35	427	3
High capacity resin Y	15	36	15	1.16	18	\$12,000	\$216,000	50	610	3

Table 7

Resin	Flow rate (cm/hr)	Harvest titer (g/L)	Harvest volume (L)	Column cycles per harvest	Column lifetime (cycles)	Column lifetime (harvests)	Yield	Column lifetime productivity (g)	Resin cost per gram
TOYOPEARL AF-rProtein A HC-650F	300	3	2000	9	100	11	95%	69,587	\$3.45
Resin X	300	3	2000	15	100	6	95%	40,593	\$5.32
High capacity resin Y	300	3	2000	10	100	10	95%	57,990	\$3.72

➤ **Table 8**

Resin	Resin Cost Per Gram at Median Resin Price (\$12,000)	Competitor Resin Price per Liter Needed to Equal Tosoh
TOYOPEARL AF-rProtein A HC-650F	\$3.45	
Resin X	\$5.32	\$7,800
High capacity resin Y	\$3.72	\$11,200

➤ **Table 9**

CONCLUSIONS

As can be seen from the above comparisons, making use of a high capacity protein A resin in your purification process is an excellent way to save on production costs. At the median resin price of \$12,000 per liter, the TOYOPEARL AF-rProtein A HC-650F resin would save customers almost \$2.00 per gram of antibody produced over a resin with a capacity of 35 g/L and almost \$0.50 per gram over a competitive high capacity resin.

With increasing pressures on producers of biopharmaceutical drugs to reduce production costs, the use of a high capacity protein A resin is a superior way to achieve this goal without making any sacrifice to product quality or processing time.