

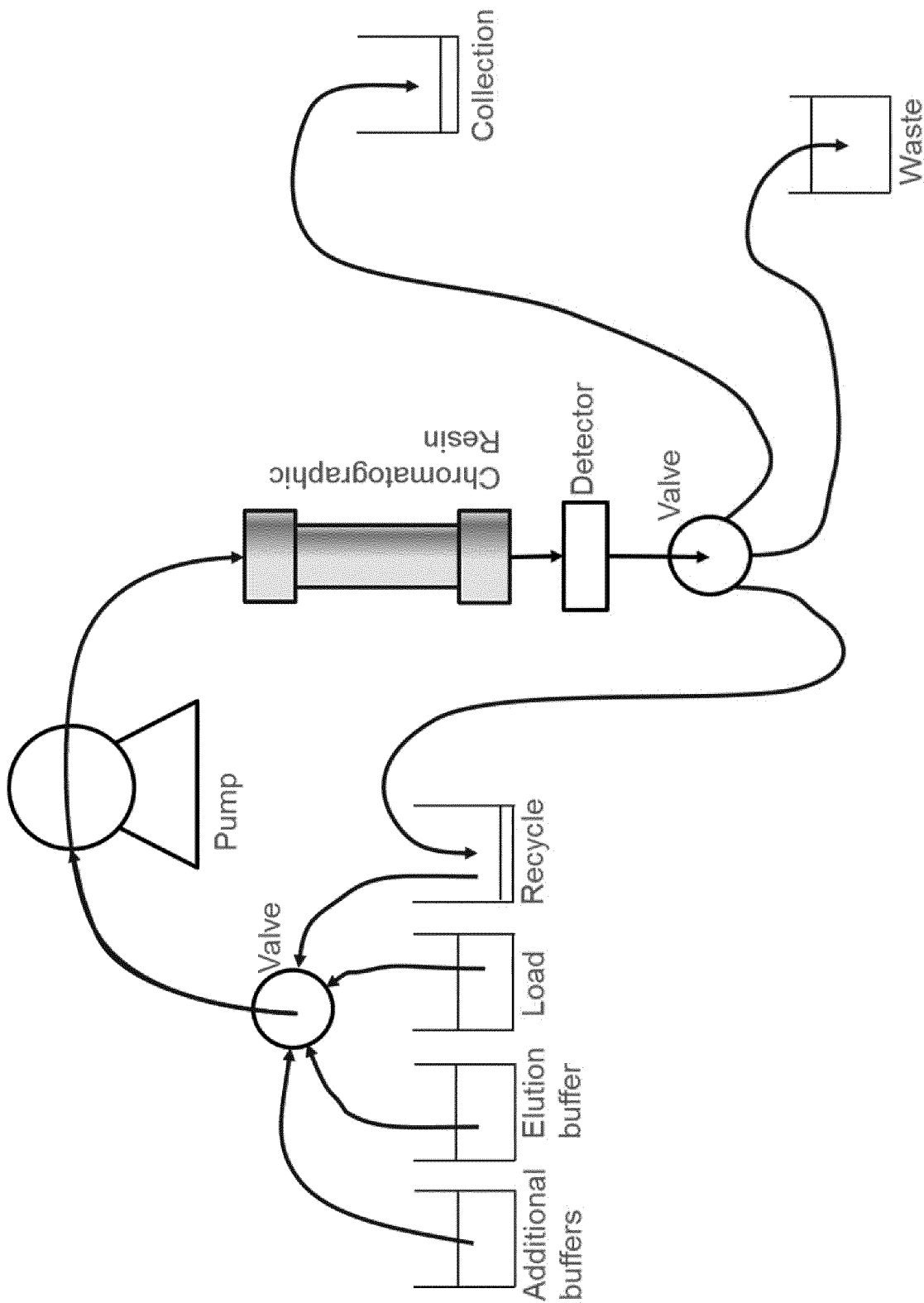


Fig. 1

Fig. 2

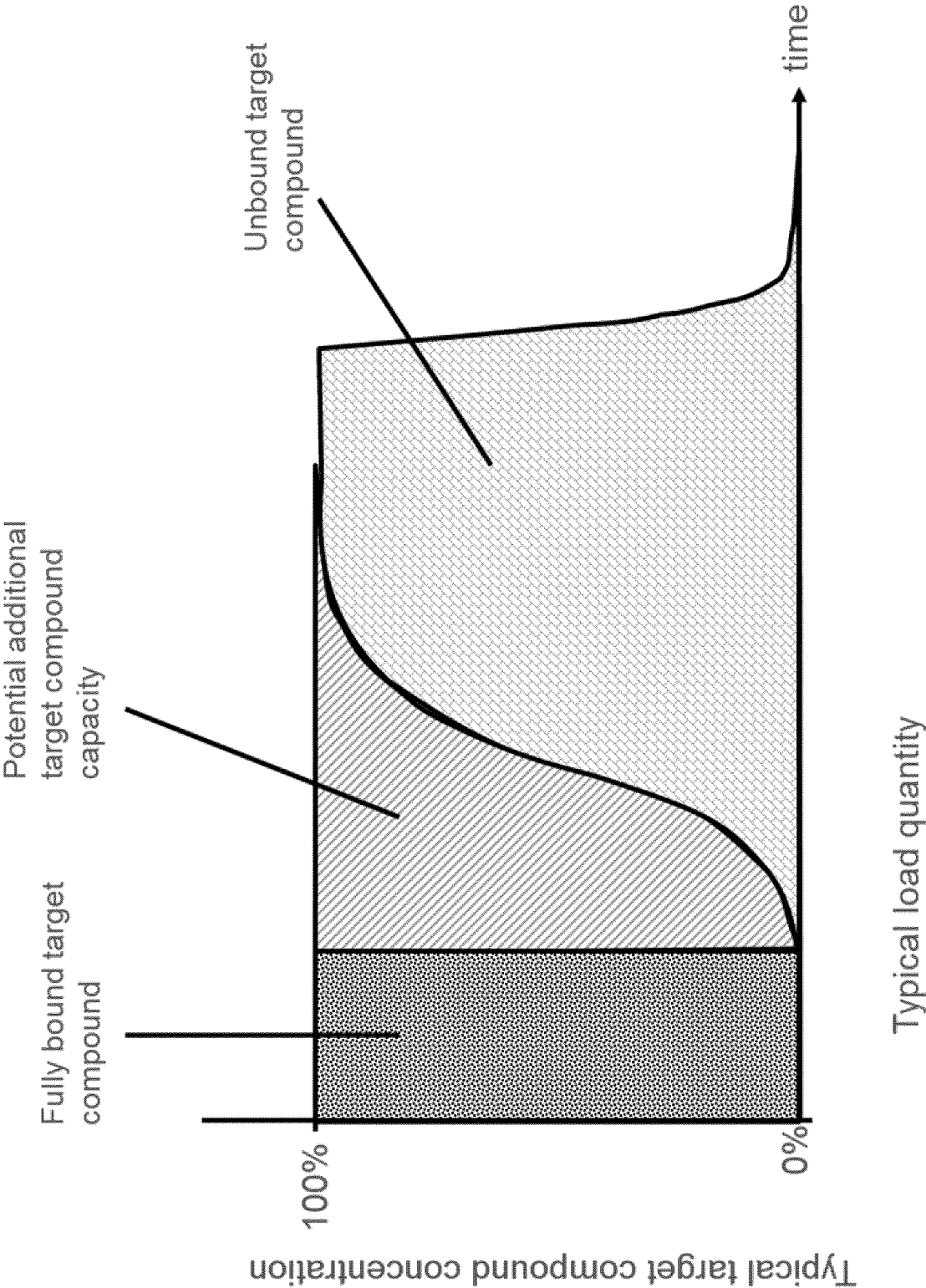


Fig. 3

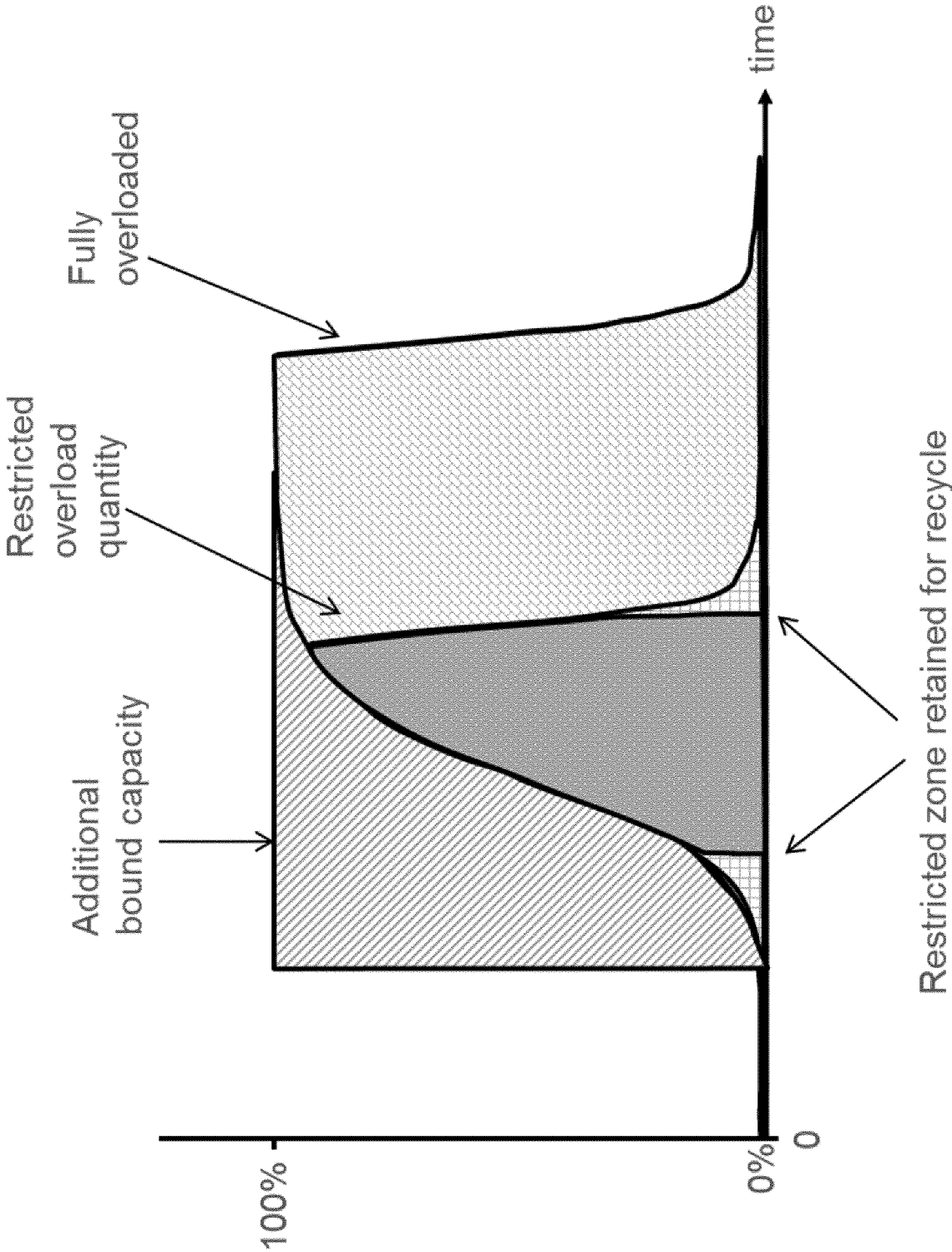
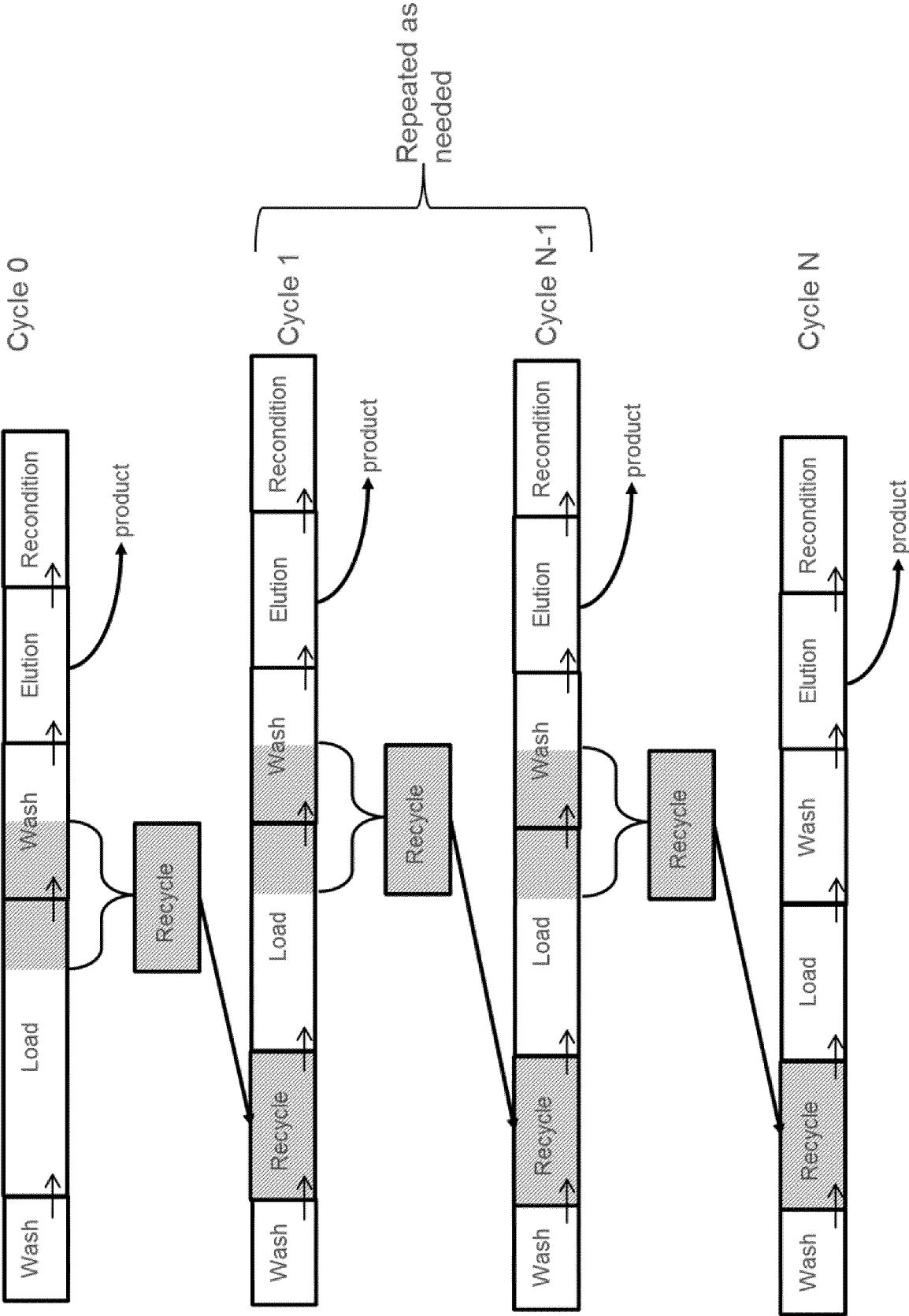


Fig. 4



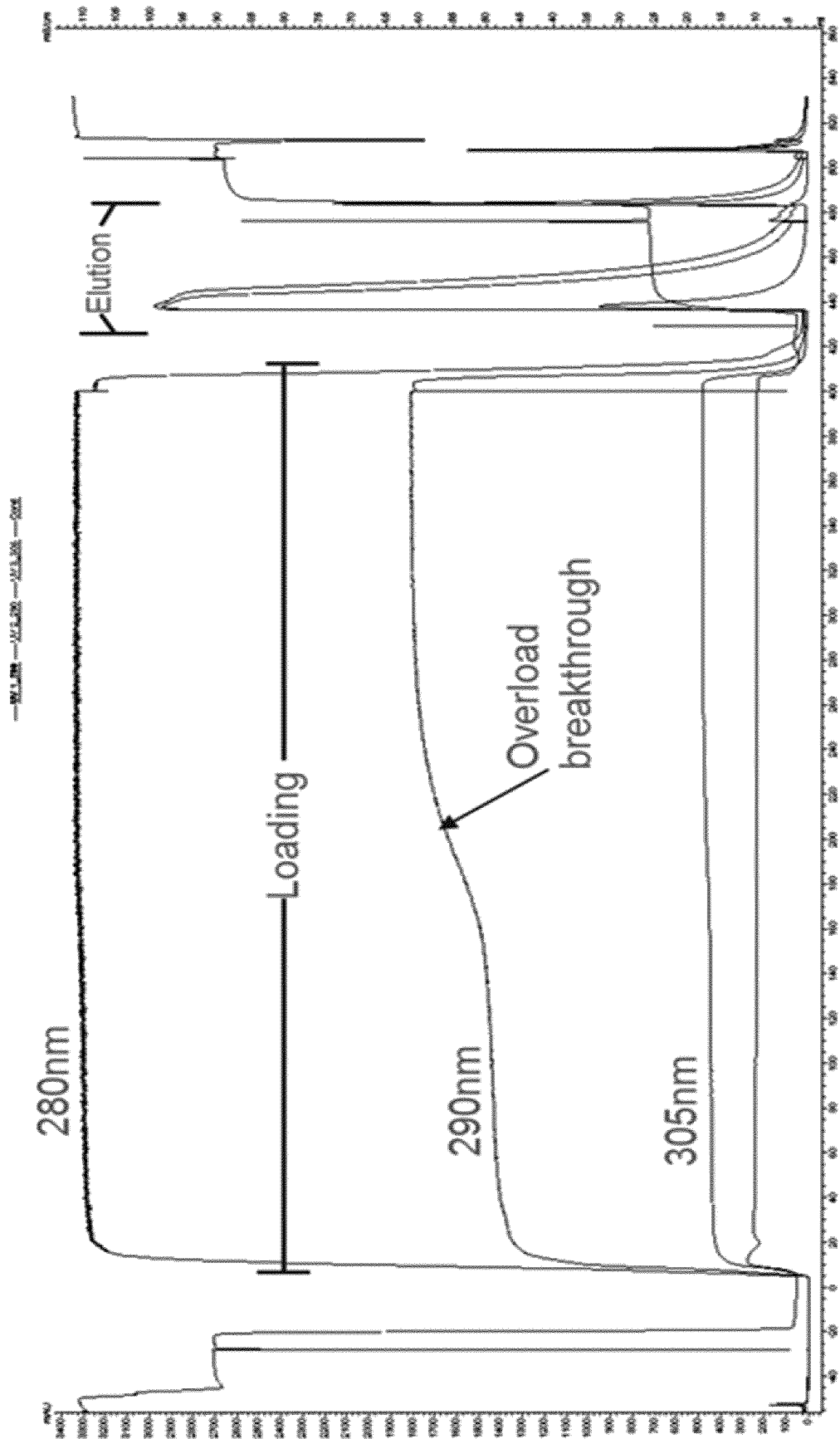


Fig. 5

Fig. 6

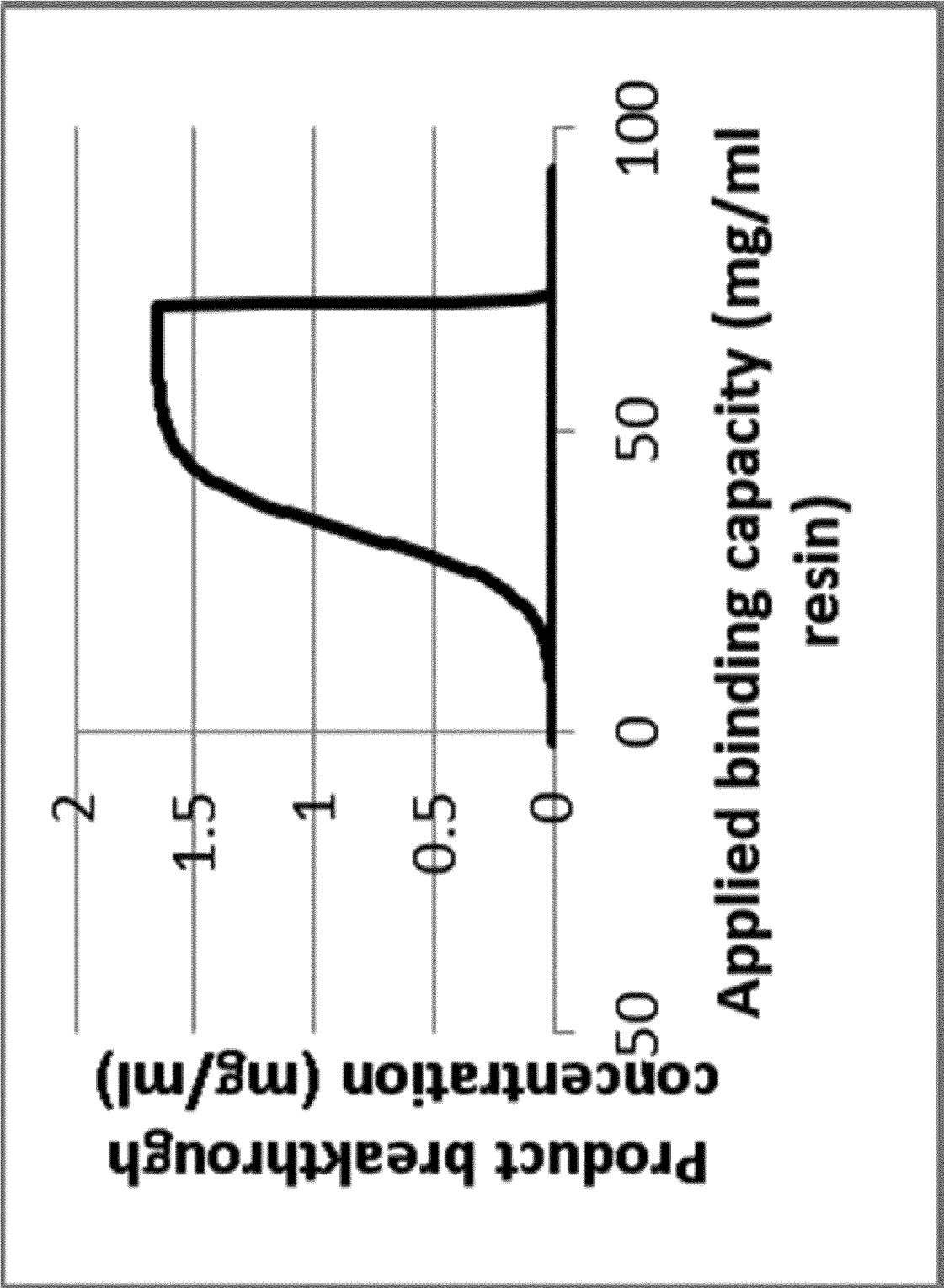


Fig.7

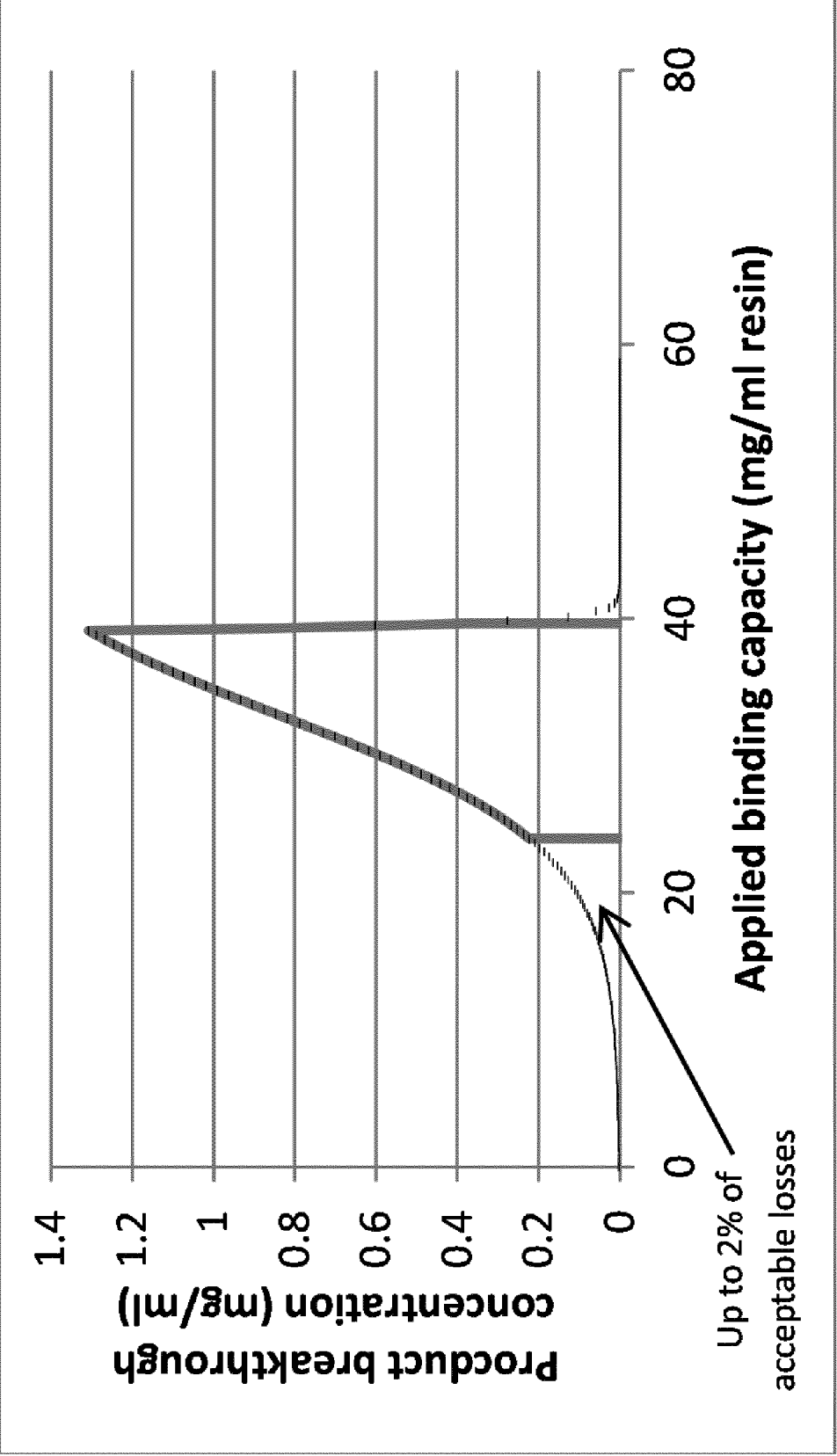


Fig.8

	Cycle 1	Cycles 2-4	Cycle 5
Stripping (CVs)	2	2	2
Cleaning (CVs)	2	2	2
CIP hold (minutes)	15	15	15
Equilibration (CVs)	3	3	3
Recycle (CVs)	0	9.45	9.45
Fresh Load (CVs)	15.44	11.27	7.89
Fresh Load and recycle collection (CVs)	8.12	8.12	0
Wash and recycle collection (CVs)	1.33	1.33	0
Washing (CVs)	1.67	1.67	3
Elution (CVs)	5	5	5
total time (minutes)	66.42	73.45	58.12

Fig. 9

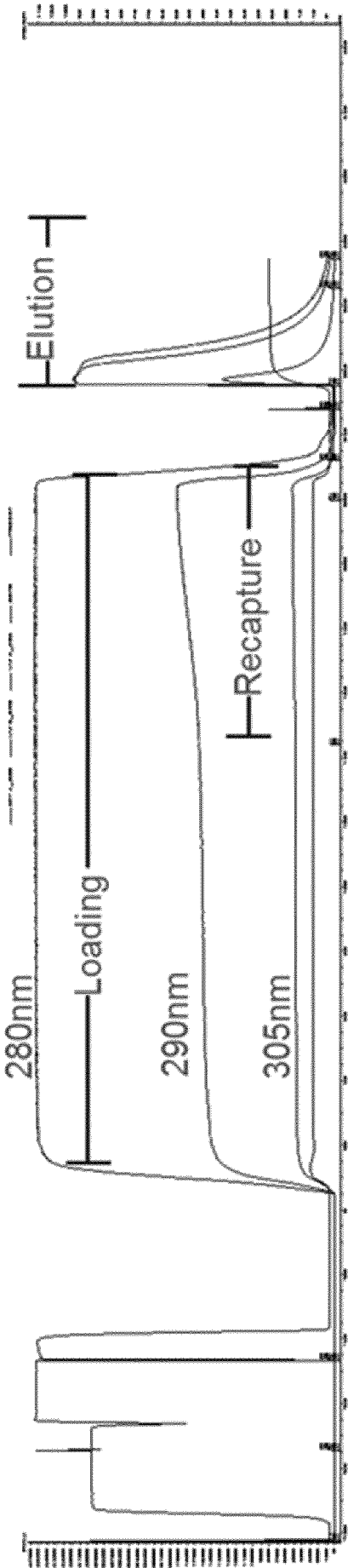


Fig. 10

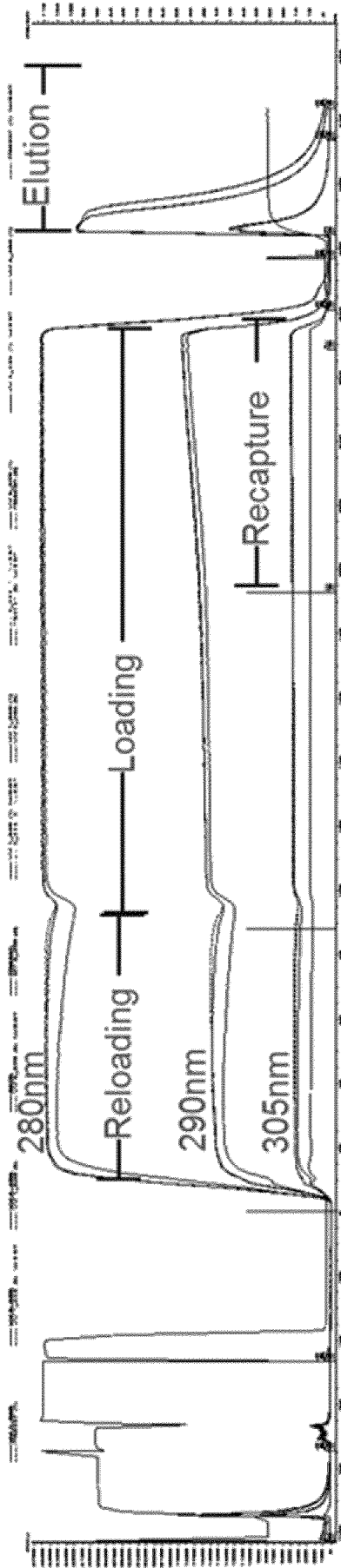


Fig. 11

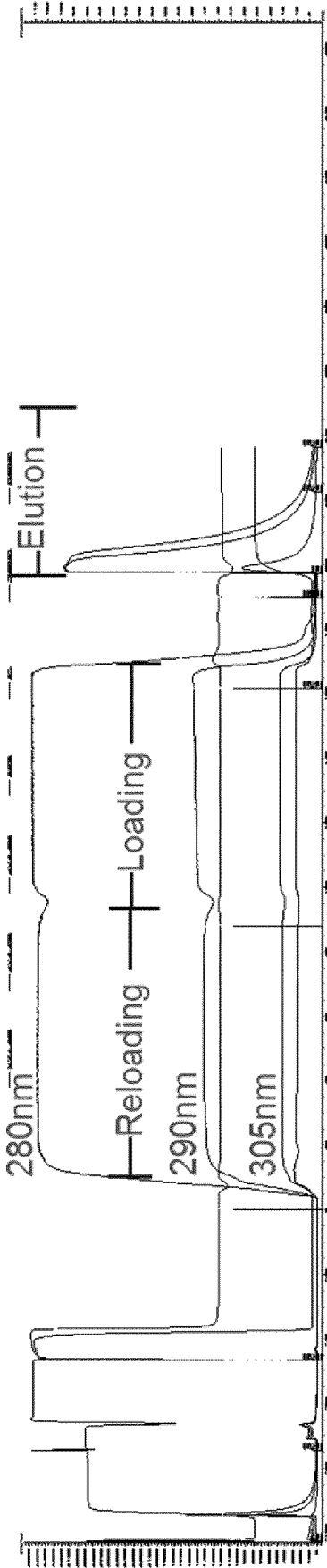


Fig. 12

	Traditional operation	Startup cycle	Running cycle 1	Running cycle 2	Running cycle 3	Final cycle	new running cycle average	new overall	new overall improvement
load mg/ml (matrix)	20.03	39.11	32.19	32.19	32.19	7.89	32.19	28.71	43.30%
eluate conc. mg/ml	6.98	9.63	9.72	9.75	9.71	7.58	9.73	9.28	32.92%
eluate vol. ml	26.16	30.43	30.23	29.80	30.08	25.41	30.04	29.19	11.58%
eluate quantity mg	182.60	293.04	293.84	290.55	292.08	192.61	292.16	270.82	48.32%
yield %	97.86%	80.46%*	98.02%	96.93%	97.44%	262.12%*	97.46%	101.28%	3.82%
impurities %	11.54%	7.66%	7.98%	7.79%	7.77%	12.19%	7.85%	8.66%	33.26%
productivity mg/ml/hour	23.52	28.37	25.65	25.65	25.65	20.68	25.65	25.34	7.74%

Fig. 13

	Traditional operation	Startup cycle	Running cycle 1	Running cycle 2	Running cycle 3	Final cycle	new running cycle average	new overall	new overall improvement
load mg/ml (matrix)	29.68	63.21	56.98	56.98	56.98	30.96	56.98	53.03	78.66%
eluate conc. mg/ml	~	14.20	14.30	14.30	14.20	11.90	14.27	13.78	~
eluate vol. ml	~	34.76	36.60	36.41	36.52	33.26	36.51	35.51	~
eluate quantity mg	~	493.59	523.38	520.66	518.58	395.79	520.88	489.33	~
yield %	>98%	83.84%*	98.62%	98.11%	97.72%	137.26%*	98.15%	99.09%	~1%
productivity mg/ml/hour	15.25	35.72	28.90	28.90	28.90	17.47	25.65	17.42	14.25%

Fig. 14

	Traditional operation	Startup cycle	Running cycle 1	Running cycle 2	Running cycle 3	Final cycle	new running cycle average	new overall	new overall change
load mg/ml (matrix)	47.9	84.1	68.5	68.5	68.5	22.9	68.5	62.5	30.5%
eluate conc. mg/ml	21.0	32.9	31.9	31.3	31.4	17.2	31.2	28.8	37.8%
eluate vol. CVs	2.2	2.1	2.1	2.1	2.1	1.9	2.1	2.1	93.6%
eluate quantity mg	8780	12900	12600	12400	12400	6200	12500	11300	28.7%
yield %	96.2	80.7*	96.5	95.2	95.3	142.4*	95.7	94.9	-1.3%
productivity mg/ml/hour	20.9	16.3	21.1	20.9	20.9	41.6	21.0	19.7	-5.7%