

COST-BENEFIT ASSESSMENT OF ARROW APPLICATIONS

COST BENEFIT ASSESSMENT OF HIGH RECOVERY ARROW PROCESS (70% vs. 95% RECOVERY)

Basis:

- Applications where RO Membrane Systems Product Water Recovery % is limited by fouling and scale formation, e.g. Brackish Water Desalination, wastewater treatment and purification, Drinking Water RO Systems, etc.
- Capital cost is Budget-type, assuming low silica in raw water, low pressure systems, plastic materials on feed-side, FRP membrane housings, basic pretreatment (Cartridge Filters), basic instrumentation and controls. 50%-100% increase for Pharma, F&B & Nuclear Power.
- Fresh water cost: Rural: \$0 per m³, Urban: \$1.9 per m³ or \$7.2 per 1000 gal.
- Cost of disposal of RO Rejects: \$1.9 / m³ or \$7.2 per 1000 gal.
- Current RO System Recovery: increased to 95% using the patented ARROW[®] Process.
- Operation and Maintenance Cost includes 3-year membrane replacement, chemicals, electric power at \$0.06/kWh, and labour at 1-2.5 person years at \$25/h.
- Total Annual Costs include capital depreciation (10 year linear), O&M costs, raw water cost (if domestic water is used), and wastewater disposal costs.
- Annual cost in the case of ARROW High Recovery Process includes lower cost of disposal of RO Rejects by increasing the recovery from 70% to 95%.

ARROW SYSTEM RECOVERY (%)	WATER PRODUCTION RATE (GPM)	WATER PRODUCTION RATE (MGD)	RAW WATER USE (GPM)	RO REJECTS FLOWRATE (GPM)	CAPITAL COST FOR 95% RECOVERY (\$)	OP & MAINT. COST (\$)	TOTAL ANNUAL COST (\$)	UNIT WATER COST (\$ / 1000 GAL)	UNIT WATER COST (\$ / m ³)	CAPITAL COST FOR 70% RECOVERY (\$)	ANNUAL COST @ 70% RECOVERY (\$)	ANNUAL SAVINGS (\$)	PAYBACK PERIOD (YEARS)	COMMENTS
95%	100	0.144	105.3	5.3	\$350,000.00	\$95,973.90	\$150,891.37	\$2.87	\$0.76	\$180,000.00	\$261,762.96	\$110,871.58	1.53	No charges for raw water. \$1.9/m ³ or \$7.2/1000 gal for disposal
95%	100	0.144	105.3	5.3	\$830,000.00	\$95,973.90	\$491,567.58	\$9.35	\$2.47	\$350,000.00	\$800,608.67	\$309,041.09	1.55	Colgate: Raw Water = \$5/1000 gal; Sewer: \$13.7/1000 gal.
95%	150	0.216	157.9	7.9	\$400,000.00	\$104,566.22	\$174,442.43	\$2.21	\$0.58	\$220,000.00	\$354,159.00	\$179,716.57	1.00	No charges for raw water. \$1.9/m ³ or \$7.2/1000 gal for disposal
95%	200	0.288	210.5	10.5	\$480,000.00	\$133,338.30	\$221,173.25	\$2.10	\$0.56	\$280,000.00	\$465,707.84	\$244,534.59	0.82	No charges for raw water. \$1.9/m ³ or \$7.2/1000 gal for disposal
95%	330	0.4752	347.4	17.4	\$620,000.00	\$171,645.69	\$299,373.36	\$1.73	\$0.46	\$400,000.00	\$721,109.81	\$421,736.45	0.52	No charges for raw water. \$1.9/m ³ or \$7.2/1000 gal for disposal
95%	500	0.72	526.3	26.3	\$970,000.00	\$232,970.75	\$429,558.11	\$1.63	\$0.43	\$620,000.00	\$1,070,950.85	\$641,392.73	0.55	No charges for raw water. \$1.9/m ³ or \$7.2/1000 gal for disposal
95%	1000	1.44	1052.6	52.6	\$1,780,000.00	\$356,441.49	\$733,616.23	\$1.40	\$0.37	\$1,200,000.00	\$2,044,826.70	\$1,311,210.47	0.44	No charges for raw water. \$1.9/m ³ or \$7.2/1000 gal for disposal
95%	2000	2.88	2105.3	105.3	\$3,280,000.00	\$603,382.98	\$1,329,732.46	\$1.26	\$0.33	\$2,300,000.00	\$3,986,578.39	\$2,656,845.94	0.37	No charges for raw water. \$1.9/m ³ or \$7.2/1000 gal for disposal

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