

MULTI-OBJECTIVE OPTIMIZATION APPLIED TO THE INTEGRATION OF POLYAMIDE AND CELLULOSE ACETATE REVERSE OSMOSIS MEMBRANES IN HYBRID CASCADES FOR WET CHEMICALS ULTRAPURIFICATION

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Supporting information

Table S1

Anionic and metallic impurity limits and other requirements for electronic grade hydrogen peroxide according to SEMI C30-1110 standard.

SEMI Electronic Grade	H₂O₂ Assay	Total Oxidizable Carbon (TOC) limit	Anion limit range	Cation limit range
1	30-32%	20 ppm	2-5 ppm	10-1000 ppb
2	30-32%	20 ppm	200-400 ppb	5-10 ppb
3	30-32%	20 ppm	200-400 ppb	1 ppb
4	30-32%	10 ppm	30 ppb	100 ppt
5	30-32%	10 ppm	30 ppb	10 ppt

Table S2

Competitiveness niches of the different PA cascades for each electronic grade.

SEMI Grade 1											
SF		1.0	2.5	5.0	5.5	6.0	10.0	13.5	20.0	70.0	100.0
Z (mill\$/y)	2 stages	11.63	11.55	11.53	11.53	11.36	10.03	8.87			
	3 stages					11.53	11.52	11.48	11.47	11.45	11.41
SEMI Grade 2											
SF		1.0	1.5	3.6	7.0	7.9	10.0	40.0	75.0	78.2	100.0
Z (mill\$/y)	3 stages	17.96	17.69	8.84							
	4 stages	18.10	18.08	18.06	18.05	18.05	18.02	17.04	7.65	3.60	
	5 stages					18.05	18.03	17.98	17.97	17.97	17.96
SEMI Grade 3											
SF		1.0	2.0	6.0	7.8	8.0	9.4	10.0	50.0	80.0	100.0
Z (mill\$/y)	4 stages	19.74	19.58	17.73	4.17						
	5 stages	19.76	19.72	19.70	19.69	19.69	19.69	19.68	19.20	18.64	18.26
	6 stages					19.69	19.68	19.62	19.61	19.61	
SEMI Grade 4											
SF		1.0	5.0	8.0	10.0	11.2	20.0	23.0	50.0	70.0	100.0
Z (mill\$/y)	5 stages	54.74	54.14	53.57	52.48	51.53	44.65	42.32			
	6 stages	54.74	54.68	54.67	54.67	54.67	54.59	54.57	54.48	54.14	53.85
	7 stages					54.67	54.63	54.62	54.60	54.59	54.59
SEMI Grade 5											
SF		1.0	1.1	2.0	2.3	5.0	10.0	50.0	68.6	80.0	100.0
Z (mill\$/y)	5 stages	73.98	72.71	63.46	60.33						
	6 stages	76.70	76.70	76.63	76.60	76.35	75.87	58.98	44.52		
	7 stages			76.70	76.66	76.65	76.63	76.62	76.36	76.22	76.14

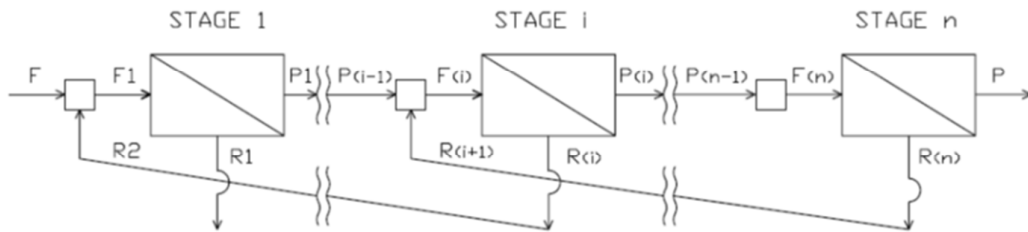


Figure S1

General scheme of an integrated countercurrent membrane cascade comprising n stages