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APPENDIX A

OPERATION OF THE EXPERIMENTAL UNIT

Step of Operation		Valve to be opened																						Operate Ⓟ	Remark
		1st SAC Column					SBA Column						2nd SAC Column					Other Valves							
		1A	2A	3A	4A	5A	1B	2B	3B	4B	5B	6B	1C	2C	3C	4C	5C	6	7	8	9	10	11	12	13		
Exhaustion		O			O		O			O								O	O			O	O			O	at 32 cu.dm./hr. till 0.2×10^4 Ohm-cm.
Back washing	1st SAC		O		O				O	O					O										O	50 % bed expansion with tap water till wash water is clear
	SBA									O		O			O										O	
	2nd SAC													O											O	
Regene-ration	1st SAC		O	O		O																				
	SBA							O	O		O															
	2nd SAC													O	O		O									
Slow Rinsing	1st SAC		O	O		O																				12 cu.dm. of deionized water at same flow-rate as regeneration
	SBA							O	O		O															
	2nd SAC													O	O		O									
Fast Rinsing	1st SAC	O			O				O	O					O					O	O	O			O	at 32 cu.dm./hr. × 15 min. with deionized water
	SBA			O	O		O			O					O					O	O	O			O	O
	2nd SAC			O	O				O	O			O							O	O	O			O	
Chromic Acid Recovery																O								O		at 16 cu.dm./hr.

Table 10 Steps of Operation of the Experimental Unit

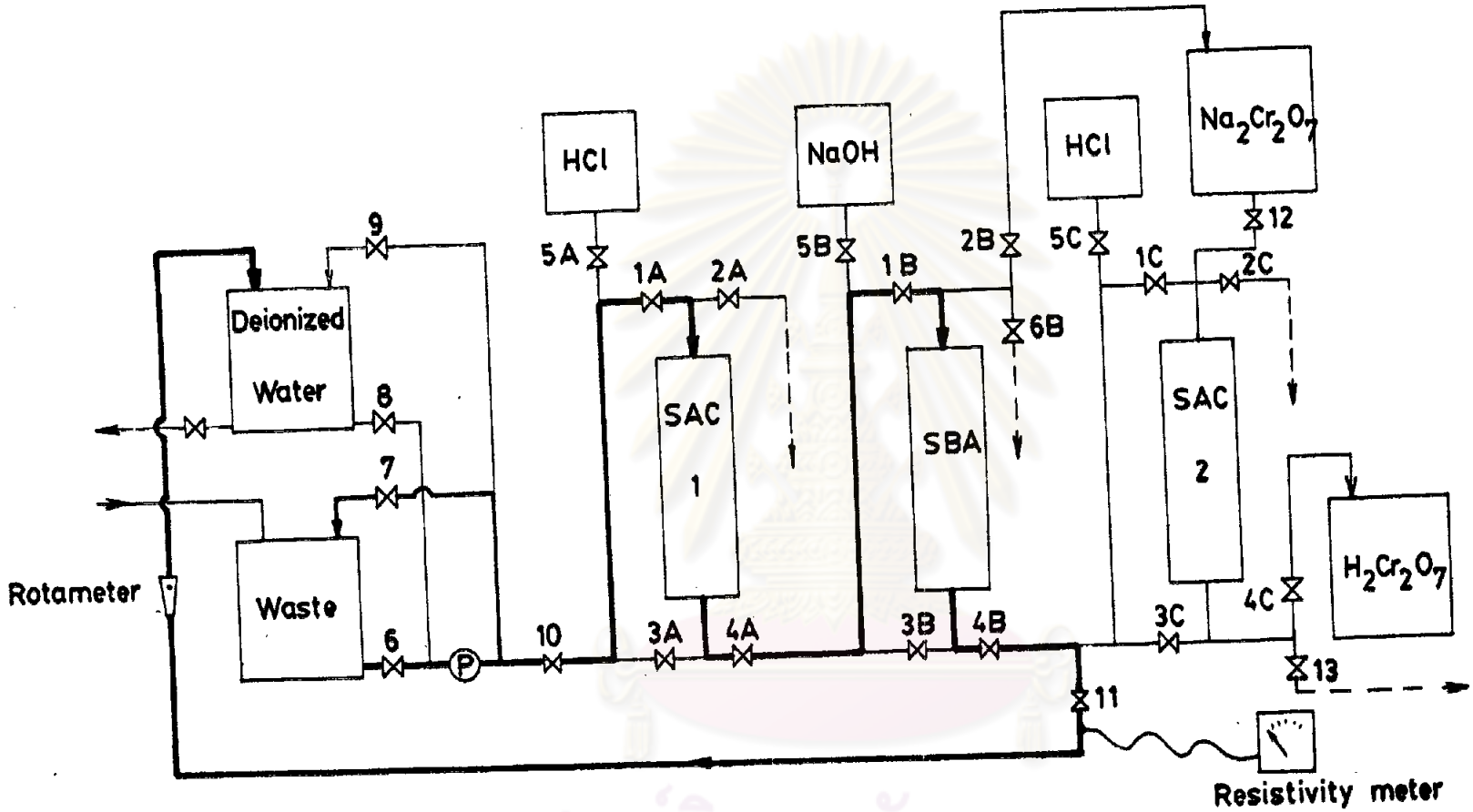

Fig. 33 Exhaustion Cycle of the Ion Exchange Pilot Plant

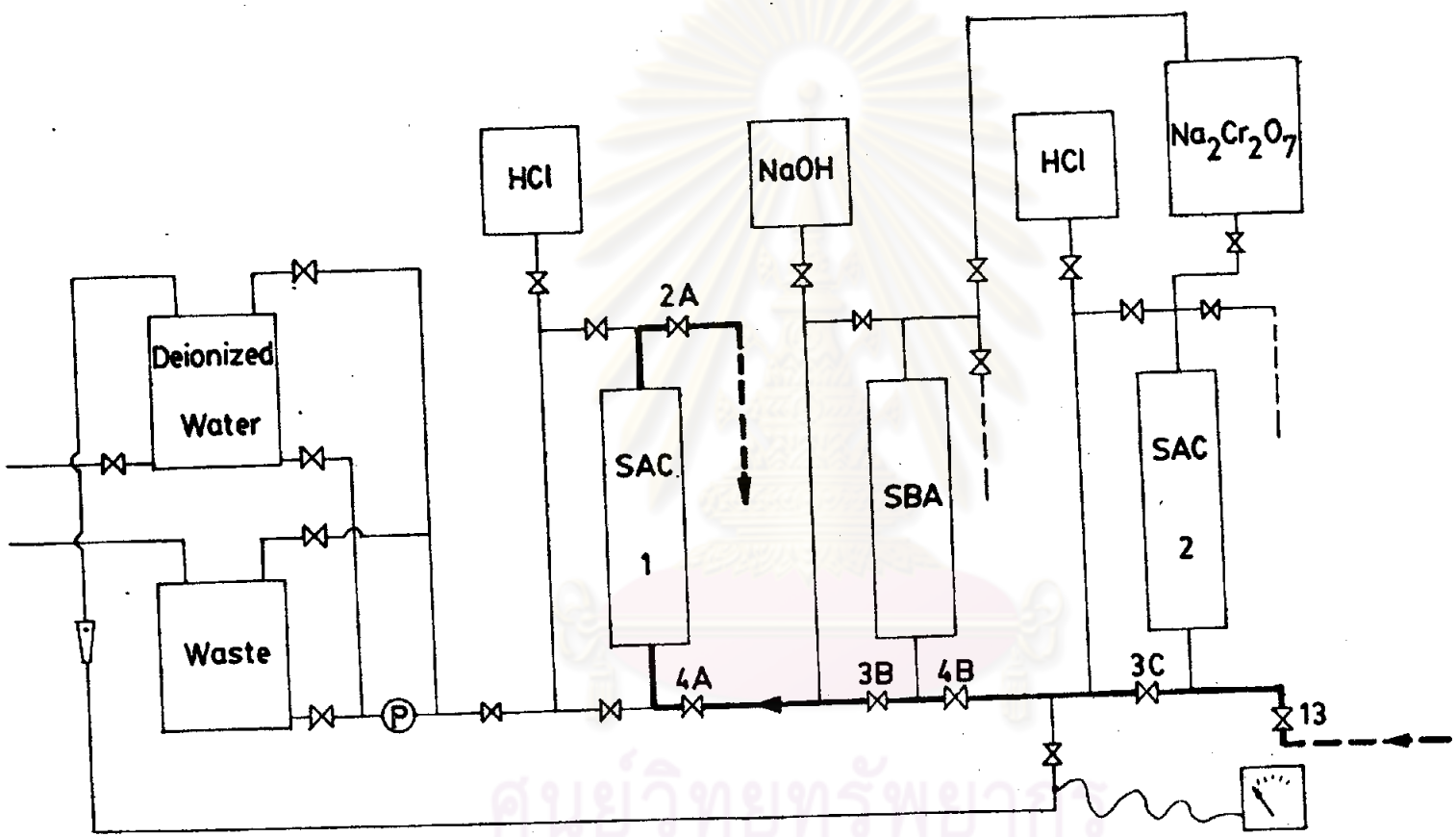

Fig. 34 Backwashing Cycle of SAC_1 Column

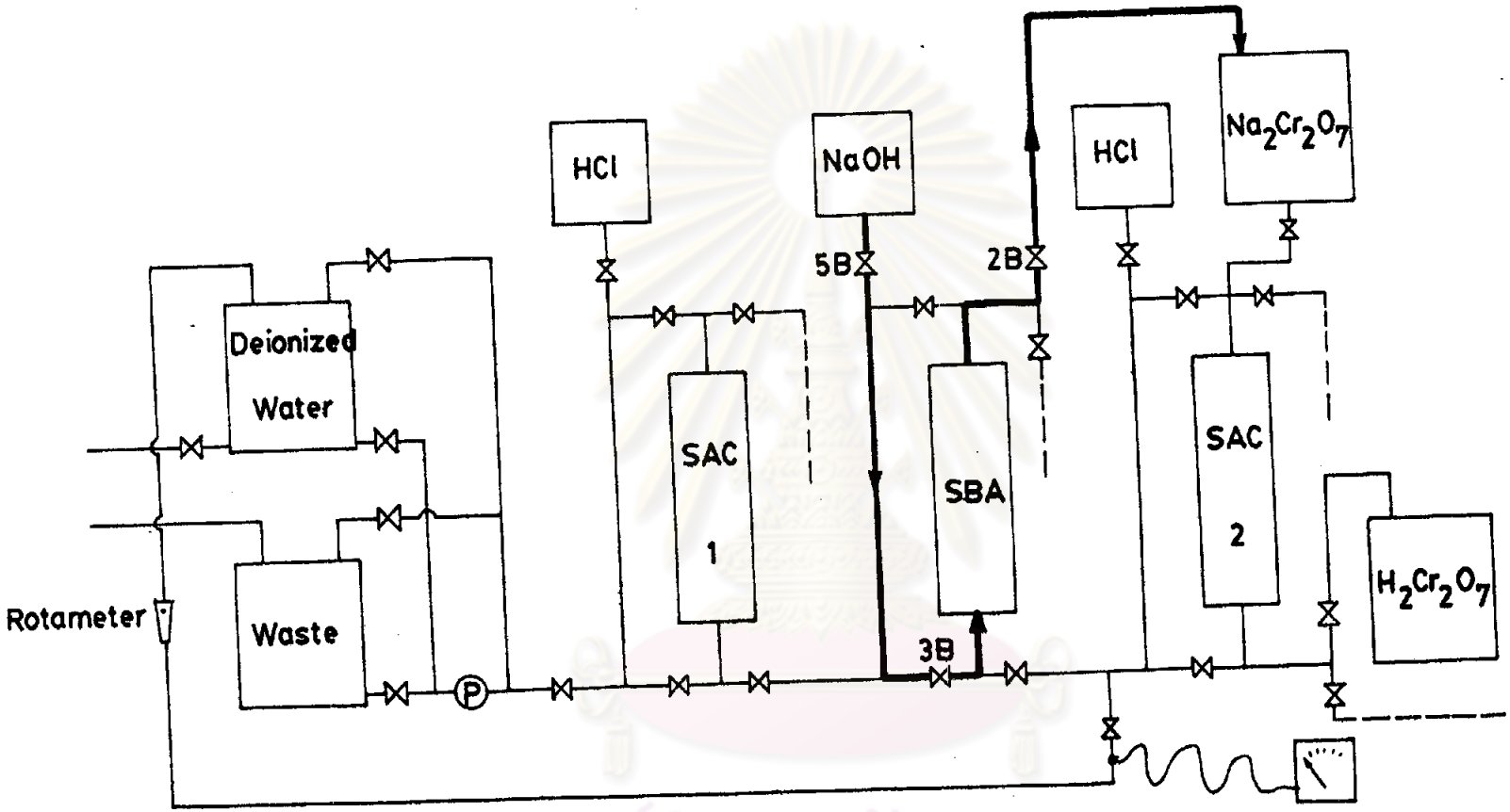

Fig. 35 Regeneration Cycle of SBA Column

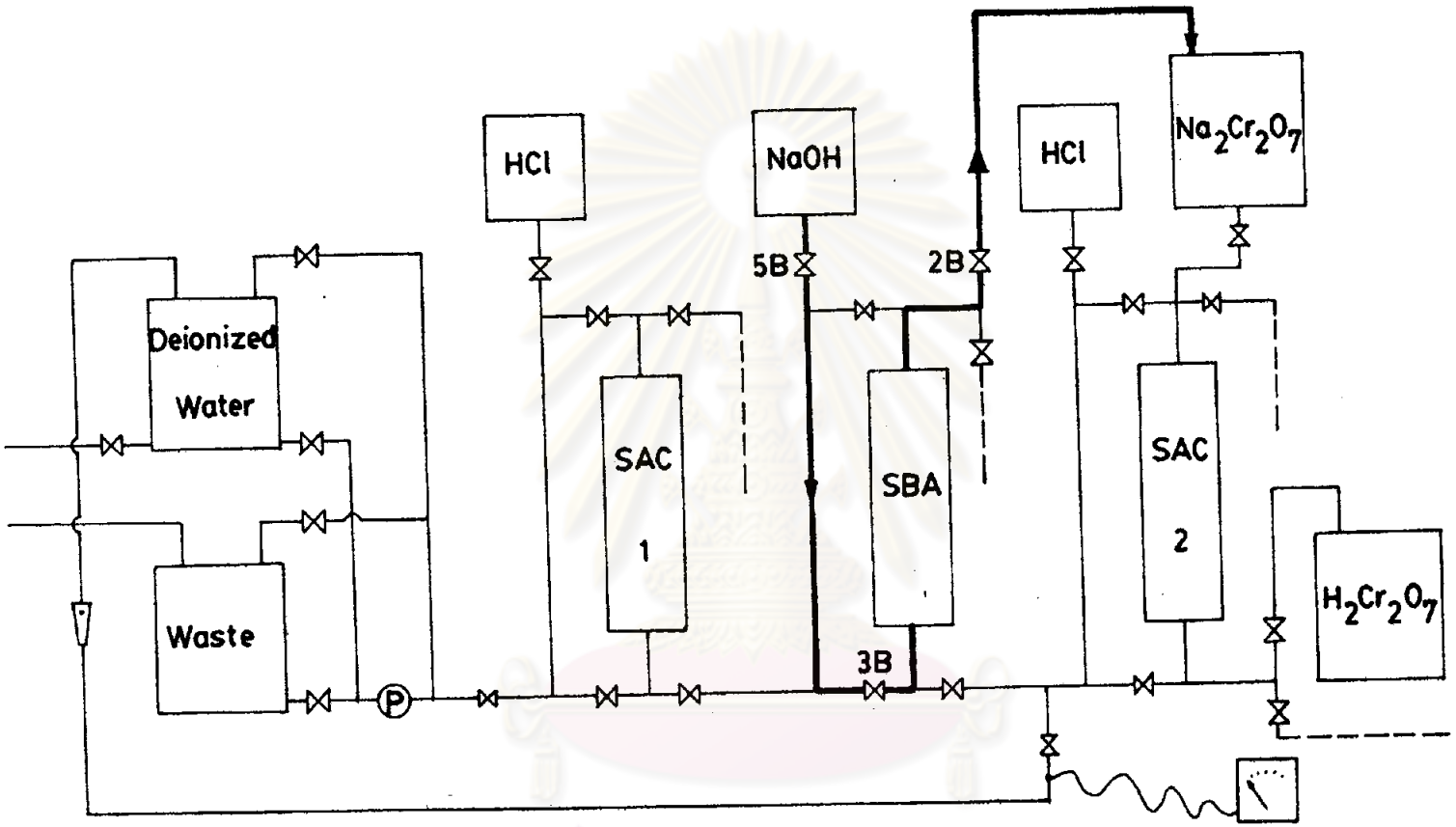

Fig. 36 Slow Rinsing Cycle of SBA Column

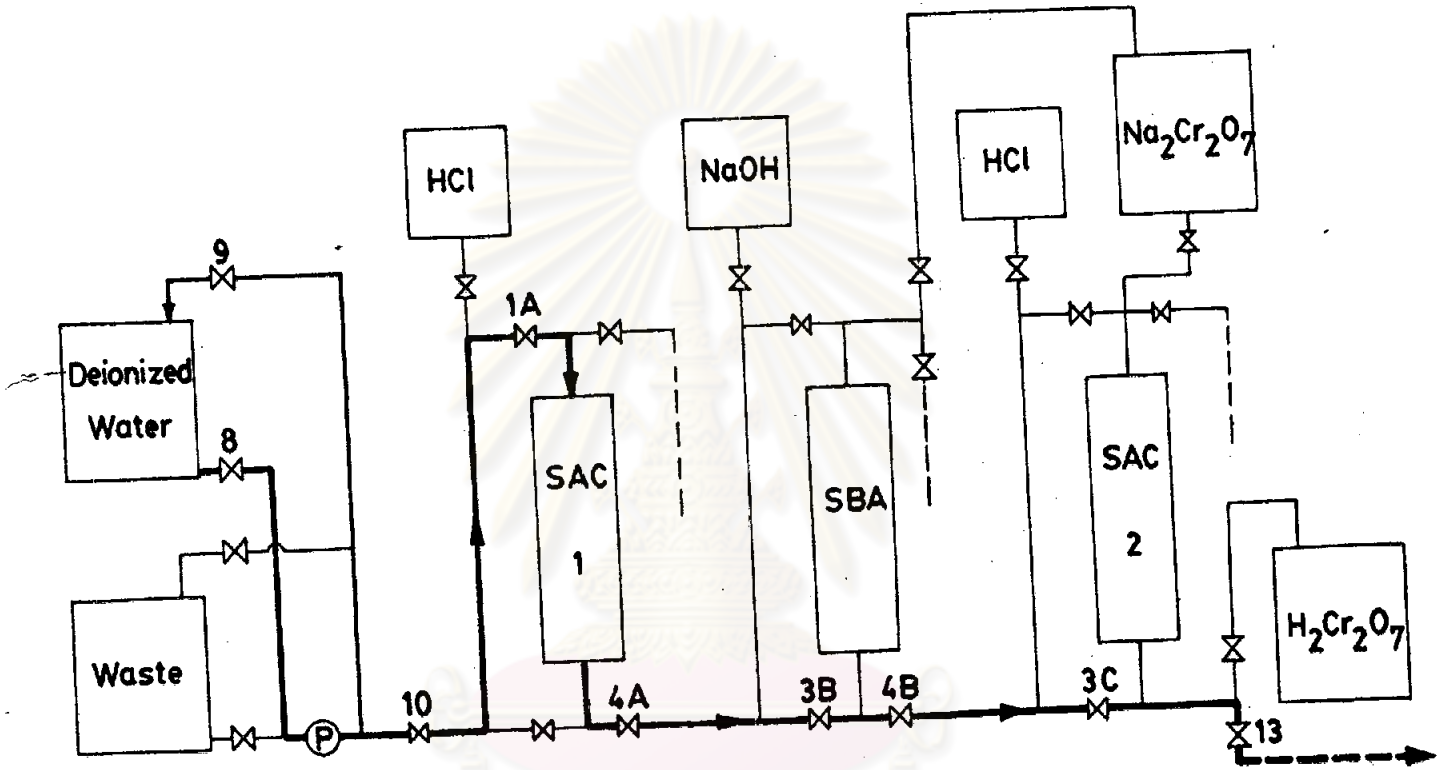

Fig. 37 Fast Rinsing Cycle of SAC_1 Column

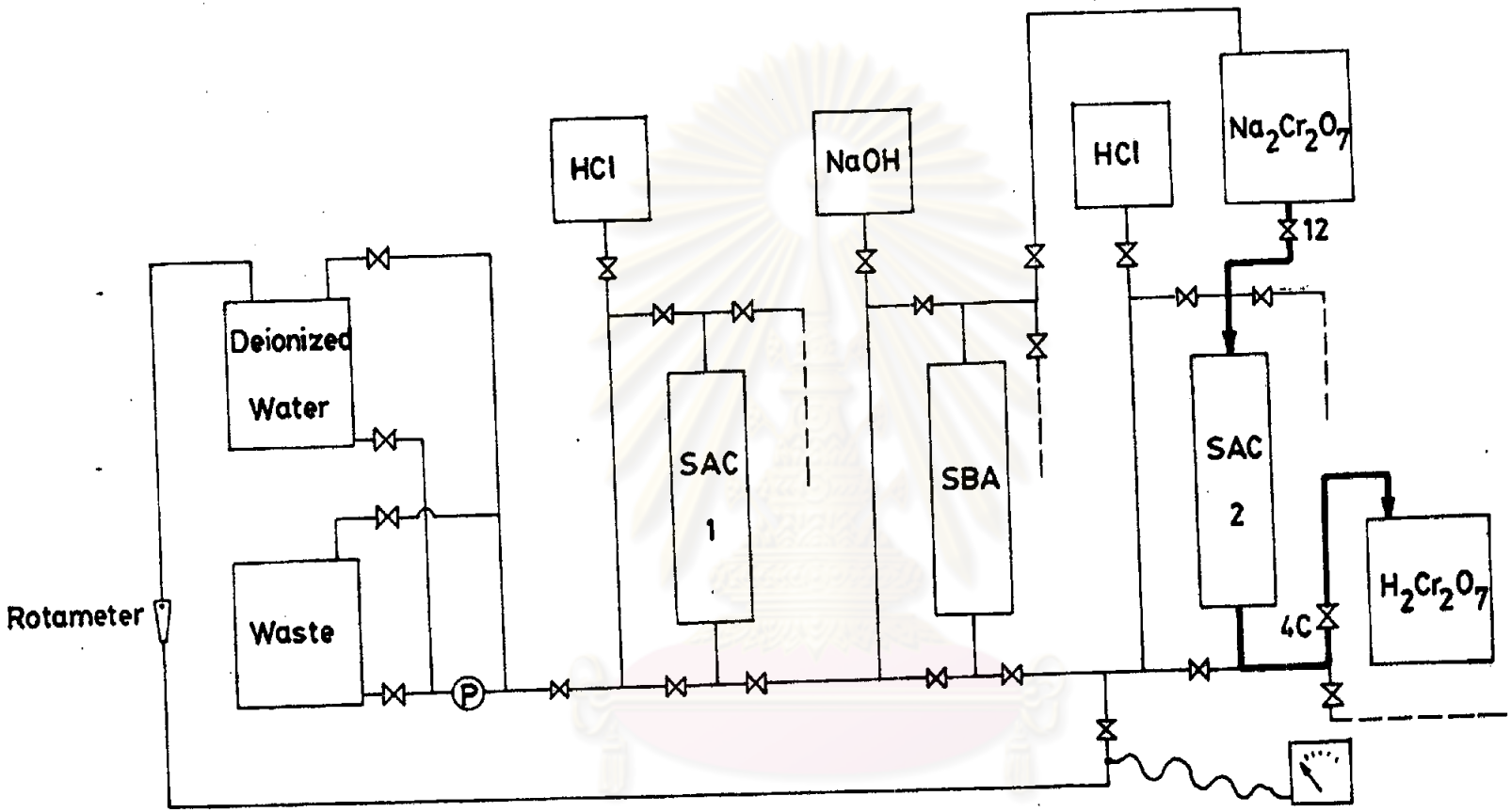

Fig. 38 Chromic Acid Reclamation Cycle

APPENDIX B

Cr VI Values of Eluted $Na_2Cr_2O_7$ and Reclaimed $H_2Cr_2O_7$

Eluted $Na_2Cr_2O_7$ from SBA Column Regeneration (Various Regeneration Level)

cu.cm.	3.5%		5.0%		7.5%	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
3.600	5.87	42	8.30	92	5.90	12
3.900	5.94	43	8.05	126	6.53	24
4,050	-	-	-	-	-	-
4,200	6.23	50	8.67	3,529	6.70	149
4,350	-	-	-	-	-	-
4,500	7.15	170	8.83	6,182	8.13	8,125
4,800	7.87	375	9.65	9,375	8.30	22,422
5,400	8.17	4,313	13.50	10,547	13.80	19,219
6,300	8.33	7,875	13.50	8,985	13.83	14,313
7,200	9.97	9,094	13.45	6,500	13.80	11,094
8.100	11.45	7,375	13.40	4,500	13.77	8,188
9,000	12.20	5,313	13.30	3,282	13.70	5,875
10.500	12.17	3,363	13.13	1.760	13.55	3,032
12,000	12.07	2,213	12.93	,960	13.40	1,67[illegible]
13,500	12.03	1,438	12.73	455	13.25	929
15,000	11.87	863	12.50	249	13.00	465
15,900	11.80	626	12.37	169	12.90	290

Note: - means 'no experiment'

Eluted $Na_2Cr_2O_7$ from SBA Column Regeneration (Various Regeneration Level) (Continued)

cu.cm.	10.0%		12.5%		15.0%	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
3,600	7.15	8	4.67	3	-	33
3,900	-	-	4,90	3	-	-
4,050	8.00	39	-	-	-	-
4,200	8.10	2,500	7.80	1,891	-	-
4,350	12.50	21,797	-	-	-	-
4,500	-	-	13.37	23,360	-	23,300
4,800	13.77	19,297	13.90	18,438	-	-
5,400	13.80	14,922	13.90	15,782	-	18,400
6,300	13.77	11,355	13.90	11,094	-	14,100
7,200	13.77	8,922	13.87	8,188	-	10,750
8,100	13.73	6,407	13.87	6,157	-	8,300
9,000	13.73	5,156	13,83	4,625	-	5,720
10,500	13.65	2,663	13.73	2,625	-	3,200
12,000	13.50	1,375	13.57	1,329	-	1,629
13,500	13.30	766	13.40	713	-	740
15,000	13.10	369	13.20	350	-	350
15,900	12.95	254	13.00	205	-	300

Note: - means 'no experiment'

Eluted $Na_2Cr_2O_7$ from SBA Column Regeneration (Constant Regeneration Level)

cu.cm.	3.5%		5.0%		7.5%	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
3,600	-	-	3.80	6	3,53	10
3,750	6.55	2	-	-	-	-
3,900	-	-	-	-	-	-
4,050	-	-	3.80	6	3,57	20
4,500	7,65	1,600	6.63	1,276	7.45	12,469
4,800	-	-	-	-	-	-
4,950	-	-	7.4	8,000	7.70	19,922
5,400	8.15	8,828	7.6	11,157	7.80	22,813
5,850	-	-	7.7	14,532	13.73	17,032
6,300	8.60	12,969	8.5	16,641	13.80	13,563
7,200	13.30	10,313	13.50	11,094	13.73	9,375
8,100	13,43	7,578	13.60	8,000	13.63	6,625
9,000	13.50	5,813	13.57	5,500	13.53	4,500
10,800	13.53	3,025	13.37	2,363	13.30	2,075
12,600	13.43	1,385	13.13	1,070	12.97	895
14,400	13.17	625	12.8	470	12.60	410
16,200	12.85	275	12.43	198	12.25	172
18,000	12.63	123	12.10	-	-	-
19,800	12.17	53	-	-	-	-
21,600	11.87	26	-	-	-	-

Note: - means 'no experiment'

Eluted $Na_2Cr_2O_7$ from SBA Column Regeneration (Constant Regenerat Level) (Continued)

cu.cm.	10.0%		12.5%		15.0%	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
3,600	4.27	3	3.67	5	3.85	6
3,750	-	-	-	-	-	-
3,900	-	-	-	-	-	-
4,050	6.30	173	3.70	6	3,93	33
4,500	7.73	17,422	4.60	12,032	13.60	19,532
4,800	-	-	-	-	-	-
4,950	13.55	17,500	13.00	20,469	13.65	17,188
5,400	13.63	15,000	13.17	18,047	13.63	13,907
5,850	13.63	12,500	13.23	15,469	13.60	11,375
6,300	13,60	10,200	13.25	13,563	13.53	9,532
7,200	13.50	6,850	13.30	9,750	13.40	6,625
8,100	13.40	4,938	13.30	6,750	13.25	4,375
9,000	13.30	3,375	13.25	4,475	13.10	2,925
10,800	13.03	1,490	13.13	2,250	12.70	1,325
12,600	12.70	663	13.00	975	12.30	594
14,400	12.33	272	12.75	482	-	-
16,200	-	-	-	-	-	-
18,000	-	-	-	-	-	-
19,800	-	-	-	-	-	-
21,600	-	-	-	-	-	-

Note: - means 'no experiment'

Eluted $Na_2Cr_2O_7$ from SBA Column Regeneration (Different Regeneration Flowrate)

cu.cm.	150 cu.cm./min.		100 cu.cm./min.		200 cu.cm./min.	
	pH	Cr VI	pH	Cr-VI	pH	Cr VI
3,600	5.90	12	6.60	5	4.70	1
3,900	6.53	24	-	-	7.10	13
4,200	6.70	149	-	-	8.20	5,813
4,300	-	-	8.20	2,032	-	-
4,500	8.13	8,125	8.70	11,500	8.37	14,922
4,800	8.30	22,422	8.60	19,453	10.70	18,672
5,400	13.80	19,219	13.70	16,907	13.80	12,188
6,300	13.83	14,313	13.73	12,157	13.80	8,907
7,200	13.80	11,094	13.70	8,469	13.75	6,688
8,100	13.77	8,188	-	-	13.73	5,219
8,400	-	-	13.60	5,032	-	-
9,000	13.70	5,875	13.60	3,953	13.65	3,578
10,500	13.55	3,032	13.47	2 050	13.55	1,975
12,000	13.40	1,675	13,27	975	13.35	1,119
13,500	13.25	925	13.07	500	13.20	550
15,000	13.00	465	12.80	249	13.00	291
15,900	12.90	290	12.67	252	12.87	250

Note: -menas 'no experiment'

Eluted $Na_2Cr_2O_7$ from SBA Column Regeneration Using Diluted Eluted $Na_2Cr_2O_7$ Following by 7.5% NaOH

$Na_2Cr_2O_7$ 2,200 mg/cu.dm. Cr VI 8.5 cu.dm. + 7.5 % NaOH 4.0 cu.dm.			$Na_2Cr_2O_7$ 2,525 mg/cu.dm. Cr VI 4.5 cu.dm. + 7.5 % NaOH 4.0 cu.dm.		
cu.cm.	pH	Cr VI	cu.cm.	pH	Cr VI
4,050	4.00	35	3,900	3.85	8
4,950	6.67	2,250	4,800	7.00	5,407
5,850	7.05	3,250	5,700	7.25	6,750
6,750	7.20	3,938	6,600	7.37	7,188
7,650	7.30	4,500	7,500	7.50	7,813
8,550	7.37	4,563	8,400	7.57	8,657
10,350	7.50	5,219	8,850	12.37	20,704
11,250	7.57	5,500	9,300	13.33	19,063
12,150	7.65	5,782	9,750	13.53	9,375
12,600	8.00	11,063	10,200	13.55	7,813
13,050	12.73	20,750	11,100	13.50	5,469
13,500	13.75	10,125	12,000	13.43	3,588
13,950	13.80	8,625	13,350	13.23	1,788
14,400	13.80	7,375	14,700	13.05	930
15,300	13.75	5,157	16,050	12.80	569
16,200	13.67	3,250	-	-	-
18,000	13.40	1,400	-	-	-

Note: - means 'no experiment'

Reclaimed $H_2Cr_2O_7$ from Eluted $Na_2Cr_2O_7$ Obtained at Various Regeneration Levels of SBA Column

cu.cm.	3.5%		5.0%		7.5	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
1,600	2.53	207	2.70	213	2.55	182
3,200	1.85	1,688	1.93	2,125	1.87	2,610
4,800	1.70	2,719	1.75	3,313	1.73	4,032
6,400	1.67	3,188	1.70	3,844	1.65	4,594
6,667	-	-	-	-	-	-
7,200	-	-	-	-	-	-
7,467	-	-	-	-	-	-
8,000	1.60	3,313	1.7	3,906	1.63	4,969
8,533	-	-	-	-	-	-
9,600	1.63	3,500	2.73	4,094	1.73	5,110
9,867	-	-	12.57	4,157	-	-
10,933	-	-	-	-	11.67	5,469
11,200	1.63	3,532	-	-	-	-
12,800	1.60	3,485	-	-	-	-
14,400	1.60	3,516	-	-	-	-
16,000	1.63	3,500	-	-	-	-

Note: - means ' no experiment'

Reclaimed $H_2Cr_2O_7$ from Eluted $Na_2Cr_2O_7$ Obtained at Various Regeneration Levels of SBA Column (Continued)

cu.cm.	10.0%		12.5%		15.0%	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
1,600	2.20	650	2.43	237	2.60	260
3,200	1.70	2,832	1.77	2,407	1.85	2,560
4,800	1.65	3,969	1.70	3,563	1.70	4,100
6,400	1.60	4,344	1.70	3,969	1.65	4,950
6,667	11.93	4,782	-	-	-	-
7,200	-	-	1.85	4,203	-	-
7,467	-	-	12.60	4,297	-	-
8,000	-	-	-	-	1.80	5,250
8,533	-	-	-	-	11.10	4,780
9,600	-	-	-	-	-	-

Reclaimed $H_2Cr_2O_7$ from Eluted $Na_2Cr_2O_7$ Obtained at Constant Regeneration Level of SBA Column

cu.cm.	10.0%		12.5%		15.0%	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
1,600	2.60	240	2.43	469	2.35	497
3,200	1.80	2,538	1.77	2,975	1.80	2,188
4,800	1.63	3,850	1.63	4,400	1.63	3,688
6,400	1.57	4,338	1.57	5,000	1.55	4,475
8,000	1.55	4,463	1.57	5,313	1.53	4,650
9,600	1.57	4,750	1.67	5,563	1.50	4,938
10,667	-	-	6.37	5,625	6.40	5,063
10,933	5.30	4,800	-	-	-	-
11,200	7.00	4,625	-	-	-	-

Note: - means 'no experiment'

Reclaimed $H_2Cr_2O_7$ from Eluted $Na_2Cr_2O_7$ Obtained at Constant Regeneration Level of 5BA Column (Continued)

cu.cm.	3.5%		5.0%		7.5%	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
1,600	2.60	281	2.40	503	2.55	182
3,200	1.97	1,750	1.90	2,138	1.87	2,610
4,800	1.85	2,275	1.77	3,100	1.73	4,032
6,400	1.80	2,675	1.73	3,413	1.65	4,594
8,000	1.75	2,825	1.70	3,613	1.63	4,969
9,600	1.73	2,900	1.67	3,750	1.73	5,110
10,933	-	-	-	-	11.67	5,469
11,200	1.73	2,900	1.70	4,163	-	-
12,267	-	-	6.70	4,225	-	-
12,533	-	-	12.20	4,088	-	-
12,800	1.85	2,975	-	-	-	-
13,867	6.75	2,975	-	-	-	-
14,133	11.33	3,000	-	-	-	-

Reclaimed $H_2Cr_2O_7$ from Concentrated $Na_2Cr_2O_7$ Solutions

cu.cm.	$Na_2Cr_2O_7$ 14,922 mg/cu.dm. Cr VI		$Na_2Cr_2O_7$ 11,485 mg/cu.dm. Cr VI	
	pH	Cr VI	pH	Cr VI
1,600	2.30	650	1.87	1,538
2,400	1.67	4,094	1.50	4,438
3,200	1.50	7,110	1.37	6,157
4,000	1.40	8,907	1.30	7,657
4,800	1.37	10,000	1.30	8,125
5,600	1.35	10,547	-	-
6,700	-	-	1.27	8,219
8,000	1.33	10,500	-	-

Reclaimed $H_2Cr_2O_7$ from Eluted $Na_2Cr_2O_7$ Obtained from SBA Column Regeneration at Different Regeneration Flowrate

cu.cm.	150 cu.cm./min.		100 cu.cm./min.		200 cu.cm./min.	
	pH	Cr VI	pH	Cr VI	pH	Cr VI
1,600	2.55	182	2.50	278	2.57	252
3,200	1.87	2,610	1.83	2,363	1.90	2,075
4,800	1.73	4,032	1.70	3,375	1.77	3,138
6,400	1.65	4,594	1.65	3,850	1.70	3,450
8,000	1.63	4,969	1.63	4,175	1.65	3,700
9,600	1.73	5,110	1.73	3,975	1.73	3,950
10,400	-	-	9.57	4,438	12.30	3,875
10,933	11.67	5,469	-	-	-	-

Note: - means 'no experiment'

APPENDIX C

Acidity of Reclaimed Chromic Acid

Acidity of $H_2Cr_2O_7$ Reclaimed From $Na_2Cr_2O_7$ Obtained at Various Regeneration Level of SBA Column

cu.cm.	3.5%		5.0%		7.5%	
	pH	Acidity	pH	Acidity	pH	Acidity
1,600	2.53	802	2.70	705	2.55	600
3,200	1.85	4,814	1.93	5,387	1.87	6,200
4,800	1.70	7,924	1.75	8,257	1.73	9,400
6,400	1.67	9,177	1.70	9,365	1.65	10,900
8,000	1.60	9,629	1.70	9,869	1.63	11,800
9,600	1.63	9,980	2.73	4,179	1.73	10,600
11,200	1.63	9,729	-	-	-	-
12,800	1.60	10,030	-	-	-	-
14,400	1.60	9,930	-	-	-	-
16,000	1.63	9,980	-	-	-	-

cu.cm.	10.0%		12.5%		15.0%	
	pH	Acidity	pH	Acidity	pH	Acidity
1,600	2.20	1,561	2.43	875	2.60	-
3,200	1.70	5,337	1.77	6,550	1.85	-
4,800	1.65	9,063	1.70	9,800	1.70	-
6,400	1.60	9,919	1.70	11,050	1.65	-
7,200	-	-	1.85	8,100	-	-
8,000	-	-	-	-	1.80	-

Note: - means 'no experiment'

Acidity of $H_2Cr_2O_7$ Reclaimed from $Na_2Cr_2O_7$ Obtained at Constant Regeneration Level of SBA Column

cu.cm.	3.5%		5.0%		7.5%	
	pH	Acidity	pH	Acidity	pH	Acidity
1,600	2.60	856	2.40	1,863	2.55	600
3,200	1.97	4,481	1.90	6,092	1.87	6,200
4,800	1.85	6,193	1.77	8,408	1.73	9,400
6,400	1.80	7,401	1.73	9,617	1.65	10,900
8,000	1.75	7,553	1.70	10,120	1.63	11,800
9,600	1.73	7,250	1.67	10,523	1.73	10,600
11,200	1.73	7,905	1.70	9,919	-	-
12,267	-	-	6.70	2,014	-	-
12,800	1.85	6,394	-	-	-	-
13,867	6.75	755	-	-	-	-

cu.cm.	10.0%		12.5%		15.0%	
	pH	Acidity	pH	Acidity	pH	Acidity
1,600	2.60	831	2.43	1,334	2.35	1,385
3,200	1.80	7,401	1.77	8,207	1.80	5,690
4,800	1.63	11,027	1.63	11,681	1.63	9,781
6,400	1.57	12,588	1.57	13,695	1.55	11,278
8,000	1.55	13,041	1.57	13,443	1.53	12,084
9,600	1.57	11,983	1.67	11,480	1.50	12,789
10,667	-	-	6.37	3,373	6.40	3,122
10,933	5.70	4,179	-	-	-	-
11,200	7.00	730	-	-	-	-

Note: - means 'no experiment'

Acidity of $H_2Cr_2O_7$ Reclaimed from $Na_2Cr_2O_7$ Obtained from SBA Columr Regeneration at Different Regeneration Flowrate

cu.cm.	150 cu.cm./min.		100 cu.cm./min.		200 cu.cm./min.	
	pH	Acidity	pH	Acidity	pH	Acidity
1,600	2.55	600	2.50	4,200	2.57	800
3,200	1.87	6,200	1.83	6,600	1.90	6,100
4,800	1.73	9,400	1.70	9,450	1.77	9,150
6,400	1.63	10,900	1.65	10,800	1.70	10,150
8,000	1.63	11,800	1.63	11,450	1.65	10,750
9,600	1.73	10,600	1.73	9,700	1.73	9,550

Acidity of $H_2Cr_2O_7$ Reclaimed from Concentrated $Na_2Cr_2O_7$ Solutions

cu.cm.	$Na_2Cr_2O_7$ 14,922 mg/cu.dm. Cr VI		$Na_2Cr_2O_7$ 11,485 mg/cu.dm. Cr VI	
	pH	Acidity	pH	Acidity
1,600	2.30	1,863	1.87	3,902
2,400	1.67	10,825	1.50	10,574
3,200	1.50	18,478	1.37	15,206
4,000	1.40	23,665	1.30	18,327
4,800	1.37	25,981	1.30	19,032
5,600	1.35	26,434	-	-
6,700	-	-	1.27	18,881
8,000	1.33	26,484	-	-

Note: - means 'no experiment'

APPENDIX D

Na Content of Reclaimed Chromic Acid

Na Content of $H_2Cr_2O_7$ Reclaimed from $Na_2Cr_2O_7$ Obtained at Various Regeneration Levels of SBA Column

cu.cm.	3.5%		5.0%		7.5%	
	pH	Na	pH	Na	pH	Na
1,600	2.53	trace	2.70	trace	2.55	trace
3,200	1.85	1.7	1.93	1.7	1.87	1.5
4,800	1.70	2.0	1.75	2.5	1.73	2.3
6,400	1.67	2.0	1.70	2.7	1.65	2.5
8,000	1.60	2.0	1.70	67.5	1.63	4.0
9,600	1.63	2.7	2.73	3,000	1.73	622.5
9,867	-	-	12.57	7,125	-	-
10,933	-	-	-	-	11.67	6,938
11,200	1.63	3.3	-	-	-	-
12,800	1.60	5.0	-	-	-	-
14,400	1.60	8.5	-	-	-	-
16,000	1.63	14.0	-	-	-	-

Note: -means 'no experiment'

Na Content of $H_2Cr_2O_7$ Reclaimed from $Na_2Cr_2O_7$ Obtained at Various Regeneration Levels (Continued)

cu.cm.	10.0%		12.5%		15.0%	
	pH	Na	pH	Na	pH	Na
1,600	2.20	1.5	2.43	trace	2.60	trace
3,200	1.70	8.3	1.77	2.3	1.85	1.7
4,800	1.65	17	1.70	2.7	1.70	2.5
6,400	1.60	50	1.70	13.8	1.65	3.5
6,667	11.93	6,719	-	-	-	-
7,200	-	-	1.85	1,725	-	-
7,467	-	-	12.60	7,688	-	-
8,000	-	-	-		1.80	906
8,533	-	-	-		11.10	7,588

Na Content of $H_2Cr_2O_7$ Reclaimed from $Na_2Cr_2O_7$ Obtained from SBA Column Regeneration at Different Regeneration Flowrate

cu.cm.	150 cu.cm./min.		100 cu.cm./min.		200 cu.cm./min.	
	pH	Na	pH	Na	pH	Na
1,600	2.55	trace	2.50	0.3	2.57	0.7
3,200	1.87	1.5	1.83	2.3	1.90	1.8
4,800	1.73	2.3	1.70	3.3	1.77	2.3
6,400	1.65	2.5	1.65	3.7	1.70	2.3
8,000	1.63	4.0	1.63	10.0	1.65	2.7
9,600	1.73	622.5	1.73	1,000	1.73	837.5
10,400	-	-	9.57	6,563	12.30	6,800
10,933	11.60	6,938	-	-	-	-

Na Content of $H_2Cr_2O_7$ Reclaimed from $Na_2Cr_2O_7$ Obtained at Constant Regeneration Level of SBA Column

cu.cm.	3.5%		5.0%		7.5%	
	pH	Na	pH	Na	pH	Na
1,600	2.60	trace	2.40	7.5	2.55	trace
3,200	1.97	1.0	1.90	36	1.87	1.5
4,800	1.85	1.5	1.77	63	1.73	2.3
6,400	1.80	1.5	1.73	105	1.65	2.5
8,000	1.75	5.0	1.70	162.5	1.63	4.0
9,600	1.73	5.0	1.67	207.5	1.73	622.5
10,933	-	-	-	-	11.67	6,938
11,200	1.73	12.5	1.70	762.5	-	-
12,267	-	-	6.70	3,800	-	-
12,533	-	-	12.20	5,000	-	-
12,800	1.85	525	-	-	-	-
13,867	6.75	2,625	-	-	-	-
14,133	11.33	3,475	-	-	-	-

cu.cm.	10.0%		12.5%		15.0%	
	pH	Na	pH	Na	pH	Na
1,600	2.60	0.5	2.43	6.5	2.35	68
3,200	1.80	3.0	1.77	38	1.80	248
4,800	1.63	5.0	1.63	45	1.63	470
6,400	1.57	8.5	1.57	178	1.55	600
8,000	1.55	16.5	1.57	513	1.53	700
9,600	1.57	550	1.67	1,781	1.50	775
10,367	-	-	6.37	4,500	6.40	4,575
10,933	5.30	1,406	-	-	-	-
11,200	7.00	4,700	-	-	-	-

Note: - means ' no experiment '

Na Content of $H_2Cr_2O_7$ Reclaimed from Concentrated $Na_2Cr_2O_7$ Solution

cu.cm.	$Na_2Cr_2O_7$ 14,922 mg/cu.dm. Cr VI		$Na_2Cr_2O_7$ 11,485 mg/cu.dm. Cr VI	
	pH	Na	pH	Na
1,600	2.30	16	1.87	17
2,400	1.67	154	1.50	46
3,200	1.50	445	1.37	93
4,000	1.40	631	1.30	135
4,800	1.37	769	1.30	180
5,600	1.35	940	-	-
6,700	-	-	1.27	350
8,000	1.33	1,000	-	-

Note:' - means 'no experiment'

APPENDIX E

General Guidance for Designing an Ion Exchange Unit

In order to design a demineralization process, it is necessary that these following informations are specifiec: treated water volume per cycle; service hour per cycle; impurities in terms of all cations and anions in the influent, and required characteristics of treated effluent. Beside, performance of the ion exchange resins such as operating capacity, regeneration level, allowable ion leakage, etc., must be known or set up.

1. Resin Volume Estimation

All values of cation and anion concentrations must be converted to be either gm./cu.dm. as $CaCo_3$ or meq./cu.dm., If they are expressed as meq./cu.dm., total concentration of cations will be equal to that of anions. The resin volume of SAC and SBA columns can be estimated by dividing the quantity of total cations or total anions by the operating capacity of the corresponding resins, respectively. The quantity of regenerant required can be calculated from the designed regeneration level.

2. Consideration for Ion Exchange Column Design

The exchange columns and regenerant container must be made of non-corrosive materials such as polyvinylchloride (PVC) or steel with rubber lining. All pipes, valves, and fittings must be also made of non-corrosive material. Strainer or manifold

pipe with slits can be used as water distributor inside the column. Sometimes, several layer of gravel or anthracite have been used as subfill. Depth of resin in the column is ranging from 100 to 150 cm.. The column height should be adjusted so that there will be a space for 50 per cent expansion of resin bed when the column is backwashed.

More detail for designing an ion exchange unit can be found in references no. 11, 13 and 14 of this thesis.

VITA

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