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APPENDIX A

Experimental Data for Equilibration Time Study

Condition :	[QUAT]	0, 0.2, 0.3, and 0.4	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.04	M

Time (hr.)	$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm			
	No QUAT	0.2 M QUAT	0.3 M QUAT	0.4 M QUAT
0.0	0.237	3.469	4.452	6.692
0.2	0.043	1.995	2.333	2.660
0.3	0.289	2.005	1.581	1.963
0.5	0.311	1.454	1.372	1.875
0.7	0.403	1.454	1.213	1.462
0.8	0.033	1.523	1.421	2.153
1.0	0.184	1.762	1.659	1.761
1.2	0.622	1.096	1.338	1.385
1.3	0.185	1.652	1.175	1.441
1.5	0.216	1.958	2.211	1.576
1.7	0.206	1.530	1.864	1.523
1.8	0.200	1.670	1.372	1.531
2.0	0.186	1.768	1.974	1.529
2.2	0.238	1.721	1.817	1.481
2.3	0.200	1.630	1.876	1.324
2.5	0.157	1.808	2.005	1.391
2.7	0.183	1.739	1.747	1.006
2.8	0.146	1.481	1.521	1.480
3.0	0.176	1.323	1.410	1.511
3.2	0.023	1.335	1.408	1.595
3.3	0.146	1.907	2.092	1.603
3.5	0.099	1.712	1.363	1.601
3.7	0.067	1.208	1.186	2.739
3.8	0.123	1.711	1.210	1.442

Time (hr)	$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm			
	QUAT 0 M	QUAT 0.2M	QUAT 0.3M	QUAT 0.4M
4.0	0.100	1.763	1.233	1.408
4.5	0.087	1.773	1.164	1.784
5.0	0.096	1.733	1.431	1.745
5.5	0.893	1.712	1.430	1.617
6.0	0.043	1.951	2.213	2.159
7.0	0.003	1.710	2.101	2.019
8	0.184	1.530	1.128	1.525
9	0.000	1.575	1.381	2.408
12	0.180	1.422	1.471	1.921
15	0.086	1.462	1.474	1.427
18	0.126	1.462	1.676	1.446
21	0.126	1.365	1.846	1.908
24	0.073	1.496	1.999	1.838
27	0.105	1.500	1.286	1.924
30	0.043	1.452	2.085	1.421
33	0.013	1.426	1.365	1.457
36	0.157	1.448	1.332	1.908
39	0.105	1.401	1.314	1.437
42	0.103	1.406	1.425	1.274
45	0.132	1.410	1.383	1.924
48	0.110	1.096	1.411	1.348
67	0.095	1.109	1.255	1.453
72	0.089	1.143	1.255	1.471
Average ^a	0.160 ± 0.154	1.540 ± 0.364	1.543 ± 0.536	1.642 ± 0.810
% Chromate	99.99	99.93	99.93	99.93

a = Equilibration time between 0.5 and 72 hr.
 $\% \text{CrO}_4^{2-} = (1 - [\text{CrO}_4^{2-}]_{\text{supernatant}} / [\text{CrO}_4^{2-}]_{\text{initial}}) \times 100$

APPENDIX B

Experimental Data of Semi-Batch Process

APPENDIX B.1 Effect of flow rate and crystallizer height on the precipitation

Definition

1. $[\text{CrO}_4^{2-}]_{\text{solid}}$ = Analytical result of chromate in the solid particle in the overflow solution
2. $[\text{CrO}_4^{2-}]_{\text{total}}$ = Total chromate concentration in the overflow solution
3. $[\text{CrO}_4^{2-}]_{\text{supernatant}}$ = Chromate ion concentration
4. $[\text{CrO}_4^{2-}]_{\text{solid(c)}}$ = Calculation of chromate concentration in BaCrO_4 particle
It was used to report in result and discussion.
= $[\text{CrO}_4^{2-}]_{\text{total}} - [\text{CrO}_4^{2-}]_{\text{supernatant}}$
5. % CrO_4^{2-} = Chromate ion concentration in supernatant at the outlet related to initial chromate concentration in the feed inlet
= $[\text{CrO}_4^{2-}]_{\text{supernatant}} / [\text{CrO}_4^{2-}]_{\text{initial}} \times 100$
6. % CrO_4^{2-} in BaCrO_4 = The ratio of chromate concentration in precipitate in the overflow to chromate concentration in feed
= $[\text{CrO}_4^{2-}]_{\text{solid(c)}} / [\text{CrO}_4^{2-}]_{\text{initial}} \times 100$
7. % Barium excess = The ratio of barium ion in the supernatant to barium in feed
= $[\text{Ba}^{2+}]_{\text{supernatant}} / [\text{Ba}^{2+}]_{\text{initial}} \times 100$

Run No.1

Condition :	[QUAT]	0	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.04	M
	Flow rate	4	mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.42	0.44	0.49	0.49	0.49	0.48
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	22.81	21.33	20.96	19.60	14.13	12.21
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	20.18	20.47	19.97	17.83	12.49	11.73
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	22.38	20.88	20.46	19.11	13.64	11.73
% CrO_4^{2-}	0.02	0.02	0.02	0.02	0.02	0.02
% CrO_4^{2-} in BaCrO_4	0.96	0.90	0.88	0.82	0.59	0.51
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1342	1342	1270	1246	1374	1289
% Barium excess	24.42	24.43	23.11	22.67	25.00	23.47

Run No.2

Condition :	[QUAT]	0	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.04	M
	Flow rate	6	mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.52	0.50	0.46	0.54	0.62	0.66
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	58.60	41.54	41.54	41.13	28.23	28.91
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	53.38	37.31	39.35	39.12	26.25	28.26
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	58.08	41.04	41.08	40.59	27.61	28.26
% CrO_4^{2-}	0.02	0.02	0.02	0.02	0.03	0.03
% CrO_4^{2-} in BaCrO_4	2.50	1.77	1.77	1.75	1.19	1.22
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1301	1299	1298	1331	1286	1310
% Barium excess	23.69	23.64	23.62	24.23	23.41	23.84

Run No.3

Condition :	[QUAT]	0	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.04	M
	Flow rate	8	L/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.43	0.40	0.44	0.36	0.42	0.38
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	70.26	67.77	61.50	57.31	50.62	47.85
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	69.57	65.70	57.07	52.76	44.80	42.47
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	69.83	67.37	61.06	56.95	50.20	47.47
% CrO_4^{2-}	0.02	0.02	0.02	0.02	0.02	0.02
% CrO_4^{2-} in BaCrO_4	3.01	2.90	2.63	2.45	2.16	2.05
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1130	1100	1121	1088	1121	1112
% Barium excess	20.56	20.02	20.41	19.80	20.41	20.23

Run No.4

Condition :	[QUAT]	0	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.04	M
	Flow rate	10	L/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.32	0.30	0.32	0.33	0.27	0.35
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	96.68	93.41	74.77	71.01	58.60	54.98
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	87.09	87.06	69.38	69.08	55.36	54.63
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	96.37	93.10	74.45	70.68	58.33	54.63
% CrO_4^{2-}	0.01	0.01	0.01	0.01	0.01	0.02
% CrO_4^{2-} in BaCrO_4	4.15	4.01	3.21	3.05	2.51	2.35
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1121	1104	1108	1141	1085	1042
% Barium excess	20.41	20.09	20.17	20.77	19.76	18.97

Run No.5

Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.43	0.56	0.49	0.24	0.27	0.37
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	105.76	99.90	92.41	94.25	84.58	80.20
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	97.57	92.34	91.21	87.09	83.35	79.82
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	105.33	99.34	91.93	94.01	84.31	79.83
% CrO_4^{2-}	0.02	0.02	0.02	0.01	0.01	0.02
% CrO_4^{2-} in BaCrO_4	4.54	4.28	3.96	4.05	3.63	3.44
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1089	1086	1026	1021	1101	1102
% Barium excess	19.83	19.77	18.68	18.59	20.05	20.07

Run No.6

Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.54	0.44	0.92	0.83	0.22	0.38
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	135.49	129.34	113.95	105.34	94.74	82.39
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	131.11	116.78	103.64	96.58	85.09	82.01
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	134.95	128.90	113.03	104.51	94.53	82.01
% CrO_4^{2-}	0.02	0.02	0.04	0.04	0.01	0.02
% CrO_4^{2-} in BaCrO_4	5.82	5.56	4.87	4.50	4.07	3.53
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1011	1109	1007	1041	1019	1010
% Barium excess	18.41	20.19	18.32	18.95	18.55	18.38

Run No.7

Condition : [QUAT] 0.2 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 4 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	2.12	1.99	2.02	2.33	1.59	1.52
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	127.70	188.70	180.10	150.60	140.90	111.86
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	121.90	180.20	176.71	145.71	131.14	102.45
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	125.58	186.71	178.08	148.27	139.31	110.34
% CrO_4^{2-}	0.09	0.09	0.09	0.10	0.07	0.07
% CrO_4^{2-} in BaCrO_4	5.41	8.05	7.68	6.39	6.00	4.76
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3047	2949	3018	3006	3010	2993
% Barium excess	55.46	53.68	54.93	54.72	54.79	54.48
$[\text{QUAT}]_{\text{supernatant}}$	14268	12015	10514	9808	8724	8342
% QUAT	44.13	37.16	32.52	30.33	26.98	25.80

Run No.8

Condition : [QUAT] 0.2 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 6 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	4.34	3.96	3.97	3.47	3.19	3.29
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	260.30	251.50	258.40	248.70	236.10	221.81
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	247.70	238.50	237.30	237.10	208.30	217.87
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	255.96	247.54	254.43	245.24	232.91	218.52
% CrO_4^{2-}	0.19	0.17	0.17	0.15	0.14	0.14
% CrO_4^{2-} in BaCrO_4	11.03	10.67	10.97	10.57	10.04	9.42
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2370	2330	2281	2200	2151	2006
% Barium excess	43.14	42.41	41.53	40.04	39.16	36.52
$[\text{QUAT}]_{\text{supernatant}}$	15217	13082	11475	10180	9274	8800
% QUAT	47.06	40.46	35.49	31.48	28.68	27.21

Run No.9

Condition : [QUAT] 0.2 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 8 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.21	5.14	3.49	3.58	3.00	3.39
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	460.60	478.30	472.90	466.40	484.80	417.79
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	432.80	426.30	435.50	448.10	434.80	400.39
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	455.39	473.16	469.41	462.82	481.80	414.40
% CrO_4^{2-}	0.22	0.22	0.15	0.15	0.13	0.15
% CrO_4^{2-} in BaCrO_4	19.63	20.40	20.23	19.95	20.77	17.86
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2669	2399	2369	2189	2310	1897
% Barium excess	48.59	43.68	43.12	39.84	42.04	34.54
$[\text{QUAT}]_{\text{supernatant}}$	14939	14271	12793	12425	12086	8655
% QUAT	46.20	44.14	39.56	38.42	37.38	26.77

Run No.10

Condition : [QUAT] 0.2 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 10 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.10	4.04	2.86	2.62	2.96	1.92
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	738.60	718.50	699.50	665.12	678.13	622.81
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	702.94	652.13	670.31	624.64	615.23	572.57
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	733.50	714.46	696.65	662.50	675.17	620.89
% CrO_4^{2-}	0.22	0.17	0.12	0.11	0.13	0.08
% CrO_4^{2-} in BaCrO_4	31.62	30.80	30.03	28.56	29.10	26.76
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2414	1949	2309	1934	1843	1812
% Barium excess	43.94	35.47	42.04	35.20	33.54	32.99
$[\text{QUAT}]_{\text{supernatant}}$	14157	13429	13296	12613	11078	10822
% QUAT	43.78	41.53	41.12	39.01	34.26	33.47

Run No.11

Condition : [QUAT] 0.2 M
 [CrO₄²⁻]_{initial} 0.02 M
 [Ba²⁺]_{initial} 0.04 M
 Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	5.24	4.89	3.20	3.41	3.25	3.45
[CrO ₄ ²⁻] _{total} , ppm	1094.0	1174.8	1184.8	1155.6	1113.7	984.4
[CrO ₄ ²⁻] _{solid} , ppm	991.6	1106.6	1125.9	1117.8	1100.3	949.8
[CrO ₄ ²⁻] _{solid(e)} , ppm	1088.7	1169.9	1181.6	1152.2	1110.5	980.9
% CrO ₄ ²⁻	0.23	0.21	0.14	0.15	0.14	0.15
% CrO ₄ ²⁻ in BaCrO ₄	46.93	50.43	50.93	49.66	47.87	42.28
[Ba ²⁺] _{supernatant}	2035	1822	1791	1798	1819	1737
% Barium excess	37.04	33.17	32.59	32.73	33.11	31.61
[QUAT] _{supernatant}	14187	14137	13363	12277	13254	12672
% QUAT	43.87	43.72	41.33	37.97	40.99	39.19

Run No.12

Condition : [QUAT] 0.2 M
 [CrO₄²⁻]_{initial} 0.02 M
 [Ba²⁺]_{initial} 0.04 M
 Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	5.28	5.47	4.84	3.84	3.13	3.46
[CrO ₄ ²⁻] _{total} , ppm	1240.6	1307.8	1244.6	1258.6	1240.7	1142.2
[CrO ₄ ²⁻] _{solid} , ppm	1153.2	1206.7	1152.5	1194.0	1171.0	1056.1
[CrO ₄ ²⁻] _{solid(e)} , ppm	1235.3	1302.3	1239.7	1254.8	1237.5	1138.8
% CrO ₄ ²⁻	0.23	0.24	0.21	0.17	0.13	0.15
% CrO ₄ ²⁻ in BaCrO ₄	53.25	56.13	53.44	54.09	53.34	49.08
[Ba ²⁺] _{supernatant}	1671	1700	1690	1691	1698	1701
% Barium excess	30.42	30.94	30.77	30.78	30.92	30.97
[QUAT] _{supernatant}	14403	14262	13913	13862	13591	13803
% QUAT	44.54	44.11	43.03	42.87	42.03	42.69

Run No.13

Condition :	[QUAT]	0.3	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.04	M
	Flow rate	4	mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	1.40	1.46	1.37	0.78	0.15	0.15
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	49.99	43.12	45.15	46.00	43.50	45.75
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	47.76	40.52	43.36	42.76	40.76	42.33
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	48.59	41.66	43.78	45.22	43.35	45.60
% CrO_4^{2-}	0.06	0.06	0.06	0.03	0.01	0.01
% CrO_4^{2-} in BaCrO_4	2.09	1.80	1.89	1.95	1.87	1.97
$[\text{Ba}^{2+}]_{\text{supernatant}}$	4493	4414	4070	3577	3321	3044
% Barium excess	81.78	80.34	74.09	65.11	60.44	55.41
$[\text{QUAT}]_{\text{supernatant}}$	8675	8741	7954	5762	4008	3489
% QUAT	17.89	18.02	16.40	11.88	8.26	7.19

Run No.14

Condition :	[QUAT]	0.3	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.04	M
	Flow rate	6	mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	2.00	2.11	2.23	0.80	0.43	0.37
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	215.30	239.90	204.30	154.20	101.70	66.96
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	200.60	221.50	187.60	139.30	101.00	55.82
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	213.30	237.79	202.07	153.40	101.27	66.59
% CrO_4^{2-}	0.09	0.09	0.10	0.03	0.02	0.02
% CrO_4^{2-} in BaCrO_4	9.19	10.25	8.71	6.61	4.37	2.87
$[\text{Ba}^{2+}]_{\text{supernatant}}$	4123	4012	3892	3505	3321	2808
% Barium excess	75.05	73.03	70.85	63.80	60.44	51.11
$[\text{QUAT}]_{\text{supernatant}}$	10859	10985	10374	8209	5560	4019
% QUAT	22.39	22.65	21.39	16.92	11.46	8.29

Run No.15

Condition : [QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 8 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	4.44	3.62	3.06	3.65	3.48	3.31
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1094.6	915.5	911.2	833.3	861.9	784.9
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	973.4	833.9	826.6	785.7	825.1	711.0
$[\text{CrO}_4^{2-}]_{\text{solid(e)}}$, ppm	1090.2	911.9	908.1	829.6	858.4	781.6
% CrO_4^{2-}	0.19	0.16	0.13	0.16	0.15	0.14
% CrO_4^{2-} in BaCrO_4	46.99	39.31	39.14	35.76	37.00	33.69
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3554	2972	2784	2625	2529	2418
% Barium excess	64.69	54.10	50.68	47.78	46.04	44.01
$[\text{QUAT}]_{\text{supernatant}}$	12964	12589	12419	11229	11065	10029
% QUAT	26.73	25.95	25.60	23.15	22.81	20.68

Run No.16

Condition : [QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 10 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.20	3.23	3.24	3.47	3.24	2.86
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1183.6	1134.2	1089.8	1022.6	907.3	787.6
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	1078.0	1102.1	989.2	966.6	850.9	756.5
$[\text{CrO}_4^{2-}]_{\text{solid(e)}}$, ppm	1178.4	1131.0	1086.6	1019.1	904.1	784.7
% CrO_4^{2-}	0.22	0.14	0.14	0.15	0.14	0.12
% CrO_4^{2-} in BaCrO_4	50.79	48.75	46.84	43.93	38.97	33.82
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3044	2748	2697	2472	2350	2231
% Barium excess	55.40	50.01	49.09	45.00	42.77	40.62
$[\text{QUAT}]_{\text{supernatant}}$	14588	13964	13419	13229	12065	11029
% QUAT	30.08	28.79	27.67	27.27	24.87	22.74

Run No.17

Condition : [QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.23	3.40	3.28	3.32	3.38	3.33
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1431.1	1186.0	1142.7	1102.6	1075.8	1031.1
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	1321.6	1150.1	1132.6	1001.5	987.6	975.5
$[\text{CrO}_4^{2-}]_{\text{solid(e)}}$, ppm	1425.9	1182.6	1139.4	1099.3	1072.4	1027.8
% CrO_4^{2-}	0.23	0.15	0.14	0.14	0.15	0.14
% CrO_4^{2-} in BaCrO_4	61.46	50.97	49.11	47.38	46.23	44.30
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2260	2141	2114	2104	2094	1919
% Barium excess	41.14	38.96	38.48	38.29	38.12	34.92
[QUAT] _{supernatant}	16255	16205	16146	16102	15670	14718
% QUAT	33.51	33.41	33.29	33.20	32.31	30.34

Run No.18

Condition : [QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.37	3.17	3.54	3.29	3.26	3.49
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1641.3	1629.6	1537.1	1477.3	1257.0	1169.1
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	1328.6	1597.0	1402.4	1322.6	1157.7	1012.5
$[\text{CrO}_4^{2-}]_{\text{solid(e)}}$, ppm	1636.0	1626.4	1533.5	1474.0	1253.7	1165.6
% CrO_4^{2-}	0.23	0.14	0.15	0.14	0.14	0.15
% CrO_4^{2-} in BaCrO_4	70.52	70.10	66.10	63.53	54.04	50.24
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2307	2205	2039	1937	1790	1782
% Barium excess	41.99	40.13	37.11	35.26	32.57	32.43
[QUAT] _{supernatant}	18525	17600	17533	17584	17522	17564
% QUAT	38.19	36.29	36.15	36.25	36.13	36.21

Run No.19

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 4 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.96	0.83	0.96	0.55	0.15	0.07
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	128.97	96.43	84.23	67.05	47.32	30.14
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	110.42	92.23	79.64	60.11	38.59	27.14
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	128.01	95.60	83.27	66.51	47.17	30.08
% CrO_4^{2-}	0.04	0.04	0.04	0.02	0.01	0.00
% CrO_4^{2-} in BaCrO_4	5.52	4.12	3.59	2.87	2.03	1.30
$[\text{Ba}^{2+}]_{\text{supernatant}}$	5118	4946	4558	4466	4089	3917
% Barium excess	93.16	90.04	82.96	81.30	74.43	71.31
[QUAT] _{supernatant}	8349	6616	5544	4604	3687	2233
% QUAT	12.91	10.23	8.57	7.12	5.70	3.45

Run No.20

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 6 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	1.95	0.58	0.71	0.42	0.32	0.26
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	207.36	199.26	153.12	95.68	80.43	39.00
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	199.67	186.34	134.64	90.69	75.36	30.61
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	205.41	198.68	152.41	95.26	80.11	38.74
% CrO_4^{2-}	0.08	0.03	0.03	0.02	0.01	0.01
% CrO_4^{2-} in BaCrO_4	8.85	8.56	6.57	4.11	3.45	1.67
$[\text{Ba}^{2+}]_{\text{supernatant}}$	4775	4466	4147	4124	3837	3729
% Barium excess	86.92	81.30	75.48	75.07	69.85	67.88
[QUAT] _{supernatant}	9618	8208	7176	5540	5169	2468
% QUAT	14.87	12.69	11.10	8.57	7.99	3.82

Run No.21

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 8 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.11	0.80	1.49	0.60	0.53	0.32
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	784.95	661.14	668.87	593.83	585.52	419.33
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	779.83	659.26	621.25	553.94	562.21	399.21
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	779.84	660.34	667.38	593.23	584.99	419.01
% CrO_4^{2-}	0.22	0.03	0.06	0.03	0.02	0.01
% CrO_4^{2-} in BaCrO_4	33.61	28.46	28.77	25.57	25.22	18.06
$[\text{Ba}^{2+}]_{\text{supernatant}}$	4212	3864	3790	3622	3464	3295
% Barium excess	76.66	70.33	68.99	65.92	63.05	59.98
$[\text{QUAT}]_{\text{supernatant}}$	10989	9215	8256	7811	5184	5132
% QUAT	16.99	14.25	12.77	12.08	8.02	7.94

Run No.22

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 10 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.45	3.44	3.00	3.05	2.93	3.09
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1288.5	1170.6	1084.1	1001.9	943.7	884.6
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	1260.3	1067.2	999.9	980.5	920.1	850.7
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	1283.1	1167.1	1081.1	998.8	940.7	881.5
% CrO_4^{2-}	0.24	0.15	0.13	0.13	0.13	0.13
% CrO_4^{2-} in BaCrO_4	55.30	50.31	46.60	43.05	40.55	37.99
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3453	3169	3095	2968	2968	2927
% Barium excess	62.85	57.68	56.33	54.03	54.03	53.27
$[\text{QUAT}]_{\text{supernatant}}$	12821	12619	12501	11696	10239	7879
% QUAT	19.83	19.51	19.33	18.09	15.83	12.18

Run No.23

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.48	3.27	3.15	3.11	3.21	3.28
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1283.7	1263.8	1206.0	1127.4	1100.5	1084.8
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	1161.0	1150.7	1111.3	1036.9	1089.7	998.7
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	1278.3	1260.5	1202.8	1124.3	1097.3	1081.5
% CrO_4^{2-}	0.24	0.14	0.14	0.13	0.14	0.14
% CrO_4^{2-} in BaCrO_4	55.10	54.33	51.85	48.46	47.30	46.62
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3254	3014	2820	2625	2557	2523
% Barium excess	59.24	54.87	51.33	47.79	46.54	45.92
$[\text{QUAT}]_{\text{supernatant}}$	19206	19115	19064	18289	18256	15731
% QUAT	29.70	29.56	29.48	28.28	28.23	24.32

Run No.24

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	5.72	3.40	3.25	3.74	3.82	3.43
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1413.9	1289.1	1287.4	1213.3	1201.4	1134.3
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	1366.3	1157.4	1145.4	1112.4	1093.9	1066.7
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	1408.2	1285.7	1284.1	1209.5	1197.6	1130.9
% CrO_4^{2-}	0.25	0.15	0.14	0.16	0.16	0.15
% CrO_4^{2-} in BaCrO_4	60.70	55.42	55.35	52.14	51.62	48.75
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2957	2340	2180	2054	2022	1980
% Barium excess	53.83	42.59	39.68	37.39	36.80	36.03
$[\text{QUAT}]_{\text{supernatant}}$	21150	21336	20695	19216	18913	18583
% QUAT	32.70	32.99	32.00	29.71	29.24	28.73

APPENDIX B.2 Effect of concentration ratio on the precipitation

Condition :	[QUAT]	0, 0.2, 0.3, and 0.4	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.02, 0.03, 0.04, and 0.05	M
	Flow rate	14	ml/min
	Height	83	cm

$[\text{Ba}^{2+}]/[\text{CrO}_4^{2-}]$	$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm			
	[QUAT] 0 M	[QUAT] 0.2 M	[QUAT] 0.3 M	[QUAT] 0.4 M
1	2.38	8.87	11.08	12.27
1.5	0.51	5.03	5.26	5.55
2	0.38	3.46	3.49	3.43
2.5	0.29	0.42	1.62	1.67

$[\text{Ba}^{2+}]/[\text{CrO}_4^{2-}]$	% Chromate			
	[QUAT] 0 M	[QUAT] 0.2 M	[QUAT] 0.3 M	[QUAT] 0.4 M
1	0.10	0.38	0.48	0.53
1.5	0.02	0.22	0.23	0.24
2	0.02	0.15	0.15	0.15
2.5	0.01	0.02	0.07	0.07

$$\% \text{CrO}_4^{2-} = \left(\frac{[\text{CrO}_4^{2-}]_{\text{supernatant}}}{[\text{CrO}_4^{2-}]_{\text{initial}}} \right) \times 100$$

APPENDIX C

Experimental Data of Continuous Process

APPENDIX C.1 Effect of flow rate and crystallizer height on the precipitation

Definition

1. $[\text{CrO}_4^{2-}]_{\text{solid}}$ = Analytical result of chromate in the solid particle in the overflow solution
2. $[\text{CrO}_4^{2-}]_{\text{total}}$ = Total chromate concentration in the overflow solution
3. $[\text{CrO}_4^{2-}]_{\text{supernatant}}$ = Chromate ion concentration
4. $[\text{CrO}_4^{2-}]_{\text{solid(c)}}$ = Calculation of chromate concentration in BaCrO_4 particle
It was used to report in result and discussion.
= $[\text{CrO}_4^{2-}]_{\text{total}} - [\text{CrO}_4^{2-}]_{\text{supernatant}}$
5. % CrO_4^{2-} = Chromate ion concentration in supernatant at the outlet related to initial chromate concentration in the feed inlet
= $[\text{CrO}_4^{2-}]_{\text{supernatant}} / [\text{CrO}_4^{2-}]_{\text{initial}} \times 100$
6. % CrO_4^{2-} in BaCrO_4 = The ratio of chromate concentration in precipitate in the overflow to chromate concentration in feed
= $[\text{CrO}_4^{2-}]_{\text{solid(c)}} / [\text{CrO}_4^{2-}]_{\text{initial}} \times 100$
7. % Barium excess = The ratio of barium ion in the supernatant to barium in feed
= $[\text{Ba}^{2+}]_{\text{supernatant}} / [\text{Ba}^{2+}]_{\text{initial}} \times 100$

Run No.1
 Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 4 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.54	0.46	0.46	0.45	0.46	0.43
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	57.73	33.76	26.32	20.60	19.41	15.69
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	55.05	31.90	24.95	17.66	15.21	14.72
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	57.19	33.30	25.87	20.15	18.95	15.26
% CrO_4^{2-}	0.02	0.02	0.02	0.02	0.02	0.02
% CrO_4^{2-} in BaCrO_4	2.46	1.44	1.11	0.87	0.82	0.66
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2126	2135	2126	2126	2126	2135
% Barium excess	38.71	38.87	38.71	38.71	38.71	38.87

Run No.2
 Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 6 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.42	0.38	0.38	0.26	0.26	0.24
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	68.77	46.21	32.64	30.67	25.76	22.16
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	65.35	43.90	31.27	29.15	24.50	18.81
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	68.35	45.83	32.26	30.41	25.51	21.92
% CrO_4^{2-}	0.02	0.02	0.02	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	2.95	1.98	1.39	1.31	1.10	0.94
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2029	2029	2020	2029	2020	2020
% Barium excess	36.94	36.94	36.78	36.94	36.78	36.78

Run No.3

Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 8 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.41	0.37	0.28	0.26	0.24	0.24
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	137.20	70.33	56.91	50.48	36.47	36.17
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	135.45	61.45	53.42	49.55	35.54	35.69
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	136.79	69.96	56.64	50.22	36.23	35.94
% CrO_4^{2-}	0.02	0.02	0.01	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	5.90	3.02	2.44	2.16	1.56	1.55
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1,985	1,985	1,994	1,976	1,985	1,985
% Barium excess	36.13	36.13	36.30	35.97	36.13	36.13

Run No.4

Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 10 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.38	0.37	0.37	0.32	0.31	0.33
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	165.26	92.26	65.91	62.53	59.81	48.77
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	150.54	89.36	63.12	53.75	57.21	47.62
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	164.89	91.89	65.53	62.20	59.51	48.44
% CrO_4^{2-}	0.02	0.02	0.02	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	7.11	3.96	2.82	2.68	2.56	2.09
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1932	1923	1932	1932	1923	1932
% Barium excess	35.17	35.01	35.17	35.17	35.01	35.17

Run No.5
 Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.38	0.38	0.37	0.33	0.33	0.31
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	204.22	113.04	71.67	66.24	61.56	50.59
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	201.06	97.65	69.70	64.35	51.63	48.66
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	203.84	112.66	71.30	65.91	61.23	50.29
% CrO_4^{2-}	0.02	0.02	0.02	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	8.79	4.86	3.07	2.84	2.64	2.17
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1923	1923	1932	1923	1923	1932
% Barium excess	35.01	35.01	35.17	35.01	35.01	35.17

Run No.6
 Condition : [QUAT] 0 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.39	0.38	0.38	0.38	0.37	0.38
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	220.93	143.47	85.71	70.03	66.50	52.09
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	213.87	133.86	73.42	63.04	65.44	49.98
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	220.54	143.09	85.33	69.65	66.12	51.72
% CrO_4^{2-}	0.02	0.02	0.02	0.02	0.02	0.02
% CrO_4^{2-} in BaCrO_4	9.51	6.17	3.68	3.00	2.85	2.23
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1923	1923	1923	1915	1923	1915
% Barium excess	35.00	35.00	35.00	34.86	35.00	34.86

Run No.7

Condition : [QUAT] 0.2 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 4 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	1.26	0.48	0.54	0.50	0.54	0.27
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	208.01	63.83	49.78	37.47	36.62	33.38
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	186.49	61.89	47.17	32.98	29.07	33.07
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	206.75	63.34	49.23	36.97	36.08	33.11
% CrO_4^{2-}	0.05	0.02	0.02	0.02	0.02	0.01
% CrO_4^{2-} in BaCrO_4	8.91	2.73	2.12	1.59	1.56	1.43
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3653	3547	3582	3538	3556	3565
% Barium excess	66.50	64.57	65.21	64.41	64.73	64.89
$[\text{QUAT}]_{\text{supernatant}}$	7641	7550	7689	7740	7856	7466
% QUAT	23.63	23.35	23.78	23.94	24.30	23.09

Run No.8

Condition : [QUAT] 0.2 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 6 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.42	0.58	0.58	0.82	1.05	0.53
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	740.85	420.67	233.33	198.03	190.29	188.89
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	721.65	415.87	230.70	195.71	185.02	177.28
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	740.42	420.09	232.75	197.21	189.24	188.37
% CrO_4^{2-}	0.02	0.03	0.02	0.04	0.05	0.02
% CrO_4^{2-} in BaCrO_4	31.91	18.11	10.03	8.50	8.16	8.12
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2320	2409	2391	2329	2320	2400
% Barium excess	42.24	43.85	43.52	42.40	42.24	43.69
$[\text{QUAT}]_{\text{supernatant}}$	10274	10119	10023	10063	10403	10422
% QUAT	31.77	31.29	31.00	31.12	32.17	32.23

Run No.9

Condition : [QUAT] 0.2 M
 [CrO₄²⁻]_{initial} 0.02 M
 [Ba²⁺]_{initial} 0.04 M
 Flow rate 8 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	0.64	0.62	0.68	0.67	0.66	0.56
[CrO ₄ ²⁻] _{total} . ppm	1014.43	863.32	758.97	655.24	601.36	618.70
[CrO ₄ ²⁻] _{solid} . ppm	985.32	831.74	728.00	642.85	582.78	594.54
[CrO ₄ ²⁻] _{solid(c)} . ppm	1013.79	862.70	758.28	654.57	600.70	618.14
% CrO ₄ ²⁻	0.03	0.03	0.03	0.03	0.03	0.02
% CrO ₄ ²⁻ in BaCrO ₄	43.70	37.19	32.68	28.21	25.89	26.64
[Ba ²⁺] _{supernatant}	1817	1809	1747	1782	1817	1747
% Barium excess	33.08	32.92	31.80	32.44	33.08	31.80
[QUAT] _{supernatant}	11963	11943	11775	11995	12168	11950
% QUAT	37.00	36.93	36.41	37.10	37.63	36.96

Run No.10

Condition : [QUAT] 0.2 M
 [CrO₄²⁻]_{initial} 0.02 M
 [Ba²⁺]_{initial} 0.04 M
 Flow rate 10 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	0.56	0.48	0.36	0.39	0.47	0.47
[CrO ₄ ²⁻] _{total} . ppm	994.61	928.35	897.07	812.85	799.84	731.10
[CrO ₄ ²⁻] _{solid} . ppm	851.24	910.08	891.19	804.80	684.34	640.06
[CrO ₄ ²⁻] _{solid(c)} . ppm	994.05	927.87	896.72	812.45	799.38	730.63
% CrO ₄ ²⁻	0.02	0.02	0.02	0.02	0.02	0.02
% CrO ₄ ²⁻ in BaCrO ₄	42.85	39.99	38.65	35.02	34.46	31.49
[Ba ²⁺] _{supernatant}	1729	1756	1817	1853	1870	1862
% Barium excess	31.48	31.96	33.08	33.73	34.05	33.89
[QUAT] _{supernatant}	12681	12757	12480	12725	12581	12651
% QUAT	39.22	39.45	38.59	39.35	38.91	39.13

Run No.11

Condition :

[QUAT] 0.2 M

[CrO₄²⁻]_{initial} 0.02 M[Ba²⁺]_{initial} 0.04 M

Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	0.57	0.30	0.63	0.34	0.35	0.35
[CrO ₄ ²⁻] _{total} · ppm	997.09	948.16	940.42	946.93	918.44	901.41
[CrO ₄ ²⁻] _{solid} · ppm	754.32	898.62	901.10	896.14	870.75	856.20
[CrO ₄ ²⁻] _{solid(c)} · ppm	996.52	947.87	939.79	946.58	918.09	901.06
% CrO ₄ ²⁻	0.02	0.01	0.03	0.01	0.02	0.01
% CrO ₄ ²⁻ in BaCrO ₄	42.95	40.86	40.51	40.80	39.57	38.84
[Ba ²⁺] _{supernatant}	1756	1835	1729	1703	1791	1809
% Barium excess	31.96	33.40	31.48	30.99	32.60	32.92
[QUAT] _{supernatant}	12808	12796	12907	12761	12936	12813
% QUAT	39.61	39.57	39.92	39.46	40.00	39.62

Run No.12

Condition :

[QUAT] 0.2 M

[CrO₄²⁻]_{initial} 0.02 M[Ba²⁺]_{initial} 0.04 M

Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	0.51	0.31	0.34	0.33	0.35	0.30
[CrO ₄ ²⁻] _{total} · ppm	997.81	957.95	950.51	947.81	934.30	916.73
[CrO ₄ ²⁻] _{solid} · ppm	953.22	943.08	934.30	923.48	923.48	903.89
[CrO ₄ ²⁻] _{solid(c)} · ppm	997.31	957.64	950.17	947.48	933.94	916.42
% CrO ₄ ²⁻	0.02	0.01	0.01	0.01	0.02	0.01
% CrO ₄ ²⁻ in BaCrO ₄	42.99	41.28	40.96	40.84	40.26	39.50
[Ba ²⁺] _{supernatant}	1671	1720	1690	1690	1749	1798
% Barium excess	30.41	31.31	30.77	30.77	31.84	32.73
[QUAT] _{supernatant}	13065	12862	12912	12862	12927	12803
% QUAT	40.41	39.78	39.93	39.78	39.98	39.59

Run No.13

Condition : [QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 4 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.32	0.20	0.22	0.15	0.27	0.25
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	140.06	67.02	37.06	25.32	33.90	30.75
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	130.25	60.85	33.72	22.94	30.48	28.40
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	139.74	66.82	36.85	25.17	33.63	30.50
% CrO_4^{2-}	0.01	0.01	0.01	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	6.02	2.88	1.59	1.08	1.45	1.31
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3455	3401	3374	3464	3499	3508
% Barium excess	62.88	61.91	61.42	63.05	63.70	63.86
[QUAT] _{supernatant}	5601	5566	5583	6200	5918	5995
% QUAT	11.55	11.48	11.51	12.78	12.20	12.36

Run No.14

Condition : [QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 6 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.37	0.37	0.21	0.26	0.20	0.19
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	263.84	132.33	86.76	60.67	48.59	48.36
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	228.82	117.69	71.67	42.64	30.34	46.99
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	263.46	131.96	86.55	60.41	48.39	48.17
% CrO_4^{2-}	0.02	0.02	0.01	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	11.36	5.69	3.73	2.60	2.09	2.08
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3401	3284	3392	3275	3383	3347
% Barium excess	61.91	59.79	61.74	59.62	61.58	60.93
[QUAT] _{supernatant}	5921	6086	6136	5997	6029	6114
% QUAT	12.21	12.55	12.65	12.36	12.43	12.61

Run No.15

Condition :

[QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 8 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.34	0.48	0.28	0.34	0.27	0.28
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	680.77	504.74	340.78	282.25	256.24	280.86
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	620.86	460.15	334.74	270.95	235.81	252.53
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	680.43	504.26	340.50	281.92	255.97	280.58
% CrO_4^{2-}	0.01	0.02	0.01	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	29.33	21.74	14.68	12.15	11.03	12.09
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3240	3258	3213	3222	3177	3186
% Barium excess	58.97	59.30	58.48	58.64	57.83	57.99
[QUAT] _{supernatant}	9915	9799	9612	9459	9665	9951
% QUAT	20.44	20.20	19.82	19.50	19.93	20.52

Run No.16

Condition :

[QUAT] 0.3 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 10 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.49	0.39	0.52	0.52	0.44	0.43
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	967.36	960.55	960.86	1001.73	966.74	957.14
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	838.55	889.64	789.31	772.59	703.54	831.12
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	966.88	960.16	960.34	1001.21	966.30	956.71
% CrO_4^{2-}	0.02	0.02	0.02	0.02	0.02	0.02
% CrO_4^{2-} in BaCrO_4	41.68	41.39	41.39	43.16	41.65	41.24
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1950	1968	1985	1959	1976	1932
% Barium excess	35.49	35.81	36.14	35.65	35.98	35.16
[QUAT] _{supernatant}	16826	16747	17073	16994	17415	17145
% QUAT	34.69	34.53	35.20	35.04	35.90	35.35

Run No.17

Condition : [QUAT] 0.3 M
 [CrO₄²⁻]_{initial} 0.02 M
 [Ba²⁺]_{initial} 0.04 M
 Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	0.34	0.34	0.33	0.26	0.32	0.37
[CrO ₄ ²⁻] _{total} , ppm	989.35	1006.38	1009.48	976.65	971.08	1002.04
[CrO ₄ ²⁻] _{solid} , ppm	974.18	958.07	975.72	915.65	850.01	831.74
[CrO ₄ ²⁻] _{solid(c)} , ppm	989.01	1006.04	1009.14	976.40	970.76	1001.68
% CrO ₄ ²⁻	0.01	0.01	0.01	0.01	0.01	0.02
% CrO ₄ ²⁻ in BaCrO ₄	42.63	43.36	43.50	42.09	41.84	43.18
[Ba ²⁺] _{supernatant}	1779	1770	1761	1753	1735	1753
% Barium excess	32.39	32.23	32.06	31.90	31.57	31.90
[QUAT] _{supernatant}	18054	17499	17549	17398	17229	17633
% QUAT	37.22	36.08	36.18	35.87	35.52	36.36

Run No.18

Condition : [QUAT] 0.3 M
 [CrO₄²⁻]_{initial} 0.02 M
 [Ba²⁺]_{initial} 0.04 M
 Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
[CrO ₄ ²⁻] _{supernatant} , ppm	0.32	0.33	0.33	0.33	0.32	0.31
[CrO ₄ ²⁻] _{total} , ppm	1047.18	1037.27	1031.50	1030.67	1024.07	1018.29
[CrO ₄ ²⁻] _{solid} , ppm	971.26	975.38	899.47	967.96	1001.79	1010.04
[CrO ₄ ²⁻] _{solid(c)} , ppm	1046.86	1036.94	1031.17	1030.34	1023.75	1017.99
% CrO ₄ ²⁻	0.01	0.01	0.01	0.01	0.01	0.01
% CrO ₄ ²⁻ in BaCrO ₄	45.12	44.70	44.45	44.41	44.13	43.88
[Ba ²⁺] _{supernatant}	1771	1845	1799	1836	1817	1753
% Barium excess	32.24	33.58	32.74	33.41	33.08	31.90
[QUAT] _{supernatant}	17684	17381	17600	17532	17583	17818
% QUAT	36.46	35.83	36.29	36.15	36.25	36.74

Run No.19

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 4 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.31	0.20	0.12	0.11	0.07	0.11
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	30.30	21.08	7.33	6.55	7.89	5.66
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	27.51	20.45	5.88	5.40	7.14	5.47
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	29.99	20.89	7.21	6.44	7.81	5.54
% CrO_4^{2-}	0.01	0.01	0.01	0.00	0.00	0.00
% CrO_4^{2-} in BaCrO_4	1.29	0.90	0.31	0.28	0.34	0.24
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3831	3867	3876	3777	3804	3804
% Barium excess	69.73	70.39	70.55	68.76	69.24	69.24
[QUAT] _{supernatant}	2551	2640	2544	2381	2414	2467
% QUAT	3.94	4.08	3.93	3.68	3.73	3.81

Run No.20

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 6 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.07	0.08	0.15	0.15	0.13	0.30
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	32.16	8.33	8.29	5.77	6.58	5.84
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	27.81	7.51	7.74	5.36	5.95	5.36
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	32.09	8.26	8.15	5.62	6.46	5.54
% CrO_4^{2-}	0.00	0.00	0.01	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	1.38	0.36	0.35	0.24	0.28	0.24
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3920	3858	3867	3903	3929	3804
% Barium excess	71.36	70.22	70.39	71.04	71.53	69.24
[QUAT] _{supernatant}	2719	2579	2763	2590	2785	2660
% QUAT	4.20	3.99	4.27	4.01	4.31	4.11

Run No.21

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 8 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.20	0.18	0.41	0.15	0.14	0.12
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	170.47	119.07	121.24	84.70	88.57	74.32
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	144.31	107.61	113.65	77.27	87.02	65.50
$[\text{CrO}_4^{2-}]_{\text{solid(e)}}$, ppm	170.27	118.88	120.83	84.55	88.43	74.21
% CrO_4^{2-}	0.01	0.01	0.02	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	7.34	5.12	5.21	3.64	3.81	3.20
$[\text{Ba}^{2+}]_{\text{supernatant}}$	3401	3284	3392	3275	3383	3347
% Barium excess	61.91	59.79	61.74	59.62	61.58	60.93
[QUAT] _{supernatant}	3869	4196	3730	3914	3737	3892
% QUAT	5.98	6.49	5.77	6.05	5.78	6.02

Run No.22

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 10 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.19	0.20	0.24	0.24	0.29	0.27
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	626.75	524.87	461.70	446.22	454.89	456.75
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	558.93	434.15	415.26	417.42	411.85	436.31
$[\text{CrO}_4^{2-}]_{\text{solid(e)}}$, ppm	626.56	524.68	461.46	445.99	454.60	456.48
% CrO_4^{2-}	0.01	0.01	0.01	0.01	0.01	0.01
% CrO_4^{2-} in BaCrO_4	27.01	22.62	19.89	19.22	19.59	19.68
$[\text{Ba}^{2+}]_{\text{supernatant}}$	2559	2657	2586	2604	2559	2568
% Barium excess	46.58	48.37	47.07	47.39	46.58	46.74
[QUAT] _{supernatant}	7948	7758	8002	7780	7755	7873
% QUAT	12.29	12.00	12.37	12.03	11.99	12.17

Run No.23

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 12 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.35	0.25	0.26	0.21	0.46	0.52
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1022.2	1034.6	1019.1	1031.5	1028.4	1022.2
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	988.1	1000.5	997.4	1012.9	988.1	1003.6
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	1021.8	1034.3	1018.8	1031.2	1027.9	1021.7
% CrO_4^{2-}	0.02	0.01	0.01	0.01	0.02	0.02
% CrO_4^{2-} in BaCrO_4	44.04	44.58	43.91	44.45	44.31	44.04
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1779	1770	1761	1753	1735	1753
% Barium excess	32.39	32.23	32.06	31.90	31.57	31.90
$[\text{QUAT}]_{\text{supernatant}}$	18172	17902	18121	18273	17919	18054
% QUAT	28.10	27.68	28.02	28.25	27.71	27.92

Run No.24

Condition : [QUAT] 0.4 M
 $[\text{CrO}_4^{2-}]_{\text{initial}}$ 0.02 M
 $[\text{Ba}^{2+}]_{\text{initial}}$ 0.04 M
 Flow rate 14 mL/min

	Height					
	33 cm	43 cm	53 cm	63 cm	73 cm	83 cm
$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm	0.38	0.37	0.43	0.38	0.35	0.39
$[\text{CrO}_4^{2-}]_{\text{total}}$, ppm	1121.0	1111.9	1121.0	1139.0	1111.9	1111.9
$[\text{CrO}_4^{2-}]_{\text{solid}}$, ppm	1066.7	1057.7	1075.8	1084.8	1093.9	1066.7
$[\text{CrO}_4^{2-}]_{\text{solid(c)}}$, ppm	1120.6	1111.6	1120.5	1138.7	1111.6	1111.5
% CrO_4^{2-}	0.02	0.02	0.02	0.02	0.01	0.02
% CrO_4^{2-} in BaCrO_4	48.30	47.91	48.30	49.08	47.91	47.91
$[\text{Ba}^{2+}]_{\text{supernatant}}$	1757	1779	1768	1757	1745	1757
% Barium excess	31.97	32.39	32.18	31.97	31.77	31.97
$[\text{QUAT}]_{\text{supernatant}}$	18357	18289	18205	18357	18323	18357
% QUAT	28.39	28.28	28.15	28.39	28.33	28.39

APPENDIX C.1A Summary of the effect of flow rate on the precipitation
on the precipitation

Condition : Flow rate 4 - 14 mL/min
 Height 83 cm

Flow rate mL/min		[QUAT]			
		0 M	0.2 M	0.3 M	0.4 M
4	% BaCrO ₄ particle	0.66	1.43	1.31	0.24
	% Chromate	0.02	0.01	0.01	0.00
	% QUAT	-	23.09	12.36	3.81
6	% BaCrO ₄ particle	0.94	8.12	2.08	0.24
	% Chromate	0.01	0.02	0.01	0.01
	% QUAT	-	32.23	12.61	4.11
8	% BaCrO ₄ particle	1.55	26.64	12.09	3.2
	% Chromate	0.01	0.02	0.01	0.01
	% QUAT	-	36.96	20.52	6.02
10	% BaCrO ₄ particle	2.09	31.49	41.24	19.68
	% Chromate	0.01	0.02	0.02	0.01
	% QUAT	-	39.13	35.35	12.17
12	% BaCrO ₄ particle	2.17	38.84	43.18	44.04
	% Chromate	0.01	0.01	0.02	0.02
	% QUAT	-	39.62	36.36	27.92
14	% BaCrO ₄ particle	2.23	39.5	43.88	47.91
	% Chromate	0.02	0.01	0.01	0.02
	% QUAT	-	39.59	36.74	28.39

APPENDIX C.2 Effect of concentration ratio on the precipitation

Condition :	[QUAT]	0, 0.2, 0.3, and 0.4	M
	$[\text{CrO}_4^{2-}]_{\text{initial}}$	0.02	M
	$[\text{Ba}^{2+}]_{\text{initial}}$	0.02, 0.03, 0.04, and 0.05	M
	Flow rate	14	mL/min
	Height	83	cm

$[\text{Ba}^{2+}]/[\text{CrO}_4^{2-}]$	$[\text{CrO}_4^{2-}]_{\text{supernatant}}$, ppm			
	[QUAT] 0 M	[QUAT] 0.2 M	[QUAT] 0.3 M	[QUAT] 0.4 M
1	1.18	3.63	5.55	6.68
1.5	0.62	2.36	2.74	3.43
2	0.38	0.30	0.31	0.39
2.5	0.22	0.26	0.28	0.26

$[\text{Ba}^{2+}]/[\text{CrO}_4^{2-}]$	% Chromate			
	[QUAT] 0 M	[QUAT] 0.2 M	[QUAT] 0.3 M	[QUAT] 0.4 M
1	0.05	0.16	0.24	0.29
1.5	0.03	0.10	0.12	0.15
2	0.02	0.01	0.01	0.02
2.5	0.01	0.01	0.01	0.01

$$\% \text{CrO}_4^{2-} = \left(\frac{[\text{CrO}_4^{2-}]_{\text{supernatant}}}{[\text{CrO}_4^{2-}]_{\text{initial}}} \right) \times 100$$

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