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APPENDICES

APPENDIX A Experimental data for C8 adsorption study on carbon black.

Weight of carbon black = 2.5 g
 Volume of solution = 20 ml
 Temperature = 30°C
 pH = 9

Table A1 Data for C8 adsorption on carbon black without calcium addition.

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Different C8 concentration (μM)	C8 adsorption (μmole/m ²)
1925.00	1689.20	235.80	0.0246
2891.67	2353.95	537.72	0.0560
3863.02	2905.25	957.77	0.0998
7729.17	5653.09	2076.07	0.2163
8682.29	5923.05	2759.24	0.2874
10244.79	7337.93	2906.86	0.3028
19942.71	14979.51	4963.20	0.5170
37619.79	28366.43	9253.36	0.9639
49619.79	37626.48	11993.32	1.2493
61666.67	50286.02	11380.64	1.1855
69114.58	55400.90	13713.68	1.4285
78229.17	62775.32	15453.85	1.6098
87604.17	72211.67	15392.50	1.6034
97395.83	80397.84	16997.99	1.7706
117031.25	99700.15	17331.10	1.8053
136718.75	112481.02	24237.73	2.5248
175156.25	151189.39	23966.86	2.4965
198177.08	168659.69	29517.40	3.0747
248203.13	219970.99	28232.13	2.9408
299739.58	254677.87	45061.71	4.6939
385937.50	355063.22	30874.28	3.2161
593229.17	524894.98	68334.18	7.1181
682812.50	621255.33	61557.17	6.4122

Table A2 Data for C8 adsorption on carbon black at the initial calcium concentration 100 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Different C8 concentration (μM)	C8 adsorption ($\mu\text{mole}/\text{m}^2$)
961.04	746.02	215.02	0.0224
1912.50	1419.32	493.18	0.0514
2854.17	1971.09	883.07	0.0920
3918.75	2975.23	943.52	0.0983
4824.48	3211.66	1612.82	0.1680
5614.58	3849.47	1765.11	0.1839
6687.50	5023.20	1664.30	0.1734
7651.04	5723.08	1927.96	0.2008
8546.88	6103.03	2443.84	0.2546
9546.88	6687.97	2858.90	0.2978
20171.88	16410.23	3761.65	0.3918
29661.46	22414.69	7246.76	0.7549
39416.67	31270.55	8146.12	0.8486
48088.54	37145.56	10942.98	1.1399
58541.67	47242.98	11298.69	1.1769
67760.42	54197.25	13563.17	1.4128
77291.67	61621.26	15670.40	1.6323
87447.92	68797.85	18650.06	1.9427
97552.08	77132.90	20419.19	2.1270
113593.75	91654.61	21939.14	2.2853
134895.83	106995.03	27900.80	2.9063
158177.08	129051.37	29125.72	3.0339
177239.58	147077.11	30162.47	3.1419
198958.33	166159.13	32799.20	3.4166

Table A3 Data for C8 adsorption on carbon black at the initial calcium concentration 700 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Different C8 concentration (μM)	C8 adsorption ($\mu\text{mole}/\text{m}^2$)
944.79	300.54	644.26	0.0671
1838.54	711.54	1127.01	0.1174
2832.29	1365.34	1466.95	0.1528
5526.04	3630.53	1895.51	0.1974
7541.67	5203.17	2338.50	0.2436
9380.21	6313.01	3067.20	0.3195
12281.25	7472.92	4808.33	0.5009
16130.21	10483.12	5647.09	0.5882
20541.67	14774.42	5767.25	0.6008
29765.63	22459.74	7305.89	0.7610
38848.96	30309.13	8539.83	0.8896

Table A4 Data for C8 adsorption on carbon black at the initial calcium concentration 1000 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Different C8 concentration (μM)	C8 adsorption ($\mu\text{mole}/\text{m}^2$)
1958.33	676.02	1282.31	0.1336
4092.19	1946.71	2145.47	0.2235
4968.23	2458.14	2510.09	0.2615
5796.88	2875.98	2920.90	0.3043
12567.71	6685.84	5881.87	0.6127
16854.17	9825.31	7028.86	0.7322
19958.33	11959.89	7998.45	0.8332
29895.83	20889.68	9006.15	0.9381

Table A5 Data for the amount of adsorbed calcium on carbon black from C8 adsorption study at the initial calcium concentration 100 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Equilibrium calcium concentration (μM)	Calcium adsorption ($\mu\text{mole/m}^2$)
0	0	96.25	0.0004
961.04	746.02	51.25	0.0051
1912.50	1419.32	27.50	0.0076
2854.17	1971.09	26.25	0.0077
3918.75	2975.23	23.75	0.0079
4824.48	3211.66	27.50	0.0076
5614.58	3849.47	26.25	0.0077
6687.50	5023.20	43.75	0.0059
7651.04	5723.08	26.25	0.0077
8546.88	6103.03	25.00	0.0078
9546.88	6687.97	23.75	0.0079
20171.88	16410.23	23.75	0.0079
29661.46	22414.69	18.75	0.0085
39416.67	31270.55	21.25	0.0082
48088.54	37145.56	20.00	0.0083
58541.67	47242.98	18.75	0.0085
67760.42	54197.25	17.50	0.0086
77291.67	61621.26	15.00	0.0089
87447.92	68797.85	16.25	0.0087
97552.08	77132.90	15.00	0.0089
113593.75	91654.61	15.00	0.0089
134895.83	106995.03	12.50	0.0091
158177.08	129051.37	11.25	0.0092
177239.58	147077.11	11.25	0.0092
198958.33	166159.13	11.25	0.0092

Table A6 Data for the amount of adsorbed calcium on carbon black from C8 adsorption study at the initial calcium concentration 700 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Equilibrium calcium concentration (μM)	Calcium Adsorption ($\mu\text{mole/m}^2$)
0	0	463.50	0.0338
944.79	300.54	32.50	0.0787
1838.54	711.54	23.25	0.0797
2832.29	1365.34	22.75	0.0797
5526.04	3630.53	42.25	0.0777
7541.67	5203.17	22.00	0.0798
9380.21	6313.01	43.00	0.0776
12281.25	7472.92	20.00	0.0800
16130.21	10483.12	21.50	0.0798
20541.67	14774.42	20.25	0.0800
29765.63	22459.74	26.25	0.0793
38848.96	30309.13	20.25	0.0800

Table A7 Data for the amount of adsorbed calcium on carbon black from C8 adsorption study at the initial calcium concentration 1000 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Equilibrium calcium concentration (μM)	Calcium adsorption ($\mu\text{mole/m}^2$)
0	0	53.13	0.0986
1958.33	676.02	34.50	0.1006
4092.19	1946.71	33.25	0.1007
4968.23	2458.14	34.75	0.1005
5796.88	2875.98	57.75	0.0982
12567.71	6685.84	83.00	0.0955
16854.17	9825.31	58.25	0.0981
19958.33	11959.89	52.25	0.0987
29895.83	20889.68	31.50	0.1009

APPENDIX B

Experimental data for C8 adsorption study on paper fiber.

Weight of dry paper fiber = 1.0 g
 Volume of solution = 25 ml
 Temperature = 30°C
 pH = 9

Table B1 Data for C8 adsorption on paper fiber without calcium addition.

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Different C8 concentration (μM)	Adsorption (μmole/m ²)
571.56	128.13	443.44	0.1109
2043.75	1462.50	581.25	0.1453
3081.25	2470.83	610.42	0.1526
4064.58	3603.13	461.46	0.1154
5126.04	4366.67	759.38	0.1898
6682.29	5755.21	927.08	0.2318
8760.42	7668.75	1091.67	0.2729
10217.71	9242.71	975.00	0.2438
17942.71	16008.33	1934.38	0.4836
21369.79	19273.96	2095.83	0.5240
31614.58	29081.25	2533.33	0.6333
42343.75	39055.21	3288.54	0.8221
61119.79	54263.54	6856.25	1.7141
81093.75	72362.50	8731.25	2.1828
97812.50	90826.04	6986.46	1.7466
118489.58	107753.13	10736.46	2.6841
155963.54	144367.71	11595.83	2.8990
195104.17	183013.54	12090.63	3.0227
295104.17	279576.04	15528.12	3.8820
388593.75	364419.79	24173.96	6.0435
476093.75	443326.04	32767.71	8.1919
568750.00	536242.71	32507.29	8.1268
684895.83	653638.54	31257.29	7.8143
775937.50	744471.88	31465.63	7.8664

Table B2 Data for C8 adsorption on paper fiber at the initial calcium concentration 1000 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Different C8 concentration (μM)	Adsorption ($\mu\text{mole}/\text{m}^2$)
1060.42	257.29	803.13	0.2008
2043.75	1192.71	851.04	0.2128
4022.92	2884.38	1138.54	0.2846
6029.17	5061.46	967.71	0.2419
7898.96	6827.08	1071.88	0.2680
9876.04	8807.29	1068.75	0.2672
15437.50	13817.71	1619.79	0.4049
20281.25	18130.21	2151.04	0.5378
24510.42	21755.21	2755.21	0.6888
30604.17	26796.88	3807.29	0.9518
34135.42	30630.21	3505.21	0.8763

Table B3 Data for C8 adsorption on paper fiber at the initial calcium concentration 2000 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Different C8 concentration (μM)	Adsorption ($\mu\text{mole}/\text{m}^2$)
1079.17	419.79	659.38	0.1648
2054.17	1358.33	695.83	0.1740
3072.92	2370.83	702.08	0.1755
4084.38	3257.29	827.08	0.2068
6007.29	4872.92	1134.38	0.2836
7878.13	7035.42	842.71	0.2107
9917.71	8723.96	1193.75	0.2984

Table B4 Data for the amount of adsorbed calcium on paper fiber from C8 adsorption study at the initial calcium concentration 1000 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Equilibrium calcium concentration (μM)	Calcium adsorption ($\mu\text{mole}/\text{m}^2$)
0	0	648.1250	0.0919
1060.42	257.29	711.2500	0.0761
2043.75	1192.71	746.8750	0.0672
4022.92	2884.38	751.2500	0.0661
6029.17	5061.46	790.6250	0.0563
7898.96	6827.08	795.6250	0.0550
9876.04	8807.29	803.7500	0.0530
15437.50	13817.71	801.2500	0.0536
20281.25	18130.21	900.6250	0.0288
24510.42	21755.21	956.2500	0.0148
30604.17	26796.88	965.0000	0.0127
34135.42	30630.21	963.1250	0.0131

Table B5 Data for the amount of adsorbed calcium on paper fiber from C8 adsorption study at the initial calcium concentration 2000 μM .

Initial C8 concentration (μM)	Equilibrium C8 concentration (μM)	Equilibrium calcium concentration (μM)	Calcium adsorption ($\mu\text{mole}/\text{m}^2$)
0	0	1606.8750	0.1405
1079.17	419.79	1775.6250	0.0983
2054.17	1358.33	1808.1250	0.0902
3072.92	2370.83	1810.6250	0.0895
4084.38	3257.29	1840.6250	0.0820
6007.29	4872.92	1843.1250	0.0814
7878.13	7035.42	1823.1250	0.0864
9917.71	8723.96	1854.3750	0.0786

APPENDIX C

Experimental data for calcium adsorption on carbon black.

Weight of carbon black = 2.5 g
 Volume of solution = 20 ml
 Temperature = 30°C
 pH = 9

Table C1 Data for calcium adsorption on carbon black without C8 addition.

Initial calcium concentration (μM)	Final calcium concentration (μM)	Different calcium concentration (μM)	Adsorption (μmole/m ²)
1027.50	53.13	974.38	0.1015
1268.13	76.88	1191.25	0.1241
1523.75	46.88	1476.88	0.1538
2293.75	468.75	1825.00	0.1901
4100.00	1175.00	2925.00	0.3047
5800.00	1737.50	4062.50	0.4232
7287.50	2850.00	4437.50	0.4622
9337.50	4175.00	5162.50	0.5378
11300.00	5093.75	6206.25	0.6465
12925.00	6593.75	6331.25	0.6595
15400.00	7800.00	7600.00	0.7917
16443.75	9262.50	7181.25	0.7480
19337.50	11812.50	7525.00	0.7839
21637.50	13912.50	7725.00	0.8047
23537.50	15768.75	7768.75	0.8092
26662.50	18550.00	8112.50	0.8451
28675.00	20237.50	8437.50	0.8789
30687.50	22360.00	8327.50	0.8674
32712.50	24062.50	8650.00	0.9010
34687.50	26262.50	8425.00	0.8776

Table C2 Data for calcium adsorption on carbon black at the initial C8 concentration 100 μM .

Initial calcium concentration (μM)	Final calcium concentration (μM)	Different calcium concentration (μM)	Adsorption ($\mu\text{mole/m}^2$)
638.75	81.25	557.50	0.0581
1192.19	51.88	1140.31	0.1188
2681.25	506.25	2175.00	0.2266
4656.25	687.50	3968.75	0.4134
6468.75	2475.00	3993.75	0.4160
8525.00	2962.50	5562.50	0.5794
10350.00	4900.00	5450.00	0.5677
14862.50	8206.25	6656.25	0.6934
19368.75	12300.00	7068.75	0.7363
23562.50	15575.00	7987.50	0.8320
27625.00	19325.00	8300.00	0.8646
31687.50	22837.50	8850.00	0.9219
35587.50	26937.50	8650.00	0.9010

Table C3 Data for calcium adsorption on carbon black at the initial C8 concentration 500 μM .

Initial calcium concentration (μM)	Final calcium concentration (μM)	Different calcium concentration (μM)	Adsorption ($\mu\text{mole/m}^2$)
571.88	105.00	466.88	0.0486
1026.25	93.75	932.50	0.0971
2068.75	150.00	1918.75	0.1999
4500.00	1143.75	3356.25	0.3496
6031.25	1337.50	4693.75	0.4889
8443.75	2381.25	6062.50	0.6315
10275.00	3468.75	6806.25	0.7090
15143.75	6987.50	8156.25	0.8496
18568.75	9500.00	9068.75	0.9447
22487.50	12812.50	9675.00	1.0078
26475.00	16887.50	9587.50	0.9987
30700.00	20712.50	9987.50	1.0404
34300.00	24700.00	9600.00	1.0000

Table C4 Data for calcium adsorption on carbon black at the initial C8 concentration 1000 μM .

Initial calcium concentration (μM)	Final calcium concentration (μM)	Different calcium concentration (μM)	Adsorption ($\mu\text{mole/m}^2$)
540.00	93.75	446.25	0.0465
1039.38	88.13	951.25	0.0991
2062.50	175.00	1887.50	0.1966
4212.50	618.75	3593.75	0.3743
5981.25	1362.50	4618.75	0.4811
7900.00	1712.50	6187.50	0.6445
10056.25	3012.50	7043.75	0.7337
14487.50	5675.00	8812.50	0.9180
18506.25	8937.50	9568.75	0.9967
22175.00	12162.50	10012.50	1.0430
26462.50	16237.50	10225.00	1.0651
30075.00	19687.50	10387.50	1.0820
34800.00	24600.00	10200.00	1.0625

Table C5 Data for the amount of adsorbed C8 on carbon black from calcium adsorption study at the initial C8 concentration 500 μM .

Initial calcium concentration (μM)	Equilibrium calcium concentration (μM)	Equilibrium C8 concentration (μM)	C8 adsorption ($\mu\text{mole}/\text{m}^2$)
2068.75	150.00	423.96	0.0079
8443.75	2381.25	289.38	0.0219
10275.00	3468.75	220.42	0.0291
15143.75	6987.50	167.60	0.0346
18568.75	9500.00	154.79	0.0360
22487.50	12812.50	126.77	0.0389
26475.00	16887.50	168.23	0.0346
30700.00	20712.50	126.56	0.0389
34300.00	24700.00	130.00	0.0385

Table C6 Data for the amount of adsorbed C8 on carbon black from calcium adsorption study at the initial C8 concentration 1000 μM .

Initial calcium concentration (μM)	Equilibrium calcium concentration (μM)	Equilibrium C8 concentration (μM)	C8 adsorption ($\mu\text{mole}/\text{m}^2$)
540.00	93.75	814.27	0.0180
4212.50	618.75	697.29	0.0302
5981.25	1362.50	428.33	0.0582
7900.00	1712.50	413.75	0.0598
10056.25	3012.50	308.85	0.0707
14487.50	5675.00	249.90	0.0768
18506.25	8937.50	220.10	0.0799
22175.00	12162.50	186.88	0.0834
26462.50	16237.50	200.94	0.0819
30075.00	19687.50	201.46	0.0819
34800.00	24600.00	167.40	0.0854

APPENDIX D

Experimental data for calcium adsorption on paper fiber.

Weight of dry paper fiber = 1.0 g
 Volume of solution = 25 ml
 Temperature = 30°C
 pH = 9

Table D1 Data for calcium adsorption on paper fiber without C8 addition.

Initial calcium concentration (μM)	Equilibrium calcium concentration (μM)	Different calcium concentration (μM)	Adsorption ($\mu\text{mole}/\text{m}^2$)
565.00	224.38	340.63	0.0852
1079.38	590.00	489.38	0.1223
2793.75	1446.88	1346.88	0.3367
4925.00	3889.38	3478.13	0.8695
9018.75	6551.88	2466.88	0.6167
13056.25	9595.63	3460.63	0.8652
17925.00	12339.38	5585.63	1.3964
22350.00	15576.88	6773.13	1.6933
26987.50	19564.38	7423.13	1.8558
33937.50	24889.38	9048.13	2.2620
43462.50	35514.38	7948.13	1.9870

Table D2 Data for calcium adsorption on paper fiber at the initial C8 concentration 500 μM .

Initial calcium concentration (μM)	Equilibrium calcium concentration (μM)	Different calcium concentration (μM)	Adsorption ($\mu\text{mole}/\text{m}^2$)
980.00	430.00	550.00	0.1375
2806.25	1192.50	1613.75	0.4034
4518.75	2797.50	1721.25	0.4303
8643.75	6053.75	2590.00	0.6475
12331.25	9728.75	2602.50	0.6506
17737.50	14066.25	3671.25	0.9178
21087.50	16141.25	4946.25	1.2366
30137.50	24741.25	5396.25	1.3491
40675.00	34478.75	6196.25	1.5491

Table D3 Data for calcium adsorption on paper fiber at the initial C8 concentration 1000 μM .

Initial calcium concentration (μM)	Equilibrium calcium concentration (μM)	Different calcium concentration (μM)	Adsorption ($\mu\text{mole}/\text{m}^2$)
1136.25	468.13	668.13	0.1670
2406.25	1071.88	1334.38	0.3336
4100.00	2269.38	1830.63	0.4577
8262.50	6056.88	2205.63	0.5514
12775.00	10281.88	2493.13	0.6233
15881.25	12738.13	3143.13	0.7858
20425.00	16600.63	3824.38	0.9561
40612.50	37238.13	3374.38	0.8436

Table D4 Data for the amount of adsorbed C8 on paper fiber from calcium adsorption study at the initial C8 concentration 500 μM .

Initial calcium concentration (μM)	Equilibrium calcium concentration (μM)	Equilibrium C8 concentration (μM)	C8 adsorption ($\mu\text{mole/m}^2$)
980.00	430.00	54.17	0.0464
2806.25	1192.50	93.75	0.0423
4518.75	2797.50	180.21	0.0333
8643.75	6053.75	223.96	0.0288
12331.25	9728.75	235.42	0.0276
17737.50	14066.25	275.00	0.0234
21087.50	16141.25	411.46	0.0092
30137.50	24741.25	437.50	0.0065

Table D5 Data for the amount of adsorbed C8 on paper fiber from calcium adsorption study at the initial C8 concentration 1000 μM .

Initial calcium concentration (μM)	Equilibrium calcium concentration (μM)	Equilibrium C8 concentration (μM)	C8 adsorption ($\mu\text{mole/m}^2$)
1136.25	468.13	668.75	0.0557
2406.25	1071.88	797.92	0.0422
4100.00	2269.38	813.54	0.0406
8262.50	6056.88	836.46	0.0382
12775.00	10281.88	892.71	0.0323
15881.25	12738.13	931.25	0.0283
20425.00	16600.63	1042.71	0.0167
40612.50	37238.13	1046.88	0.0163

APPENDIX E

Experimental data for zeta potential of carbon black.

Weight of carbon black = 1.5 mg
 Volume of solution = 40 ml
 Temperature = 30°C
 pH = 9

Table E1 Data for zeta potential of carbon black with varying C8 concentration and without calcium addition.

C8 Concentration (μM)	651.46	1179.17	2377.08	3566.67	4732.29	7296.88	
(-) Zeta potential (mV)	1	42.4	42.7	39.7	39.7	39.6	37.5
	2	42.6	44.0	40.0	43.4	39.3	37.9
	3	44.8	40.5	41.9	38.2	41.3	39.4
	4	45.6	42.1	38.8	40.6	40.3	38.5
	5	45.9	42.6	40.1	41.7	41.9	37.2
	6	42.1	41.9	38.7	39.1	40.4	41.1
	7	42.0	41.8	41.1	42.4	38.9	38.0
	8	44.1	44.7	39.0	40.4	38.6	40.4
	9	44.0	41.2	41.9	40.0	41.4	38.9
	10	39.7	42.7	38.6	39.1	38.5	37.4
	11	42.2	41.4	40.3	38.9	40.4	39.9
	12	43.5	40.5	38.9	38.5	41.4	40.5
Average zeta potential (mV)	43.2	42.2	39.9	40.2	40.2	38.9	
Standard deviation	1.68	1.22	1.15	1.55	1.13	1.29	

Table E2 Data for zeta potential of carbon black with varying C8 concentration and the initial calcium concentration 100 μM .

C ₈ Concentration (μM)		557.81	1134.38	2212.50	3356.25	4451.04	6329.17	12437.50
(-) Zeta potential (mV)	1	36.2	34.4	36.2	33.7	28.3	33.3	32.4
	2	37.9	35.9	36.1	32.7	31.7	28.5	31.5
	3	35.8	37.5	34.6	34.7	30.5	29.1	29.5
	4	36.2	38.3	36.7	35.0	30.0	30.3	29.1
	5	33.6	33.3	34.9	34.6	30.0	29.6	32.5
	6	36.3	37.4	33.7	32.7	31.9	31.2	30.0
	7	38.7	37.7	35.1	33.4	32.4	32.1	29.1
	8	37.7	36.5	34.8	38.4	28.9	31.6	28.4
	9	35.5	36.9	39.2	35.4	28.0	33.1	28.2
	10	37.6	36.5	33.7	34.7	31.9	30.4	31.8
	11	38.7	34.4	33.9	32.6	32.3	30.4	29.8
	12	39.3	36.3	32.8	36.9	31.5	29.4	29.5
Average zeta potential (mV)		37.0	36.3	35.1	34.6	30.6	30.8	30.2
Standard deviation		1.57	1.46	1.65	1.68	1.51	1.48	1.45

Table E3 Data for zeta potential of carbon black with varying C8 concentration and the initial calcium concentration 700 μM .

C8 Concentration (μM)		644.90	1190.63	2380.21	3577.08	4779.17	8177.08	14114.58	17302.08
(-) Zeta potential (mV)	1	28.0	27.6	29.4	26.1	25.0	21.0	20.2	20.5
	2	29.3	29.8	28.6	23.1	20.3	25.0	22.6	19.2
	3	31.8	30.9	30.6	25.3	23.7	22.5	21.8	19.9
	4	30.0	28.3	28.0	25.0	23.9	25.0	20.9	21.2
	5	32.8	27.7	26.2	23.6	21.6	23.2	21.4	20.0
	6	32.2	27.3	30.7	23.9	23.0	22.6	23.6	18.6
	7	30.0	30.2	28.8	24.5	21.2	23.0	20.7	21.5
	8	30.9	30.9	28.3	25.0	20.6	22.1	20.0	20.9
	9	31.4	29.1	26.0	27.1	23.2	26.0	21.9	22.7
	10	31.9	28.8	31.2	25.9	21.5	21.0	20.2	20.4
	11	30.4	27.1	28.6	26.2	24.4	22.5	19.6	21.6
	12	28.8	26.8	29.9	25.8	21.8	21.6	21.0	23.5
Average zeta potential (mV)		30.6	28.7	28.9	25.1	22.5	23.0	21.2	20.8
Standard deviation		1.41	1.41	1.57	1.13	1.48	1.54	1.12	1.33

Table E4 Data for zeta potential of carbon black with varying C8 concentration and the initial calcium concentration 1000 μM .

C8 Concentration (μM)	606.77	1213.54	2375.00	3588.54	7113.54	9411.46
(-) Zeta potential (mV)						
1	19.1	17.1	17.1	10.9	12.2	10.3
2	22.8	21.0	19.4	14.1	11.0	12.8
3	20.7	20.0	20.3	12.3	11.8	11.3
4	22.3	20.4	20.1	13.3	11.0	10.2
5	20.8	18.2	20.3	11.0	9.67	10.5
6	20.6	16.8	19.0	11.3	14.7	13.5
7	20.3	19.4	17.1	10.7	10.7	10.6
8	19.5	17.7	20.3	11.7	11.0	12.1
9	20.0	18.2	17.7	14.0	10.1	11.3
10	22.7	20.8	18.2	12.6	10.5	14.3
11	19.5	18.0	19.5	10.8	9.21	11.2
12	24.2	18.6	16.6	13.8	11.2	9.95
Average zeta potential (mV)	21.0	18.9	18.8	12.2	11.1	11.5
Standard deviation	1.53	1.37	1.34	1.26	1.35	1.34

Table E5 Data for zeta potential of carbon black with varying calcium concentration and the initial C8 concentration 0 μM .

Calcium concentration (μM)		100	200	400	800	1000	2000
(-) Zeta potential (mV)	1	29.0	24.6	20.0	15.7	14.2	14.7
	2	29.4	26.1	19.5	15.4	12.6	13.6
	3	26.2	27.1	17.8	16.2	15.9	14.0
	4	27.0	24.8	16.0	14.5	16.8	14.2
	5	27.2	25.4	18.8	15.4	14.3	12.9
	6	26.3	25.9	19.6	14.7	16.1	13.5
	7	27.3	24.6	20.1	16.6	15.4	12.2
	8	29.2	24.0	20.3	17.4	16.8	14.3
	9	26.2	26.7	16.9	14.4	14.3	12.5
	10	26.8	25.1	18.0	15.9	15.7	14.7
	11	28.7	24.6	20.1	16.0	12.2	15.9
	12	26.1	24.4	17.6	14.2	14.4	12.5
Average zeta potential (mV)		27.5	25.3	18.7	15.5	14.9	13.8
Standard deviation		1.22	0.93	1.38	0.93	1.43	1.05

Table E6 Data for zeta potential of carbon black with varying calcium concentration and the initial C8 concentration 100 μM .

Calcium concentration (μM)		100	200	400	800	1000	2000
(-) Zeta potential (mV)	1	27.4	22.1	20.5	13.3	14.2	14.9
	2	27.3	19.4	19.1	13.6	16.9	13.6
	3	25.3	20.2	18.1	16.6	15.6	14.0
	4	25.1	21.0	20.0	13.4	15.1	12.9
	5	25.4	22.9	20.3	15.6	14.2	10.5
	6	24.3	22.2	17.7	16.4	14.6	10.7
	7	24.2	22.7	21.0	12.4	14.4	10.9
	8	27.4	19.0	19.1	16.7	15.0	12.5
	9	23.3	19.1	20.8	14.8	16.1	13.4
	10	25.8	22.0	20.0	15.9	14.1	13.6
	11	23.9	20.2	19.2	14.8	12.4	11.9
	12	23.3	22.0	18.0	14.2	15.6	12.0
Average zeta potential (mV)		25.2	21.1	19.5	14.8	14.9	12.6
Standard deviation		1.45	1.37	1.08	1.39	1.10	1.35

Table E7 Data for zeta potential of carbon black with varying calcium concentration and the initial C8 concentration 500 μM .

Calcium concentration (μM)		100	200	400	800	1000	2000
(-) Zeta potential (mV)	1	22.9	20.0	21.0	18.0	14.7	13.8
	2	25.4	24.3	19.3	14.9	14.7	12.4
	3	21.3	22.1	21.2	15.4	15.9	11.1
	4	24.8	22.4	18.2	15.8	11.1	11.6
	5	25.4	22.0	19.7	19.7	15.0	11.3
	6	26.2	23.9	17.5	18.6	14.2	13.7
	7	25.3	20.9	17.3	14.0	14.4	12.8
	8	25.2	24.8	20.5	18.7	13.9	11.4
	9	25.9	22.5	17.7	15.7	14.8	14.5
	10	24.1	21.2	22.0	15.9	15.0	13.0
	11	23.7	24.1	20.2	16.4	15.1	14.1
	12	24.4	19.9	20.9	15.9	14.3	12.6
Average zeta potential (mV)		24.6	22.3	19.6	16.6	14.4	12.7
Standard deviation		1.33	1.59	1.54	1.67	1.12	1.12

Table E8 Data for zeta potential of carbon black with varying calcium concentration and the initial C8 concentration 1000 μM .

Calcium concentration (μM)		100	200	400	800	1000	2000
(-) Zeta potential (mV)	1	26.2	23.0	16.6	11.7	12.0	11.0
	2	24.0	21.0	18.4	11.0	11.6	9.7
	3	25.2	19.8	15.1	12.4	11.4	11.1
	4	24.0	19.2	16.6	12.7	10.0	12.2
	5	23.2	20.1	18.6	13.2	12.3	11.5
	6	25.0	19.6	13.8	11.3	10.3	11.0
	7	20.5	21.0	13.9	14.4	10.3	12.8
	8	22.1	20.5	18.4	13.0	11.0	10.2
	9	23.8	18.0	15.1	12.8	12.0	11.6
	10	23.7	19.8	18.0	12.4	11.1	12.4
	11	24.0	20.3	17.2	11.9	11.4	12.2
	12	25.2	19.9	15.9	11.7	11.6	11.3
Average zeta potential (mV)		23.9	20.2	16.5	12.4	11.2	11.4
Standard deviation		1.45	1.15	1.65	0.90	0.71	0.87

APPENDIX F

Experimental data for zeta potential of paper fiber.

Weight of paper fiber = 1.0 g
 Volume of solution = 40 ml
 Temperature = 30°C
 pH = 9

Table F1 Data for zeta potential of paper fiber with varying C8 concentration and without calcium addition.

C8 Concentration (μM)		0.0	135.5	328.7	530.2	843.7	1071.9	2128.1	3127.1	4200.0	5156.3
(-) Zeta potential (mV)	1	31.0	26.0	26.7	22.0	22.3	20.5	21.3	20.7	20.6	21.9
	2	28.9	27.8	28.0	21.1	19.4	21.6	20.4	20.1	19.1	19.6
	3	33.2	28.1	27.1	24.5	19.7	19.8	20.3	19.6	20.3	20.1
	4	30.1	26.4	24.6	19.4	20.2	19.4	20.5	20.9	20.7	19.8
	5	29.1	26.0	26.7	21.3	19.0	17.7	19.1	21.9	20.5	20.8
	6	29.5	29.1	28.1	21.4	20.4	19.2	18.1	22.1	19.2	21.5
	7	30.8	27.8	27.2	24.0	19.3	17.7	20.6	20.7	18.6	21.4
	8	30.2	27.2	27.9	20.9	20.8	18.8	19.5	18.7	19.7	19.3
	9	31.2	28.9	24.8	20.8	18.7	19.0	17.8	19.8	19.0	20.9
	10	28.9	27.4	27.6	22.8	18.9	21.4	17.5	20.1	19.4	19.9
	11	30.4	27.2	25.5	20.7	20.2	17.1	17.2	21.9	20.8	20.9
	12	31.1	27.7	24.7	21.6	19.0	17.7	18.5	19.1	20.9	19.1
Average zeta potential (mV)		30.4	27.5	25.0	21.7	19.8	19.2	19.2	20.5	19.9	20.4
Standard deviation		1.18	0.96	1.35	1.38	0.98	1.42	1.33	1.06	0.78	0.88

Table F2 Data for zeta potential of paper fiber with varying C8 concentration and the initial calcium concentration 500 μM .

C8 Concentration (μM)		0.00	100.03	209.90	410.31	623.75	844.90	1044.79
(-) Zeta potential (mV)	1	21.2	15.8	13.3	10.8	10.7	11.2	11.7
	2	17.1	17.2	12.0	10.5	10.0	8.2	10.4
	3	18.0	15.4	13.3	10.3	10.8	11.6	12.5
	4	18.4	16.4	12.5	10.9	10.0	11.7	8.3
	5	19.3	14.7	9.7	10.6	10.6	10.5	11.0
	6	17.7	17.7	9.7	10.4	12.1	9.6	8.7
	7	18.5	15.6	12.0	9.9	10.0	8.9	7.7
	8	18.6	14.7	11.2	9.4	10.8	8.4	8.8
	9	20.6	15.8	10.2	10.8	9.4	11.5	8.8
	10	20.0	16.9	9.6	13.9	10.9	10.6	8.9
	11	18.8	14.7	9.5	11.3	10.3	9.9	9.4
	12	19.2	15.6	10.0	11.7	12.1	9.4	9.4
Average zeta potential (mV)		19.0	15.9	11.1	10.9	10.6	10.1	9.6
Standard deviation		1.14	0.95	1.42	1.08	0.78	1.20	1.40

Table F3 Data for zeta potential of paper fiber with varying C8 concentration and the initial calcium concentration 1000 μM .

C8 Concentration (μM)	0.00	90.99	206.15	405.31	642.50	827.40	1054.17
(-) Zeta potential (mV)							
1	15.7	14.4	12.2	11.7	10.0	10.2	11.6
2	15.6	14.0	11.5	12.6	10.5	11.0	9.6
3	16.2	12.6	11.3	11.9	9.4	9.6	10.2
4	15.6	12.9	10.0	10.8	9.0	9.3	11.1
5	14.7	13.5	12.6	12.1	10.8	8.4	12.0
6	14.3	15.0	11.5	12.0	10.6	8.7	11.5
7	16.6	14.7	13.0	10.6	9.8	10.1	10.3
8	15.0	13.9	13.9	10.8	10.1	8.6	9.5
9	17.2	15.8	12.5	10.6	11.7	10.2	9.4
10	16.8	12.9	12.0	11.2	11.2	9.4	8.8
11	16.2	14.4	11.4	10.1	8.7	11.4	8.4
12	14.7	13.8	12.6	10.0	10.4	9.4	9.8
Average zeta potential (mV)	15.7	14.0	12.0	11.2	10.2	9.7	10.2
Standard deviation	0.88	0.90	0.96	0.81	0.86	0.89	1.11

Table F4 Data for zeta potential of paper fiber with varying calcium concentration and the initial C8 concentration 0 μM .

Calcium concentration (μM)	0.00	100.00	200.00	400.00	600.00	800.00	1000.00	
(-) Zeta potential (mV)	1	31.0	26.2	20.4	15.4	15.5	16.0	15.7
	2	28.9	23.2	19.0	16.2	14.4	15.6	15.6
	3	33.2	25.5	19.9	17.7	14.2	14.4	16.2
	4	30.1	23.9	17.7	18.3	16.1	15.2	15.6
	5	29.1	24.1	19.3	18.5	18.1	13.0	14.7
	6	29.5	24.6	19.4	17.7	16.7	12.9	14.3
	7	30.8	25.0	18.1	17.4	14.5	15.1	16.6
	8	30.2	26.5	20.5	16.9	14.3	15.7	15.0
	9	31.2	26.3	21.1	17.8	14.4	16.9	17.2
	10	28.9	24.4	19.4	15.6	14.5	15.0	16.8
	11	30.4	24.6	20.0	15.4	15.3	15.1	16.2
	12	31.1	23.9	19.5	16.7	16.3	16.3	14.7
Average zeta potential (mV)	30.4	24.9	19.5	17.0	15.4	15.1	15.7	
Standard deviation	1.18	1.02	0.93	1.06	1.17	1.15	0.88	

Table F5 Data for zeta potential of paper fiber with varying calcium concentration and the initial C8 concentration 500 μM .

Calcium concentration (μM)		0	100	200	400	600	800	1000
(-) Zeta potential (mV)	1	23.7	17.0	18.1	14.5	8.9	9.2	9.5
	2	24.0	17.2	16.4	12.5	8.8	10.7	10.0
	3	20.8	16.3	16.5	13.2	9.7	8.4	9.3
	4	23.0	18.5	17.4	12.0	10.2	8.9	9.6
	5	22.9	16.7	17.9	13.2	8.8	10.5	9.5
	6	23.1	15.0	15.0	13.1	9.9	9.8	7.7
	7	21.0	17.4	16.6	11.5	8.2	8.9	8.4
	8	22.5	18.5	15.7	11.3	10.0	9.6	7.5
	9	22.2	17.2	13.9	14.5	8.8	8.5	9.1
	10	23.1	17.4	13.5	12.3	9.5	10.5	8.0
	11	21.2	16.7	14.9	13.1	10.4	11.0	11.2
	12	20.4	18.3	16.0	12.4	10.1	10.2	9.3
Average zeta potential (mV)		22.3	17.2	16.0	12.8	9.4	9.7	9.1
Standard deviation		1.15	0.95	1.41	0.97	0.67	0.86	1.00

Table F6 Data for zeta potential of paper fiber with varying calcium concentration and the initial C8 concentration 1000 μM .

Calcium concentration (μM)		0	100	200	400	600	800
(-) Zeta potential (mV)	1	20.2	14.2	11.6	8.5	9.4	8.0
	2	18.5	13.0	12.4	9.1	8.8	9.8
	3	19.3	14.3	9.9	10.7	10.2	8.3
	4	19.0	15.8	11.5	9.4	11.2	7.8
	5	20.1	14.5	10.7	9.8	9.6	10.8
	6	21.1	16.0	10.0	11.7	8.9	8.8
	7	20.6	13.1	11.7	9.8	8.9	7.6
	8	20.2	14.2	10.0	10.2	9.8	8.2
	9	21.2	13.8	9.6	11.6	10.0	9.7
	10	18.9	14.5	10.2	11.7	11.3	9.7
	11	21.5	14.8	10.6	11.5	11.5	9.6
	12	17.9	13.2	11.2	12.8	10.2	8.9
Average zeta potential (mV)		19.9	14.3	10.8	10.6	10.0	8.9
Standard deviation		1.10	0.92	0.84	1.24	0.92	0.95

CURRICULUM VITAE

Name : Miss Sureerat Jairakdee

Birth date : March 7, 1978

Nationality : Thai

University education :

1995-1999 Bachelor of Engineering (Chemical Engineering)
Department of Chemical Engineering,
Faculty of Engineering,
King Mongkut's University of Technology Thonburi,
Bangkok , Thailand