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APPENDICES

APPENDIX A

Experimental Data

Table A1 Experimental data of DPC adsorption onto clay

f[1]	C_i[2] (mmol/L)	M[3] (g)	C_e[4] (mmol/L)	q_e[5] (mmol/g)	Average±SD C_e (mmol/L)	Average±SD q_e (mmol/g)
0.25	2.0805	0.25007	0	0.2080	0	0.208±0.00006
		0.25017	0	0.2079		
		0.25002	0	0.2080		
0.50	4.1466	0.25018	0.0093	0.4134	0.009±0.001	0.414±0.0001
		0.25018	0.0075	0.4136		
		0.25007	0.0093	0.4136		
0.75	6.0329	0.25016	0.0314	0.5998	0.032±0.002	0.600±0.0003
		0.25018	0.0300	0.5999		
		0.25022	0.0340	0.5994		
1.00	8.4668	0.25007	0.1751	0.8289	0.143±0.031	0.832±0.003
		0.25015	0.1129	0.8349		
		0.25002	0.1411	0.8325		
1.25	10.4483	0.25016	0.8251	0.9617	0.813±0.061	0.963±0.006
		0.25010	0.7467	0.9698		
		0.25011	0.8662	0.9578		
1.50	12.4343	0.25020	1.4641	1.0961	1.638±0.211	1.079±0.021
		0.25001	1.5757	1.0858		
		0.25007	1.8733	1.0558		
1.75	14.6356	0.25010	3.1591	1.1472	3.015±0.126	1.162±0.013
		0.25024	2.9572	1.1667		
		0.25003	2.9280	1.1706		
2.00	16.7433	0.25001	4.2883	1.2455	4.395±0.118	1.235±0.012
		0.25004	4.5221	1.2219		
		0.25009	4.3759	1.2363		
2.25	18.8244	0.25012	5.6831	1.3135	5.664±0.115	1.316±0.012
		0.25009	5.7681	1.3052		
		0.25001	5.5396	1.3284		

Table A1 Experimental data of DPC adsorption onto clay (continued)

f^1	C_i^2 (mmol/L)	M^3 (g)	C_e^4 (mmol/L)	q_e^5 (mmol/g)	Average±SD C_e (mmol/L)	Average±SD q_e (mmol/g)
2.50	20.8480	0.25019	6.7687	1.4069	6.846±0.092	1.399±0.009
		0.25015	6.8219	1.4018		
		0.25005	6.9481	1.3897		
2.75	22.8671	0.25000	8.3628	1.4504	8.310±0.092	1.455±0.010
		0.25001	8.2034	1.4663		
		0.25024	8.3628	1.4490		
3.00	24.8641	0.25004	10.0033	1.4858	9.873±0.113	1.499±0.011
		0.25022	9.8107	1.5040		
		0.25005	9.8041	1.5057		

[1] Fraction of CEC satisfied by DPC

[2] Initial concentration of DPC

[3] Mass of clay used

[4] Equilibrium concentration of DPC

[5] Amount of DPC adsorbed onto clay

Table A2 Experimental data of naphthalene sorption onto clay

C_i^1 (mg/L)	C_b^2 (mg/L)	M^3 (g)	C_e^4 (mg/L)	q_e^5 (mg/g)	%R^6
1.5202	0.8858	0.05050	0.7431	0.0707	16.110
		0.05035	0.7739	0.0555	12.633
		0.05052	0.8013	0.0418	9.539
Average±SD			0.773±0.029	0.056±0.014	12.761±3.287
3.0574	1.7705	0.05037	1.1936	0.2863	32.584
		0.05039	1.1174	0.3240	36.888
		0.05052	1.3806	0.1929	22.022
Average±SD			1.231±0.135	0.268±0.067	30.498±7.649
4.6276	2.5658	0.05033	1.7199	0.4202	32.968
		0.05027	1.8622	0.3500	27.422
		0.05069	1.9528	0.3023	23.891
Average±SD			1.845±0.117	0.357±0.059	28.094±4.576
5.6399	3.3914	0.05041	2.5018	0.4412	26.231
		0.05024	2.5710	0.4082	24.191
		0.05030	2.4030	0.4913	29.144
Average±SD			2.492±0.084	0.447±0.042	26.522±2.490
7.1616	4.2296	0.05020	3.1054	0.5599	26.579
		0.05028	3.2636	0.4803	22.839
		0.05040	3.5269	0.3485	16.614
Average±SD			3.299±0.213	0.463±0.107	22.011±5.034

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of clay used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto clay

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by clay

Table A3 Experimental data of naphthalene sorption onto 0.25CEC

C_i^1 (mg/L)	C_b^2 (mg/L)	M^3 (g)	C_e^4 (mg/L)	q_e^5 (mg/g)	%R^6
1.5202	0.8858	0.05049	0.2940	0.2930	66.810
		0.05042	0.3223	0.2794	63.649
		0.05055	0.3206	0.2795	63.807
Average±SD			0.312±0.016	0.284±0.008	64.755±1.781
3.0574	1.7705	0.05033	0.7866	0.4887	55.572
		0.05046	0.7770	0.4922	56.114
		0.05037	0.7407	0.5111	58.164
Average±SD			0.768±0.024	0.497±0.012	56.617±1.367
4.6276	2.5658	0.05049	0.9320	0.8090	63.676
		0.05052	0.9978	0.7759	61.112
		0.05046	1.0898	0.7313	57.526
Average±SD			1.007±0.079	0.772±0.039	60.771±3.089
5.6399	3.3914	0.05067	1.6576	0.8554	51.123
		0.05028	1.6780	0.8519	50.522
		0.05024	1.5099	0.9363	55.479
Average±SD			1.615±0.092	0.881±0.048	52.375±2.705
7.1616	4.2296	0.05022	2.1324	1.0440	49.584
		0.05027	1.6575	1.2791	60.812
		0.05055	1.7455	1.2285	58.731
Average±SD			1.845±0.253	1.184±0.124	56.376±5.973

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 0.25CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 0.25CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 025CEC

Table A4 Experimental data of naphthalene sorption onto 0.50CEC

C_i^1 (mg/L)	C_b^2 (mg/L)	M^3 (g)	C_e^4 (mg/L)	q_e^5 (mg/g)	%R^6
1.5202	0.8858	0.05060	0.3341	0.2726	62.283
		0.05040	0.3507	0.2654	60.409
		0.05028	0.3081	0.2872	65.218
Average±SD			0.331±0.021	0.275±0.011	62.636±2.424
3.0574	1.7705	0.05034	0.6587	0.5522	62.796
		0.05047	0.7357	0.5126	58.447
		0.05025	0.5939	0.5854	66.456
Average±SD			0.663±0.071	0.550±0.036	62.566±4.009
4.6276	2.5658	0.05040	0.8266	0.8627	67.784
		0.05038	0.8669	0.8431	66.213
		0.05041	0.8954	0.8284	65.103
Average±SD			0.863±0.035	0.845±0.017	66.367±1.347
5.6399	3.3914	0.05052	1.3539	1.0083	60.078
		0.05040	1.3154	1.0298	61.214
		0.05050	1.3793	0.9961	59.329
Average±SD			1.350±0.032	1.011±0.017	60.207±0.949
7.1616	4.2296	0.05034	1.5099	1.3507	64.302
		0.05030	1.4612	1.3759	65.453
		0.05035	1.4072	1.4014	66.730
Average±SD			1.459±0.051	1.376±0.025	65.495±1.215

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 0.50CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 0.50CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 0.50CEC

Table A5 Experimental data of naphthalene sorption onto 0.75CEC

C_i[1] (mg/L)	C_b[2] (mg/L)	M[3] (g)	C_e[4] (mg/L)	q_e[5] (mg/g)	%R[6]
1.5202	0.8858	0.05049	0.2750	0.3025	68.955
		0.05028	0.2393	0.3214	72.985
		0.05062	0.2331	0.3223	73.685
Average±SD			0.249±0.023	0.315±0.011	71.875±2.553
3.0574	1.7705	0.05053	0.5688	0.5945	67.873
		0.05047	0.5672	0.5960	67.964
		0.05036	0.5435	0.6091	69.302
Average±SD			0.560±0.014	0.600±0.008	68.380±0.800
4.6276	2.5658	0.05049	0.7552	0.8965	70.567
		0.05065	0.7627	0.8900	70.274
		0.05038	0.5936	0.9787	76.865
Average±SD			0.704±0.096	0.922±0.049	72.569±3.724
5.6399	3.3914	0.05037	1.1598	1.1076	65.802
		0.05044	1.2209	1.0758	64.000
		0.05042	1.0311	1.1703	69.597
Average±SD			1.137±0.097	1.118±0.048	66.466±2.857
7.1616	4.2296	0.05033	1.2374	1.4863	70.744
		0.05030	1.2249	1.4934	71.040
		0.05027	1.1432	1.5349	72.971
Average±SD			1.202±0.051	1.505±0.026	71.585±1.210

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 0.75CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 0.75CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 0.75CEC

Table A6 Experimental data of naphthalene sorption onto 1.00CEC

C_i^1 (mg/L)	C_b^2 (mg/L)	M^3 (g)	C_e^4 (mg/L)	q_e^5 (mg/g)	%R^6
1.5202	0.8858	0.05064	0.2484	0.3147	71.958
		0.05030	0.2042	0.3388	76.947
		0.05033	0.2019	0.3397	77.207
Average±SD			0.218±0.026	0.331±0.014	75.371±2.959
3.0574	1.7705	0.05062	0.4139	0.6700	76.622
		0.05026	0.4324	0.6656	75.578
		0.05025	0.4196	0.6721	76.300
Average±SD			0.422±0.009	0.669±0.003	76.167±0.535
4.6276	2.5658	0.05055	0.5316	1.0061	79.281
		0.05063	0.5770	0.9820	77.512
		0.05023	0.5679	0.9944	77.867
Average±SD			0.559±0.024	0.994±0.012	78.220±0.936
5.6399	3.3914	0.05049	0.8896	1.2388	73.769
		0.05020	0.9103	1.2356	73.159
		0.05017	1.0199	1.1817	69.927
Average±SD			0.940±0.070	1.219±0.032	72.285±2.065
7.1616	4.2296	0.05054	1.0704	1.5627	74.693
		0.05049	1.0363	1.5811	75.499
		0.05026	1.0724	1.5704	74.645
Average±SD			1.060±0.020	1.571±0.009	74.946±0.480

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 1.00CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 1.00CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 1.00CEC

Table A7 Experimental data of naphthalene sorption onto 1.25CEC

C_i^1 (mg/L)	C_b^2 (mg/L)	M^3 (g)	C_e^4 (mg/L)	q_e^5 (mg/g)	%R^6
1.5202	0.8858	0.05028	0.2046	0.3387	76.902
		0.05035	0.1805	0.3502	79.623
		0.05026	0.1785	0.3518	79.849
Average±SD			0.188±0.015	0.347±0.007	78.791±1.640
3.0574	1.7705	0.05024	0.4007	0.6816	77.368
		0.05025	0.3871	0.6883	78.136
		0.05033	0.4090	0.6763	76.899
Average±SD			0.399±0.011	0.682±0.006	77.468±0.624
4.6276	2.5658	0.05056	0.5801	0.9819	77.391
		0.05068	0.4573	1.0401	82.177
		0.05033	0.4867	1.0328	81.031
Average±SD			0.508±0.064	1.018±0.032	80.200±2.499
5.6399	3.3914	0.05022	0.8634	1.2585	74.541
		0.05047	0.9089	1.2297	73.200
		0.05018	0.8524	1.2649	74.866
Average±SD			0.875±0.030	1.251±0.019	74.202±0.883
7.1616	4.2296	0.05029	1.0335	1.5888	75.565
		0.05022	0.9193	1.6479	78.265
		0.05037	0.9780	1.6139	76.877
Average±SD			0.977±0.057	1.617±0.030	76.902±1.350

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 1.25CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 1.25CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 1.25CEC

Table A8 Experimental data of naphthalene sorption onto 1.50CEC

C_i^1 (mg/L)	C_b^2 (mg/L)	M^3 (g)	C_e^4 (mg/L)	q_e^5 (mg/g)	%R^6
1.5202	0.8858	0.05041	0.1718	0.3541	80.605
		0.05050	0.1469	0.3658	83.416
		0.05026	0.1440	0.3690	83.744
Average±SD			0.154±0.015	0.363±0.008	82.588±1.725
3.0574	1.7705	0.05041	0.3457	0.7066	80.474
		0.05049	0.3773	0.6898	78.690
		0.05033	0.3948	0.6834	77.701
Average±SD			0.373±0.025	0.693±0.012	78.955±1.406
4.6276	2.5658	0.05055	0.5283	1.0076	79.410
		0.05040	0.5665	0.9917	77.921
		0.05056	0.4836	1.0296	81.152
Average±SD			0.526±0.041	1.010±0.019	79.494±1.617
5.6399	3.3914	0.05043	0.8329	1.2683	75.441
		0.05058	0.7813	1.2901	76.962
		0.05055	0.7475	1.3076	77.959
Average±SD			0.787±0.043	1.289±0.020	76.787±1.268
7.1616	4.2296	0.05038	0.9589	1.6230	77.329
		0.05043	0.9419	1.6298	77.731
		0.05065	0.9336	1.6269	77.927
Average±SD			0.945±0.013	1.627±0.003	77.662±0.305

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 1.50CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 1.50CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 1.50CEC

Table A9 Experimental data of naphthalene sorption onto 1.75CEC

C_i[1] (mg/L)	C_b[2] (mg/L)	M[3] (g)	C_e[4] (mg/L)	q_e[5] (mg/g)	%R[6]
1.5202	0.8858	0.05047	0.1534	0.3628	82.682
		0.05033	0.1517	0.3646	82.874
		0.05066	0.1464	0.3649	83.473
Average±SD			0.151±0.004	0.364±0.001	83.010±0.412
3.0574	1.7705	0.05031	0.3291	0.7163	81.412
		0.05062	0.3452	0.7039	80.503
		0.05029	0.2982	0.7319	83.157
Average±SD			0.324±0.024	0.717±0.014	81.691±1.349
4.6276	2.5658	0.05042	0.5039	1.0224	80.361
		0.05031	0.4657	1.0436	81.850
		0.05027	0.4659	1.0443	81.842
Average±SD			0.478±0.022	1.037±0.012	81.351±0.857
5.6399	3.3914	0.05051	0.7995	1.2829	76.426
		0.05034	0.8159	1.2790	75.942
		0.05040	0.7569	1.3068	77.682
Average±SD			0.791±0.030	1.290±0.015	76.683±0.898
7.1616	4.2296	0.05038	0.8877	1.6583	79.012
		0.05030	0.8529	1.6783	79.835
		0.05046	0.8634	1.6678	79.587
Average±SD			0.868±0.018	1.668±0.010	79.478±0.422

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 1.75CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 1.75CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 1.75CEC

Table A10 Experimental data of naphthalene sorption onto 2.00CEC

C_i[1] (mg/L)	C_b[2] (mg/L)	M[3] (g)	C_e[4] (mg/L)	q_e[5] (mg/g)	%R[6]
1.5202	0.8858	0.05049	0.1481	0.3653	83.281
		0.05023	0.1430	0.3697	83.856
		0.05064	0.1520	0.3623	82.840
Average±SD			0.148±0.005	0.366±0.004	83.326±0.510
3.0574	1.7705	0.05027	0.3190	0.7219	81.982
		0.05062	0.3250	0.7139	81.644
		0.05023	0.3451	0.7095	80.508
Average±SD			0.330±0.014	0.715±0.006	81.378±0.772
4.6276	2.5658	0.05040	0.4593	1.0449	82.099
		0.05070	0.4712	1.0329	81.635
		0.05053	0.4828	1.0306	81.183
Average±SD			0.471±0.012	1.036±0.008	81.639±0.458
5.6399	3.3914	0.05046	0.7381	1.3146	78.236
		0.05045	0.8161	1.2762	75.936
		0.05033	0.7704	1.3019	77.284
Average±SD			0.775±0.039	1.298±0.020	77.152±1.156
7.1616	4.2296	0.05040	0.8307	1.6860	80.360
		0.05055	0.8646	1.6642	79.558
		0.05024	0.8574	1.6781	79.729
Average±SD			0.851±0.018	1.676±0.011	79.882±0.422

[1] Initial concentration of naphthalene

[2] Blank concentration of naphthalene

[3] Mass of 2.00CEC used

[4] Equilibrium concentration of naphthalene

[5] Amount of naphthalene sorbed onto 2.00CEC

[6] Removal efficiencies (%) of naphthalene from synthetic wastewater by 2.00CEC

Table A11 Experimental data of phenanthrene sorption onto clay

C_i[1] (μg/L)	C_b[2] (μg/L)	M[3] (g)	C_e[4] (μg/L)	q_e[5] (μg/g)	%R[6]
49.6442	37.4313	0.02540	23.5352	13.6773	37.124
		0.02526	20.1258	17.1274	46.233
		0.02530	27.2009	10.1091	27.331
Average±SD			23.621±3.538	13.638±3.509	36.896±9.453
98.1423	76.7219	0.02563	55.6984	20.5067	27.402
		0.02572	52.0030	24.0270	32.219
		0.02574	49.1278	26.8008	35.966
Average±SD			52.276±3.294	23.778±3.154	31.862±4.293
144.0216	111.0374	0.02547	71.4548	38.8522	35.648
		0.02521	62.9267	47.7100	43.328
		0.02553	71.9723	38.2541	35.182
Average±SD			68.785±5.080	41.605±5.295	38.053±4.575
214.7613	165.7195	0.02541	89.2802	75.2059	46.126
		0.02516	101.6498	63.6623	38.662
		0.02513	114.0194	51.4327	31.197
Average±SD			101.650±12.370	63.434±11.888	38.662±7.464
267.9623	214.4970	0.02514	127.8621	86.1524	40.390
		0.02526	173.5951	40.4809	19.069
		0.02533	150.7316	62.9347	29.728
Average±SD			150.730±22.866	63.189±22.837	29.729±10.661

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of clay used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto clay

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by clay

Table A12 Experimental data of phenanthrene sorption onto 0.25CEC

C_i[1] (μg/L)	C_b[2] (μg/L)	M[3] (g)	C_e[4] (μg/L)	q_e[5] (μg/g)	%R[6]
49.6442	37.4313	0.02562	10.1957	26.5765	72.762
		0.02553	10.4901	26.3819	71.975
		0.02539	10.4379	26.5788	72.115
Average±SD			10.375±0.157	26.512±0.113	72.284±0.420
98.1423	76.7219	0.02538	20.7858	55.0986	72.908
		0.02552	21.4993	54.0974	71.978
		0.02553	22.8003	52.8022	70.282
Average±SD			21.695±1.021	53.999±1.151	71.722±1.331
144.0216	111.0374	0.02530	32.3422	77.7620	70.873
		0.02562	30.5533	78.5364	72.484
		0.02546	26.2204	83.2846	76.386
Average±SD			29.705±3.148	79.861±2.990	73.247±2.835
214.7613	165.7195	0.02541	38.6908	124.9790	76.653
		0.02537	40.6424	123.2529	75.475
		0.02546	39.9622	123.4851	75.886
Average±SD			39.765±0.991	123.906±0.937	76.005±0.598
267.9623	214.4970	0.02524	43.1543	169.7134	79.881
		0.02518	42.5311	170.7366	80.172
		0.02548	41.5874	169.6523	80.612
Average±SD			42.424±0.789	170.034±0.609	80.222±0.368

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 0.25CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 0.25CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 0.25CEC

Table A13 Experimental data of phenanthrene sorption onto 0.50CEC

C_i^1 (μg/L)	C_b^2 (μg/L)	M^3 (g)	C_e^4 (μg/L)	q_e^5 (μg/g)	%R[6]
49.6442	37.4313	0.02539	9.5749	27.4285	74.420
		0.02531	8.8626	28.2188	76.323
		0.02530	9.0787	28.0164	75.746
Average±SD			9.172±0.365	27.888±0.410	75.496±0.976
98.1423	76.7219	0.02534	15.5056	60.3949	79.790
		0.02536	18.5090	57.3866	75.875
		0.02527	18.6419	57.4594	75.702
Average±SD			17.552±1.774	58.414±1.716	77.122±2.312
144.0216	111.0374	0.02550	21.1182	88.1561	80.981
		0.02542	22.1819	87.3874	80.023
		0.02555	20.6695	88.4226	81.385
Average±SD			21.323±0.777	87.989±0.537	80.796±0.700
214.7613	165.7195	0.02539	28.4925	135.1192	82.807
		0.02534	26.8875	136.9692	83.775
		0.02532	28.7940	135.1950	82.625
Average±SD			28.058±1.025	135.761±1.047	83.069±0.618
267.9623	214.4970	0.02529	29.7508	182.6277	86.130
		0.02526	30.6981	181.9071	85.688
		0.02543	31.0068	180.3876	85.544
Average±SD			30.485±0.654	181.641±1.144	85.788±0.305

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 0.50CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 0.50CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 0.50CEC

Table A14 Experimental data of phenanthrene sorption onto 0.75CEC

C_i^1 (μg/L)	C_b^2 (μg/L)	M^3 (g)	C_e^4 (μg/L)	q_e^5 (μg/g)	%R^6
49.6442	37.4313	0.02551	4.6650	32.1112	87.537
		0.02534	4.6840	32.3079	87.486
		0.02533	4.2258	32.7729	88.711
Average±SD			4.525±0.259	32.397±0.340	87.911±0.693
98.1423	76.7219	0.02538	7.9177	67.7741	89.680
		0.02547	7.9794	67.4740	89.600
		0.02523	8.0411	68.0547	89.519
Average±SD			7.979±0.062	67.768±0.290	89.600±0.080
144.0216	111.0374	0.02545	11.1775	98.0942	89.934
		0.02532	11.3959	98.3822	89.737
		0.02526	10.8356	99.1705	90.241
Average±SD			11.136±0.282	98.549±0.557	89.971±0.254
214.7613	165.7195	0.02548	12.4880	150.3449	92.464
		0.02533	12.9296	150.7993	92.198
		0.02531	12.7088	151.1366	92.331
Average±SD			12.709±0.221	150.760±0.397	92.331±0.133
267.9623	214.4970	0.02530	15.6908	196.4488	92.685
		0.02546	14.7791	196.1095	93.110
		0.02521	15.3822	197.4562	92.829
Average±SD			15.284±0.464	196.672±0.700	92.874±0.216

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 0.75CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 0.75CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 0.75CEC

Table A15 Experimental data of phenanthrene sorption onto 1.00CEC

C_i[1] (μg/L)	C_b[2] (μg/L)	M[3] (g)	C_e[4] (μg/L)	q_e[5] (μg/g)	%R[6]
49.6442	37.4313	0.02528	3.4661	33.5890	90.740
		0.02540	3.4993	33.3976	90.651
		0.02546	3.7605	33.0625	89.954
Average±SD			3.575±0.161	33.350±0.267	90.448±0.431
98.1423	76.7219	0.02559	5.9851	69.1059	92.199
		0.02540	6.1703	69.4406	91.958
		0.02541	5.6527	69.9225	92.632
Average±SD			5.936±0.262	69.490±0.410	92.263±0.342
144.0216	111.0374	0.02562	6.8517	101.6644	93.829
		0.02538	6.5644	102.9088	94.088
		0.02534	7.0179	102.6238	93.680
Average±SD			6.811±0.229	102.399±0.652	93.866±0.207
214.7613	165.7195	0.02553	8.2999	154.1516	94.992
		0.02531	7.2482	156.5304	95.626
		0.02524	7.3099	156.9033	95.589
Average±SD			7.619±0.590	155.862±1.493	95.402±0.356
267.9623	214.4970	0.02528	9.3588	202.8661	95.637
		0.02555	9.5298	200.5550	95.557
		0.02529	9.7007	202.4479	95.477
Average±SD			9.530±0.171	201.956±1.231	95.557±0.080

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 1.00CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 1.00CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 1.00CEC

Table A16 Experimental data of phenanthrene sorption onto 1.25CEC

C_i^1 (µg/L)	C_b^2 (µg/L)	M^3 (g)	C_e^4 (µg/L)	q_e^5 (µg/g)	%R[6]
49.6442	37.4313	0.02548	1.9585	34.8046	94.768
		0.02522	2.4024	34.7233	93.582
		0.02542	1.3815	35.4542	96.309
Average±SD			1.914±0.512	34.994±0.401	94.886±1.368
98.1423	76.7219	0.02561	4.2211	70.7740	94.498
		0.02542	4.1688	71.3543	94.566
		0.02541	3.4020	72.1369	95.566
Average±SD			3.931±0.459	71.422±0.684	94.877±0.598
144.0216	111.0374	0.02553	4.2590	104.5616	96.164
		0.02566	4.3564	103.9371	96.077
		0.02563	4.1617	104.2486	96.252
Average±SD			4.259±0.097	104.249±0.312	96.164±0.088
214.7613	165.7195	0.02521	5.6622	158.7240	96.583
		0.02524	4.4870	159.6994	97.292
		0.02544	5.8474	157.1070	96.472
Average±SD			5.332±0.738	158.510±1.309	96.782±0.445
267.9623	214.4970	0.02523	7.9628	204.6514	96.288
		0.02554	6.3032	203.7919	97.061
		0.02557	6.2581	203.5969	97.082
Average±SD			6.841±0.971	204.013±0.561	96.811±0.453

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 1.25CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 1.25CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 1.25CEC

Table A17 Experimental data of phenanthrene sorption onto 1.50CEC

C_i^1 (μg/L)	C_b^2 (μg/L)	M^3 (g)	C_e^4 (μg/L)	q_e^5 (μg/g)	%R[6]
49.6442	37.4313	0.02543	1.5596	35.2652	95.833
		0.02536	1.4290	35.4912	96.182
		0.02557	1.4931	35.1371	96.011
Average±SD			1.494±0.065	35.298±0.179	96.009±0.117
98.1423	76.7219	0.02540	2.5069	73.0463	96.732
		0.02536	1.7828	73.8753	97.676
		0.02555	1.6736	73.4328	97.819
Average±SD			1.988±0.453	73.451±0.415	97.409±0.451
144.0216	111.0374	0.02551	3.6204	105.2695	96.739
		0.02531	3.2833	106.4344	97.043
		0.02555	3.8934	104.8376	96.494
Average±SD			3.599±0.306	105.514±0.826	96.759±0.190
214.7613	165.7195	0.02528	5.4580	158.4864	96.706
		0.02540	4.7814	158.4037	97.115
		0.02552	5.1209	157.3262	96.910
Average±SD			5.120±0.338	158.072±0.647	96.910±0.136
267.9623	214.4970	0.02537	6.6831	204.7831	96.884
		0.02520	6.6736	206.1740	96.889
		0.02528	6.6926	205.5028	96.880
Average±SD			6.683±0.009	205.487±0.696	96.884±0.003

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 1.50CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 1.50CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 1.50CEC

Table A18 Experimental data of phenanthrene sorption onto 1.75CEC

C_i^1 (μg/L)	C_b^2 (μg/L)	M^3 (g)	C_e^4 (μg/L)	q_e^5 (μg/g)	%R[6]
49.6442	37.4313	0.02550	1.1370	35.5827	96.962
		0.02545	1.5240	35.2724	95.929
		0.02546	1.6854	35.1000	95.497
Average±SD			1.449±0.282	35.318±0.245	96.129±0.753
98.1423	76.7219	0.02561	2.5425	72.4125	96.686
		0.02546	2.3763	73.0024	96.903
		0.02548	1.7566	73.5530	97.710
Average±SD			2.225±0.414	72.989±0.570	97.100±0.540
144.0216	111.0374	0.02559	3.1645	105.3858	97.150
		0.02539	2.6683	106.7045	97.597
		0.02538	3.6608	105.7690	96.703
Average±SD			3.165±0.496	105.953±0.678	97.150±0.447
214.7613	165.7195	0.02526	4.5155	159.5448	97.275
		0.02543	4.3564	158.6346	97.371
		0.02514	4.2994	160.5212	97.406
Average±SD			4.390±0.112	159.567±0.943	97.351±0.068
267.9623	214.4970	0.02542	7.0867	203.9834	96.697
		0.02527	6.9039	205.3750	96.781
		0.02521	7.1461	205.6237	96.668
Average±SD			7.046±0.126	204.994±0.884	96.715±0.059

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 1.75CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 1.75CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 1.75CEC

Table A19 Experimental data of phenanthrene sorption onto 2.00CEC

C_i^1 (μg/L)	C_b^2 (μg/L)	M^3 (g)	C_e^4 (μg/L)	q_e^5 (μg/g)	%R^6
49.6442	37.4313	0.02561	1.4361	35.1378	96.163
		0.02529	1.3744	35.6434	96.328
		0.02555	1.3720	35.2831	96.335
Average±SD			1.394±0.036	35.355±0.260	96.275±0.097
98.1423	76.7219	0.02532	2.7111	73.0755	96.466
		0.02541	2.9176	72.6134	96.197
		0.02533	2.2790	73.4731	97.030
Average±SD			2.636±0.326	73.054±0.430	96.564±0.425
144.0216	111.0374	0.02550	3.0909	105.8299	97.216
		0.02562	3.7510	104.6901	96.622
		0.02525	3.3806	106.5909	96.955
Average±SD			3.408±0.331	105.704±0.957	96.931±0.298
214.7613	165.7195	0.02522	4.9143	159.4024	97.035
		0.02542	4.6983	158.3608	97.165
		0.02530	4.4822	159.3254	97.295
Average±SD			4.698±0.216	159.030±0.580	97.165±0.130
267.9623	214.4970	0.02544	6.7282	204.1753	96.863
		0.02536	6.8161	204.7328	96.822
		0.02552	7.0559	203.2143	96.710
Average±SD			6.867±0.170	204.041±0.768	96.799±0.079

[1] Initial concentration of phenanthrene

[2] Blank concentration of phenanthrene

[3] Mass of 2.00CEC used

[4] Equilibrium concentration of phenanthrene

[5] Amount of naphthalene sorbed onto 2.00CEC

[6] Removal efficiencies (%) of phenanthrene from synthetic wastewater by 2.00CEC

APPENDIX B

Sorption Isotherms

Table B1 Isotherm parameters for the sorption of naphthalene onto clay and organoclays

Sorbent	Linear model		Freundlich model		
	K_d (L/g)	R^2	K_f (L/g)	n	R^2
clay	0.151	0.827	0.123	0.726	0.812
0.25CEC	0.539	0.938	0.681	1.298	0.963
0.50CEC	0.866	0.933	0.866	0.980	0.970
0.75CEC	1.104	0.923	1.139	1.071	0.963
1.00CEC	1.325	0.949	1.465	1.071	0.970
1.25CEC	1.450	0.945	1.593	1.123	0.971
1.50CEC	1.554	0.991	1.638	1.225	0.994
1.75CEC	1.616	0.955	1.766	1.220	0.982
2.00CEC	1.675	0.958	1.796	1.212	0.984

Table B2 Isotherm parameters for the sorption of phenanthrene onto clay and organoclays

Sorbent	Linear model		Freundlich model		
	K_d (L/g)	R^2	K_f (L/g)	n	R^2
clay	0.426	0.850	0.759	1.094	0.935
0.25CEC	4.132	0.916	1.316	0.803	0.965
0.50CEC	6.944	0.936	0.887	0.659	0.975
0.75CEC	15.224	0.949	3.367	0.682	0.980
1.00CEC	29.773	0.941	2.768	0.525	0.970
1.25CEC	36.184	0.950	12.933	0.702	0.959
1.50CEC	30.963	0.984	27.599	0.934	0.951
1.75CEC	30.130	0.953	27.121	0.898	0.960
2.00CEC	31.794	0.980	24.923	0.879	0.989

APPENDIX C

Calculation

Example C1; The quantity of DPC added to clay

The quantity of DPC added to clay was calculated by

$$f = \frac{M_{cation}}{CEC \times M_{clay} \times GMW_{cation} \times Z}$$

where f = fraction of CEC satisfied by DPC, M_{cation} = mass of DPC required to achieve the desired fraction of CEC (mass), M_{clay} = mass of the base clay (mass), GMW_{cation} = gram molecular weight of DPC (mass/mol), Z = moles of charge per equivalent (mol/equivalent)

Example; Mass of DPC was added to base clay 5 g to prepare 0.25CEC

So,

$$f = 0.25$$

$$M_{clay} = 5g$$

$$CEC = \frac{82 \times 10^{-3} eq}{100g}$$

$$GMW_{cation} = 283.90 \frac{g}{mol}$$

$$Z = 1 \frac{mol}{eq}$$

$$M_{cation} = 0.25 \times \frac{82 \times 10^{-3} eq}{100g} \times 5g \times 283.90 \frac{g}{mol} \times 1 \frac{mol}{eq}$$

$$= 0.2910g$$

Example C2; The amount of DPC adsorbed onto clay

The amount of DPC adsorbed onto clay was calculated by

$$q_e = \frac{(C_i - C_e)V}{M}$$

where C_i and C_e were the initial and quilibrium concentrations of DPC, respectively. V was the volume of the solution, q_e was the amount of DPC adsorbed onto clay, and M was the mass of clay used.

Example; from Table A1, 0.25007 g of clay sample combined with 0.025 L DPC solution

So,

$$M = 0.25007g$$

$$V = 0.025L$$

$$C_i = 2.0805mmol/L$$

$$C_e = 0mmol/L$$

$$q_e = \frac{(2.0805mmol/L - 0mmol/L) \times 0.025L}{0.25007g}$$

$$= 0.2080mmol/g$$

Example C3; The amount of PAHs adsorbed onto clay and organoclays

Because recovery of naphthalene in blank samples rangle from 55 to 60% and phenanthrene from 75 to 80%. Thus, the amount of PAHs adsorbed onto clay and organoclays was calculated by

$$q_e = \frac{(C_b - C_e)V}{M}$$

where C_b and C_e were the blank and quilibrium concentrations of sorbate, respectively. V was the volume of the solution, q_e was the amount of sorbate sorbed onto sorbent, and M was the mass of sorbent used.

Example; from Table A3, 0.05049 g of 0.25CEC combined with 0.025 L synthetic wastewater of naphthalene

So, $M = 0.05049g$

$$V = 0.025L$$

$$C_b = 0.8858mg/L$$

$$C_e = 0.2940mg/L$$

$$q_e = \frac{(0.8858mg/L - 0.2940mg/L) \times 0.025L}{0.05049g}$$

$$= 0.2930mg/g$$

Example C4; Removal efficiency of organoclays for PAHs

Removal efficiencies (*R*) of eight organoclays were calculated as percentage using the equation:

$$R = \frac{C_b - C_e}{C_b} \times 100$$

where C_b was the blank concentration of sorbate and C_e was the equilibrium concentration of sorbate.

Example; from Table A3, sorption of naphthalene onto 0.25CEC

$$C_b = 0.8858mg/L$$
$$C_e = 0.2940mg/L$$
$$R = \frac{0.8858mg/L - 0.2940mg/L}{0.8858mg/L} \times 100$$
$$= 66.810\%$$

BIOGRAPHY

Miss Suratchana Changchaivong was born on June 24, 1978, in Suphanburi Province, Thailand. She graduated with a Bachelor's Degree of Science in 2001 from Department of General Science, Faculty of Science, Chulalongkorn University. She attended the Master's Degree of Science at Interdisciplinary Program in Environmental Science, Graduate School, Chulalongkorn University in 2004.