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APPENDICES

APPENDICES

Table A.1 Adsorption of Cr (VI) on the surface of TiO_2 in different mole ratios of TTiP:DEG

Time (min)	**Cr (VI) adsorption on TiO2 surface (mg Cr(VI)/g TiO_2)**				
Mole ratios of TTiP:DEG	**1:0.0**	**1:0.5**	**1:1.0**	**1:1.5**	**1:2.0**
0	0.000	0.000	0.000	0.000	0.000
5	0.120	0.247	0.329	0.400	0.429
10	0.235	0.335	0.450	0.540	0.563
15	0.334	0.522	0.611	0.690	0.757
20	0.500	0.640	0.720	0.850	0.916
30	0.692	0.910	0.995	1.050	1.109
45	0.692	0.910	0.995	1.050	1.109
60	0.692	0.910	0.995	1.050	1.109

Table A.2 Photocatalytic reduction of chromium (VI) using different mole ratios of TTiP:DEG

Time (min)	**Residual concentration of Cr (VI) (mg/L)**				
Mole ratios of TTiP:DEG	**1:0.0**	**1:0.5**	**1:1.0**	**1:1.5**	**1:2.0**
0	47.925	47.270	46.850	46.674	47.015
5	47.704	47.036	46.570	46.262	45.856
10	47.647	46.439	45.976	45.775	45.183
15	47.243	45.789	45.382	44.861	44.687
20	47.070	45.207	44.750	44.522	44.219
25	47.002	44.820	44.323	43.731	43.637
30	45.295	44.529	43.324	43.111	42.806
45	43.183	42.058	41.249	40.784	40.641
60	42.363	41.139	39.175	38.361	37.841
90	39.546	35.937	35.156	34.681	33.112
120	36.733	31.956	31.012	30.068	29.664
150	32.934	26.324	25.537	25.220	25.256
180	29.505	21.836	20.351	19.721	19.820
210	26.167	19.313	17.796	17.690	17.402

Table A.3 Adsorption of Cr (VI) on the surface of TiO_2 in different calcination temperatures using TiO_2 with DEG 1.0

Time (min)	**Cr (VI) adsorption on TiO_2 surface (mg Cr(VI)/g TiO_2)**				
Calcination temperatures (°C)	**300**	**450**	**500**	**600**	**800**
0	0.000	0.000	0.000	0.000	0.000
5	0.115	0.329	0.209	0.142	0.458
10	0.195	0.450	0.352	0.258	0.523
15	0.219	0.611	0.450	0.350	0.569
20	0.283	0.720	0.581	0.467	0.585
30	0.343	0.995	0.795	0.635	0.594
45	0.343	0.995	0.795	0.635	0.594
60	0.343	0.995	0.795	0.635	0.594

Table A.4 Photocatalytic reduction of chromium (VI) in different calcination temperature using TiO_2 with DEG 1.0

Time (min)	**Residual concentration of Cr (VI) (mg/L)**				
Calcination temperatures (°C)	**300**	**450**	**500**	**600**	**800**
0	48.972	46.850	48.7044	48.096	48.218
5	48.890	46.570	48.7671	48.026	48.113
10	48.547	45.976	48.0577	46.708	47.099
15	48.353	45.382	47.1514	46.006	47.075
20	47.811	44.750	46.76	45.665	47.030
25	47.657	44.323	46.6518	45.476	46.296
30	47.648	43.324	45.4406	44.125	45.906
45	47.063	41.249	43.2618	41.255	45.871
60	46.849	39.175	40.017	37.107	44.370
90	45.451	35.156	35.3614	29.904	43.639
120	43.197	31.012	31.156	21.742	42.254
150	41.585	25.537	25.4054	12.158	41.715
180	40.670	20.351	20.1387	4.959	40.287
210	39.773	17.796	15.9017	0.012	39.892

Table A.5 Adsorption of chromium (VI) on the surface of TiO_2 in different initial concentration of Cr(VI) using TiO_2 with DEG 1.0 and calcined at 600°C

Time (min)	**Cr (VI) adsorption on TiO_2 surface (mg Cr(VI)/g TiO_2)**				
Initial concentration of Cr(VI) (mg/L)	**10**	**25**	**50**	**75**	**100**
0	0.000	0.000	0.000	0.000	0.000
5	0.093	0.144	0.271	0.357	0.526
10	0.184	0.263	0.389	0.516	0.696
15	0.222	0.370	0.473	0.625	0.780
20	0.248	0.435	0.534	0.731	0.858
30	0.267	0.491	0.635	0.775	0.901
45	0.267	0.491	0.635	0.775	0.901
60	0.267	0.491	0.635	0.775	0.901

Table A.6 Photocatalytic reduction of chromium (VI) in different initial concentration of Cr (VI) using TiO_2 with DEG 1.0 and calcined at 600°C

Time (min)	**Residual concentration of Cr (VI) (mg/L)**				
Initial concentration of Cr(VI) (mg/L)	**10**	**25**	**50**	**75**	**100**
0	9.850	24.126	48.096	73.400	98.740
5	8.217	23.023	48.026	73.156	98.638
10	6.770	22.181	46.708	72.965	98.598
15	5.044	21.320	45.665	72.698	98.510
20	3.329	20.029	44.265	72.405	97.859
25	1.618	19.239	43.076	72.206	97.699
30	0.036	18.043	42.125	71.920	97.136
45	0.008	15.054	38.255	71.226	96.831
60	0.000	11.554	34.107	70.517	96.262
90	0.000	5.554	26.904	69.190	94.949
120	0.000	0.000	19.742	67.889	93.647
150	0.000	0.000	12.158	66.483	91.840
180	0.000	0.000	4.959	65.326	90.152
210	0.000	0.000	0.012	64.035	88.898

Table A.7 Adsorption of chromium (VI) on the surface of TiO_2 in different mole ratios of TTiP:PEG

Time (min)	**Cr (VI) adsorption on TiO_2 surface (mg Cr(VI)/g TiO_2)**				
Mole ratios of TTiP:DEG	**1:0.0**	**1:0.5**	**1:1.0**	**1:1.5**	**1:2.0**
0	0.000	0.000	0.000	0.000	0.000
5	0.120	0.149	0.175	0.192	0.247
10	0.235	0.378	0.408	0.431	0.500
15	0.334	0.610	0.682	0.753	0.849
20	0.500	0.802	0.862	0.942	0.986
30	0.692	1.059	1.109	1.131	1.183
45	0.692	1.059	1.109	1.131	1.183
60	0.692	1.059	1.109	1.131	1.183

Table A.8 Photocatalytic reduction of chromium (VI) using different mole ratios of TTiP:PEG

Time (min)	**Residual concentration of Cr (VI) (mg/L)**				
Mole ratios of TTiP:PEG	**1:0.0**	**1:0.5**	**1:1.0**	**1:1.5**	**1:2.0**
0	47.925	46.701	45.599	45.845	45.939
5	47.704	45.981	45.249	45.130	45.437
10	47.647	44.609	44.365	44.487	44.326
15	47.243	43.276	43.667	43.724	43.528
20	47.070	42.542	43.485	43.565	43.438
25	47.002	41.592	42.119	42.145	42.398
30	45.295	40.052	40.635	40.404	41.702
45	43.183	37.211	37.856	37.226	37.223
60	42.363	34.625	34.849	34.249	34.388
90	39.546	30.223	30.002	30.116	28.959
120	36.733	26.367	25.671	25.246	24.795
150	32.934	22.547	22.800	21.775	21.332
180	29.505	18.057	18.353	16.058	16.302
210	26.167	14.057	13.353	13.058	12.302

Table A.9 Adsorption of chromium (VI) on the surface of TiO_2 in different calcination temperatures using TiO_2 with PEG 1.0

Time (min)	Cr (VI) adsorption on TiO_2 surface (mg Cr(VI)/g TiO_2)				
Calcination temperatures (°C)	300	450	500	600	800
0	0.000	0.000	0.000	0.000	0.000
5	0.115	0.329	0.209	0.142	0.082
10	0.195	0.450	0.352	0.258	0.161
15	0.232	0.611	0.450	0.350	0.185
20	0.283	0.720	0.581	0.467	0.250
30	0.343	0.995	0.795	0.635	0.309
45	0.343	0.995	0.795	0.635	0.309
60	0.343	0.995	0.795	0.635	0.309

Table A.10 Photocatalytic reduction of chromium (VI) in different calcination temperature using TiO_2 with PEG 1.0

Time (min)	Residual concentration of Cr (VI) (mg/L)				
Calcination temperatures (°C)	300	450	500	600	800
0	48.972	45.939	44.070	47.352	49.219
5	48.876	45.437	43.418	47.151	48.776
10	48.543	44.326	42.784	46.761	48.043
15	47.919	43.528	41.974	46.626	47.689
20	47.697	43.438	41.131	45.109	47.137
25	46.430	42.398	39.896	44.782	45.430
30	45.944	41.702	37.684	43.576	44.544
45	44.284	37.223	34.025	41.465	42.284
60	43.109	34.388	27.420	37.720	39.109
90	41.634	28.959	18.623	33.646	35.634
120	39.070	24.795	7.974	28.910	33.070
150	37.467	21.332	0.000	23.756	30.467
180	37.195	16.302	0.000	19.070	27.995
210	37.095	12.302	0.000	15.070	25.995

Table A.11 Adsorption of chromium (VI) on the surface of TiO_2 in different initial concentration of chromium (VI) using TiO_2 with PEG 1.0 and calcined at 500°C

Time (min)	**Cr (VI) adsorption on TiO_2 surface (mg Cr(VI)/g TiO_2)**				
Initial concentration of Cr(VI) (mg/L)	**10**	**25**	**50**	**75**	**100**
0	0.000	0.000	0.000	0.000	0.000
5	0.078	0.157	0.209	1.103	1.912
10	0.121	0.275	0.352	1.406	2.447
15	0.161	0.338	0.450	1.492	2.572
20	0.176	0.401	0.581	1.557	2.647
30	0.226	0.473	0.795	1.628	2.686
45	0.226	0.473	0.795	1.628	2.686
60	0.226	0.473	0.795	1.628	2.686

Table A.12 Photocatalytic reduction of chromium (VI) in different initial concentration of chromium (VI) using TiO_2 with PEG 1.0 and calcined at 500°C

Time (min)	**Residual concentration of Cr (VI) (mg/L)**				
Initial concentration of Cr(VI) (mg/L)	**10**	**25**	**50**	**75**	**100**
0	9.322	21.581	44.070	70.116	91.941
5	6.940	19.873	43.418	69.199	91.385
10	4.718	16.814	42.784	68.018	90.190
15	2.798	15.894	41.974	67.287	89.310
20	0.863	13.981	41.131	66.630	88.393
25	0.032	11.563	39.896	65.918	87.799
30	0.000	10.574	37.684	65.258	87.182
45	0.000	3.389	34.025	63.227	84.841
60	0.000	0.000	27.420	60.295	82.268
90	0.000	0.000	18.623	56.960	78.207
120	0.000	0.000	7.974	53.315	74.190
150	0.000	0.000	0.000	49.424	70.635
180	0.000	0.000	0.000	46.780	65.993
210	0.000	0.000	0.000	43.256	63.001

Table A.13 Adsorption of chromium (VI) on the surface of TiO_2 in different calcination temperatures using TiO_2 without additive

Time (min)	Cr (VI) adsorption on TiO_2 surface (mg Cr(VI)/g TiO_2)				
Calcination temperatures (°C)	300	450	500	600	800
0	0.000	0.000	0.000	0.000	0.000
5	0.502	0.741	0.299	0.076	0.171
10	1.747	1.004	0.556	0.176	0.210
15	2.201	1.567	1.093	0.205	0.334
20	2.843	2.021	1.295	0.507	0.579
30	3.617	3.326	1.440	0.851	0.684
45	3.617	3.326	1.440	0.851	0.684
60	3.617	3.326	1.440	0.851	0.684

Table A.14 Photocatalytic reduction of chromium (VI) in different calcination temperature using TiO_2 without additive

Time (min)	Residual concentration of Cr (VI) (mg/L)				
Calcination temperatures (°C)	300	450	500	600	800
0	46.383	46.674	48.560	49.149	49.316
5	45.456	45.523	48.228	48.805	48.865
10	44.514	44.855	48.142	48.155	48.558
15	44.370	44.363	47.810	48.024	48.286
20	43.817	43.898	47.140	47.642	47.741
25	43.192	43.321	46.588	47.477	47.511
30	42.341	42.496	46.160	47.106	47.484
45	40.299	41.528	44.919	46.295	47.357
60	38.162	40.620	44.137	45.402	46.721
90	34.972	38.513	41.755	44.965	45.971
120	32.940	35.774	40.696	43.652	44.172
150	30.443	32.074	38.940	42.495	42.202
180	26.985	28.734	37.601	41.618	40.932
210	22.316	25.484	37.887	38.589	39.561

Table A.15 Adsorption of chromium (VI) on the surface of TiO_2 in different initial concentration of chromium (VI) using TiO_2 without additive and calcined at 300°C

Time (min)	**Cr (VI) adsorption on TiO_2 surface (mg Cr(VI)/g TiO_2)**				
Initial concentration of Cr(VI) (mg/L)	**10**	**25**	**50**	**75**	**100**
0	0.000	0.000	0.000	0.000	0.000
5	0.535	0.929	2.502	1.154	2.800
10	0.576	1.177	2.747	2.053	3.570
15	0.644	1.340	3.001	2.828	4.236
20	0.761	1.441	3.143	5.187	4.903
30	0.838	2.420	3.617	6.483	6.228
45	0.838	2.420	3.617	6.483	6.228
60	0.838	2.420	3.617	6.483	6.228

Table A.16 Photocatalytic reduction of chromium (VI) in different initial concentration of chromium (VI) using TiO_2 without additive and calcined at 300°C

Time (min)	**Residual concentration of Cr (VI) (mg/L)**				
Initial concentration of Cr(VI) (mg/L)	**10**	**25**	**50**	**75**	**100**
0	9.162	22.580	46.383	68.517	93.772
5	7.105	22.378	45.456	67.801	93.333
10	5.492	21.738	44.514	67.559	92.926
15	3.894	20.249	44.370	67.518	92.702
20	2.402	19.606	43.817	67.513	92.556
25	0.882	18.859	43.492	67.093	92.105
30	0.005	18.538	43.341	67.002	91.946
45	0.000	16.646	41.299	64.269	89.606
60	0.000	14.222	39.162	61.231	85.052
90	0.000	10.219	36.972	57.941	77.553
120	0.000	5.040	32.940	52.867	76.180
150	0.000	2.612	30.443	48.469	73.019
180	0.000	0.025	27.985	44.668	70.882
210	0.000	0.000	25.316	41.707	69.768

BIOGRAPHY

Miss. Jirapat Ananpattarachai was born on January 1, 1980 in Khonkaen, Thailand. She attended Khonkaenwittayayon School and graduated in 1997. She received her Bachelor's degree (Honor) in Environmental Engineering from faculty of Engineering, King Mongkut's University of Technology Thonburi (KMUTT) in 2003. At KMUTT, she have studied in the topic of "Effect of isopropanol on preparation of thin film TiO_2 by Sol-Gel method" as her senior project which was published in an Science and Technology of Advanced Material. Her areas of specialist are in chemical wastewater treatment, photochemistry, industrial and hazardous waste treatment.

After that she pursued her Master Degree studies in the International Postgraduate Program in Environmental Management (Hazardous Waste Management), Inter-Department of Environmental Management Chulalongkorn University, Bangkok, Thailand on May, 2004. As a master student of this program, she developed her analytical skill in solving water pollution from her thesis "Effect of diethylene glycol and polyethylene glycol (M.W. 600) on synthesis of TiO_2 nanopowder and its application for Chromium (VI) removal" by which she can present the findings of her works through an International Conference on Hazardous Waste Management for a Sustainable Future at Bangkok, Thailand on the year of 2006.