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APPENDICES

APPENDICES

Appendix A Adsorption Isotherm

Table A1 Adsorption isotherm of AQUARD®alone

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
1	1875	316.7	1558.125	316.875	31.68753
2	3000	413.0	1947.331	1052.669	105.26692
3	4000	415.4	1957.031	2042.969	204.29694
4	4500	418.0	1967.539	2532.461	253.24612
5	5000	453.1	2109.399	2890.601	289.06010
6	5500	494.3	2275.913	3224.087	322.40871
7	6000	518.8	2374.932	3625.068	362.50679
8	6500	548.5	2494.968	4005.032	400.50324
9	7000	583.4	2636.019	4363.981	436.39806
10	7500	617.4	2773.434	4726.566	472.65662
11	8000	648.1	2897.511	5102.489	510.24890
12	8500	673.9	3001.784	5498.216	549.82158
13	9000	685.8	3049.879	5950.121	595.01207
14	9500	698.5	3101.208	6398.792	639.87924
15	10000	731.6	3234.985	6765.015	676.50154
16	10500	769.2	3386.949	7113.051	711.30513
17	11000	813.1	3564.375	7435.625	743.56250
18	11500	847.2	3702.194	7797.806	779.78065
19	12000	889.6	3873.557	8126.443	812.64426
20	12500	947.4	4107.162	8392.838	839.28382
21	13000	972.0	4206.585	8793.415	879.34148
22	13500	1011.0	4364.208	9135.792	913.57924
23	14000	1024.0	4416.748	9583.252	958.32516
24	16500	1729.0	7266.076	9233.924	923.39236
25	18000	1899.0	7953.148	10046.850	1004.68516
26	18750	1986.0	8304.768	10445.230	1044.52324
27	19500	2077.0	8672.553	10827.450	1082.74468
28	20250	2137.0	8915.049	11334.950	1133.49508
29	21000	2227.0	9278.793	11721.210	1172.12068
30	21750	2351.0	9779.952	11970.050	1197.00484

Table A1(cont.) Adsorption isotherm of 1:0 AQUARD®:TericX10 molar ratio.

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
31	22500	2460.0	10220.490	12279.510	1227.95140
32	23250	2697.0	11178.350	12071.650	1207.16548
33	24000	2987.0	12350.410	11649.590	1164.95908
34	24750	2975.0	12301.910	12448.090	1244.80900
35	25500	3224.0	13308.270	12191.730	1219.17316
36	26250	3310.0	13655.850	12594.150	1259.41540
37	27000	3341.0	13781.140	13218.860	1321.88644
38	27750	3547.0	14613.710	13136.290	1313.62948
39	28500	3650.0	15029.990	13470.010	1347.00100
40	29250	3783.0	15567.520	13682.480	1368.24772
41	30000	3705.0	15252.280	14747.720	1474.77220
42	30750	4261.0	17499.410	13250.590	1325.05924
43	31500	4330.0	17778.280	13721.720	1372.17220
44	32250	4581.0	18792.720	13457.280	1345.72804
45	33000	4916.0	20146.660	12853.340	1285.33444
46	33750	5002.0	20494.230	13255.770	1325.57668
47	34500	5087.0	20837.770	13662.230	1366.22308
48	35250	5383.0	22034.080	13215.920	1321.59172
49	36000	5637.0	23060.650	12939.350	1293.93508
50	37500	5827.0	23828.550	13671.450	1367.14468
51	39000	6240.0	25497.730	13502.270	1350.22660
52	40500	6589.0	26908.250	13591.750	1359.1748
53	42000	7052.0	28779.510	13220.490	1322.0487

Final** = Final* x 4.0416 +278.15

13781.14 = 316.7 x 4.0416+278.15

Adsorbed* = initial - Final**

13218.86 = 1875 - 316.7

Adsorbed** = 0.2 x 20 x Adsorbed*/1000

1321.88644 = 0.2 x 20 x 13218.86/1000

Table A2 Adsorption isotherm of 1:1 AQUARD®:TericX10 molar ratio.

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
1	4000	327.2	1178.718	2821.282	282.12820
2	5000	344.9	1237.048	3762.952	376.29520
3	6000	397.7	1411.050	4855.950	458.89500
4	7000	443.1	1560.666	5439.334	543.93340
5	8000	459.0	1613.065	6386.936	638.69360
6	9000	538.1	1873.739	7126.261	712.62610
7	10000	612.1	2117.606	7882.394	788.23940
8	12000	703.5	2418.814	9581.186	958.11860
9	13000	829.3	2833.388	10166.610	1016.66100
10	14000	1362.0	4588.901	9411.099	941.10990
11	15000	1371.0	4618.561	10381.440	1038.14400
12	16000	1388.0	4674.584	11325.420	1132.54200
13	17000	1790.0	59999.375	11000.630	1100.06300
14	18000	1818.0	6091.649	11908.350	1190.83500
15	19000	2225.0	7432.918	11567.080	1156.30900
16	20000	2560.0	8536.910	11463.090	1146.30900
17	21000	2576.0	8589.638	12410.360	1241.03600
18	22500	2745.0	9146.578	13353.420	1335.34200
19	24000	3082.0	10257.160	13742.840	1374.28400
20	27000	3858.0	12814.470	14185.530	1418.55300
21	30000	4469.0	14828.020	15171.980	1517.19800
22	33000	5668.0	18779.320	14220.680	1422.06800
23	36000	6603.0	21860.620	14139.380	1413.93800
24	39000	7481.0	24754.070	14245.930	1424.59300
25	42000	8654.0	28619.690	13380.310	1338.03100
26	48000	10400.0	34373.630	13626.370	1362.63700
27	51000	11270.0	37240.720	13759.290	1375.92900
28	54000	12510.0	41327.140	12672.870	1267.28700
29	57000	13350.0	44095.360	12904.650	1290.46500
30	60000	14520.0	47951.090	12048.910	1204.89100

Final** = Final* x 3.2955+100.43

1178.718 = 327.2 x 3.2955+100.43

Adsorbed* = initial - Final**

2821.282 = 4000 - 1178.718

Adsorbed** = 0.2 x 20 x Adsorbed*/1000

282.1282 = 0.2 x 20 x 821.282/1000

Table A3 Adsorption isotherm of 3:1 AQUARD®: TericX10 molar ratio.

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
1	600	135.1	554.401	45.599	4.56
2	900	159	645.664	254.336	25.434
3	1200	177.7	717.069	482.931	48.293
4	1500	200.9	805.658	694.341	69.434
5	1800	230.7	919.45	880.55	88.055
6	2100	235.4	937.396	1162.603	116.26
7	2400	258.5	1025.604	1374.396	137.439
8	2700	251.2	997.729	1702.271	170.227
9	3000	267	1058.062	1941.938	194.194
10	3600	349.6	1373.469	2226.53	222.653
11	4800	395.6	1549.121	3250.879	325.088
12	6000	448.4	1750.737	4249.263	424.926
13	7200	523.3	2036.743	5163.257	516.326
14	8400	593.5	2304.802	6059.198	609.52
15	9600	653.5	2533.912	7066.088	706.609
16	10800	727	2814.572	7985.428	798.543
17	12000	772.6	2988.695	9011.305	901.13
18	13200	861.6	3328.542	9871.458	987.146
19	14400	969.5	3740.557	10659.442	1065.944
20	16200	1059	4082.313	12117.686	1211.769

Table A3(cont.) Adsorption isotherm of 3:1 AQUARD®: TericX10 molar ratio.

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
21	18000	1174	4521.441	13478.56	1347.856
22	21000	1701	6533.791	14466.21	1446.621
23	24000	2518	9653.505	14346.5	1434.649
24	27000	3319	12712.123	13655.14	1428.788
25	30000	4135	15828.019	14171.98	1417.198
26	33000	5056	19344.858	13655.14	1365.514
27	39000	6634	19344.858	13629.55	1362.955
28	42000	7396	25370.451	13719.85	1371.985
29	45000	8222	28280.148	13565.77	1356.577
30	48000	9089	31434.229	13255.13	1325.513
31	51000	9953	34744.869	12955.95	1295.595
32	54000	10520	40209.142	13790.86	1379.086
33	60000	12250	46815.147	13184.85	1318.485

Final** = Final* x 3.8185+38.52

554.401 = 135.1 x 3.8185+38.52

Adsorbed* = initial - Final**

45.599 = 600 - 554.401

Adsorbed**= 0.2 x 20 x Adsorbed*/1000

4.560 = 0.2 x 20 x 45.599/1000

Table A4 Adsorption isotherm of 1:3 AQUARD®: TericX10 molar ratio.

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
1	480	114.6	418.098	61.902	6.190
2	540	113.9	416.241	123.759	12.376
3	600	123.9	442.774	157.226	15.723
4	900	145.3	499.554	400.445	40.045
5	1200	145.3	499.554	400.445	70.045
6	1500	174	575.704	924.296	92.430

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
7	1800	283.9	867.302	932.698	3.27
8	2100	219.5	696.429	1403.571	140.357
9	2400	216.6	688.735	1711.265	171.127
10	3000	185.1	60.155	2394.844	239.484
11	3600	201.7	649.201	2950.799	295.08
12	4800	237.3	743.658	4056.342	405.634
13	6000	280	856.954	5143.046	514.305
14	7200	381.4	1125.998	6074.001	607.4
15	8400	1048	2664.312	5505.311	693.562
16	10800	1597	4351.35	6448.65	644.865
17	12000	1765	4797.105	7202.895	720.615
18	13200	2312	6248.4596	6951.54	695.154
19	14400	2657	7163.848	7236.152	723.615
20	16200	3479	9344.861	6855.139	685.513
21	18000	3876	10398.221	7601.779	760.178
22	21000	4521	12109.599	8890.401	889.04
23	24000	5676	15174.161	8825.839	882.584
24	27000	6356	16978.405	10021.59	1002.16
25	30000	7418	19796.209	10203.79	1020.379
26	33000	8819	23513.483	9486.517	948.6517
27	36000	9381	25004.637	10995.36	1099.536
28	39000	10760	28663.538	10336.46	1033.646
29	42000	11830	31502.569	10497.43	1049.743
30	45000	12380	32961.884	12038.12	1203.812
31	48000	13790	36703.037	11296.96	1129.696
32	51000	15140	40284.992	10715.01	1071.501
33	54000	16540	43999.612	10000.39	1000.039
34	57000	17330	46095.719	10904.28	1090.428
35	60000	18440	46040.882	10959.19	1095.912

Final** = Final* x 2.6533+114.03

418.098= 114.6x 2.6533+114.03

Adsorbed* = initial - Final**

61.902 = 480 - 418.098

Adsorbed**= 0.2 x 20 x Adsorbed*/1000

6.190 = 0.2 x 20 x 61.902/1000

Table A4 Adsorption isotherm of 0:1 AQUARD®: TericX10 molar ratio.

	Initial µmol	Final* ppm	Final** µmol/l	Adsorbed* µmol	Adsorbed** (umol/g)
1	1200	262.4	1098.657	101.343	10.134
2	3000	773.7	2398.024	601.976	60.978
3	4000	1095	3214.544	785.457	78.246
4	5000	1406	4004.888	995.112	99.511
5	6000	1744	4863.847	1136.153	113.615
6	7000	2026	5580.494	1419.506	141.951
7	8000	2296	6266.645	1733.355	173.336
8	10000	3225	8627.513	1372.488	137.249
9	11000	3611	9608.454	1391.546	139.155
10	12000	3856	10231.073	1768.927	176.893
11	13000	4210	11130.693	1869.307	186.931
12	14000	4652	12253.948	1746.054	174.605
13	15000	5042	13245.055	1754.945	175.495
14	16000	5553	14543.659	1456.341	145.634
15	17000	6018	15725.363	1274.637	127.464
16	18000	6422	16752.049	1247.951	124.795
17	19000	6781	17664.375	1335.625	133.563
18	20000	7204	18739.345	1260.655	126.066

Final** = Final* x 2.5413+431.82

1098.657= 262.4x 2.5413+431.82

Adsorbed* = initial - Final**

10.134= 1200 - 1098.657

Adsorbed**= 0.2 x 20 x Adsorbed*/1000

10.134= 0.2 x 20 x 101.343/1000

Appendix B Continuous Stirred Tank Reactor

Monomer Loading Calculation

Table B1 Calculation of the amount of monomer loading for the surface modification

Monomer	Isoprene
Molecular weight	68.12
Density	0.681

Pump Flow Rate Determination

Table B2 Calculation of pump flow rate for 30 min retention times of the surface modification

Reactor size	1	liter (V)
Total run volume	12.5	liters

(τ)	($v = V / \tau$)		($t = \tau / v$)		
Mean resident time (min)	Flow rate		Total run time		
	ml / sec	ml / min	min	h	h : min
30	0.556	33.33	375	6.25	6:15

Calculation is based on a ratio of 1 grams clay per liter of AQUARD® solution, and for 125 grams clay modification per a run.

CURRICULUM VITAE

Name: Miss Sanchuta Senasuttipan

Date of Birth: June 16, 1978

Nationality Thai

University Education:

1997 – 2001 Bachelor Degree of Science in Chemistry, Faculty of Science, Chaingmai University, Chaing Mai, Thailand