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APPENDIX

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## APPENDIX A

## I. Exposure Tests for Carbon steel specimens

The 1<sup>st</sup> experiment : exposure at 10 °C

React <sup>a</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	H <sub>2</sub> O	1023.8	0.0392	0.0409
2	H <sub>2</sub> O+HCl 150 ppm	1023.85	0.0681	0.0625
3	CH <sub>3</sub> OH	1023.9	0.0009	0.0014
4	Petroleum ether(PE)	1023.95	0.0012	0.0014
5	CH <sub>3</sub> OH+DMM 250 ppm	1024	0.0016	0.0015
6	CH <sub>3</sub> OH+DMM 200 ppm	1024.05	0.0009	0.0008
7	CH <sub>3</sub> OH+DMM 150 ppm	1024.1	0.0015	0.0004
8	CH <sub>3</sub> OH+DMM 100 ppm	1024.15	0.0008	0.0015
9	PE+DMM 250 ppm	1024.2	0.0009	0.0009
10	PE+DMM 200 ppm	1024.25	0.0022	0.0022
11	PE+DMM 150 ppm	1024.3	0.0012	0.0012
12	PE+DMM100 ppm	1024.35	0.0019	0.0019
13	CH <sub>3</sub> OH+Hg	1024.4	0.0017	0.0017
14	PE+Hg	1024.45	0.0016	0.0016
15	Cyclohexane+Hg	1024.5	0.0022	0.0022
16	CH <sub>3</sub> OH+HCL 150 +DMM 250 ppm	783.9	0.0118	0.0118
17	CH <sub>3</sub> OH+HCL 150 +DMM 200 ppm	783.95	0.0107	0.0107
18	CH <sub>3</sub> OH+HCL 150 +DMM 150 ppm	784	0.0125	0.0125
19	CH <sub>3</sub> OH+HCL 150 +DMM 100 ppm	784.05	0.0130	0.0130
20	PE+HCl 150 ppm+DMM 150 ppm	784.1	0.0044	0.0044
21	CH <sub>3</sub> OH+HCl 150 ppm+DMM 50 pp	784.12	0.0170	0.021
22	CH <sub>3</sub> OH+HCl 150 ppm	784.15	0.0131	0.0131
23	PE+HCl 150 ppm	784.2	0.0076	0.0076

The 2<sup>nd</sup> experiment : exposure at 30°C

React <sup>d</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	CH <sub>3</sub> OH+H <sub>2</sub> O 200 ppm	828.3	0.0005	0.0007
2	PE+H <sub>2</sub> O 200 ppm	828.35	0.0006	0.0005
3	CH <sub>3</sub> OH	828.4	0.0001	0.0002
4	Petroleum ether(PE)	828.45	0.0006	0.0008
5	CH <sub>3</sub> OH+DMM 250 ppm	828.5	0.0005	0.0005
6	CH <sub>3</sub> OH+DMM 200 ppm	828.55	0.0012	0.0009
7	CH <sub>3</sub> OH+DMM 150 ppm	828.6	0.0007	0.0007
8	CH <sub>3</sub> OH+DMM 100 ppm	828.65	0.0003	0.0005
9	CH <sub>3</sub> OH+DMM 50 ppm	828.68	0.0004	0.0004
10	PE+DMM 250 ppm	828.7	0.0007	0.0002
11	PE+DMM 200 ppm	828.75	0.0003	0.0006
12	PE+DMM 150 ppm	828.8	0.0004	0.0007
13	PE+DMM 100 ppm	828.85	0.0004	0.0003
14	PE+DMM 50 ppm	828.87	0.0005	0.0005
15	CH <sub>3</sub> OH+HCL 150 +DMM 250 ppm	828.9	0.0252	0.0252
16	CH <sub>3</sub> OH+HCL 150 +DMM 200 ppm	828.95	0.0181	0.0259
17	CH <sub>3</sub> OH+HCL 150 +DMM 150 ppm	829	0.025	0.0257
18	CH <sub>3</sub> OH+HCL 150 +DMM 100 ppm	829.05	0.019	0.0255
19	CH <sub>3</sub> OH+HCL 150 +DMM 50 ppm	829.08	0.0207	0.0210
20	PE+HCl 150 ppm+DMM 250 ppm	829.1	0.0052	0.0054
21	PE+HCl 150 ppm+DMM 200 ppm	829.15	0.0041	0.0040
22	PE+HCl 150 ppm+DMM 150 ppm	829.2	0.0043	0.0044

23	PE+HCl 150 ppm+DMM 100 ppm	829.25	0.0050	0.0050
24	PE+HCl 150 ppm+DMM 50 ppm	829.28	0.0032	0.0032
25	CH <sub>3</sub> OH+Hg	829.3	0.0006	0.0004
26	PE+Hg	829.35	0.0001	0.0004
27	Cyclohexane+Hg	829.40	0.0016	0.0015
28	CH <sub>3</sub> OH+HCl 150 ppm	829.45	0.0189	0.0188
29	PE+HCl 150 ppm	829.5	0.007	0.0071
30	H <sub>2</sub> O	662.6	0.0328	0.0302
31	H <sup>2</sup> O+HCl 150 ppm	662.7	0.0618	0.0638

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The 3<sup>rd</sup> experiment : exposure at 50°C

React <sup>n</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	H <sub>2</sub> O	915.9	0.0450	0.0350
2	H <sub>2</sub> O+HCl 150 ppm	915.95	0.155	0.2915
3	CH <sub>3</sub> OH	916.98	0.0012	0.0013
4	PE	916	0.0015	0.0015
5	CH <sub>3</sub> OH+DMM 250 ppm	916	0.0041	0.0038
6	CH <sub>3</sub> OH+DMM 200 ppm	916.05	0.0031	0.0052
7	CH <sub>3</sub> OH+DMM 150 ppm	916.10	0.0036	0.0033
8	CH <sub>3</sub> OH+DMM 100 ppm	916.15	0.0048	0.0042
	CH <sub>3</sub> OH+HCl 150 ppm	916.18	0.0180	0.0180
9	PE+DMM 250 ppm	916.20	0.0003	0.0005
10	PE+DMM 200 ppm	916.25	0.0028	0.009
11	PE+DMM 150 ppm	916.3	0.003	0.0043
12	PE+DMM100 ppm	916.35	0.0036	0.008
	PE+DMM 150 ppm+HCl 150 ppm	916.38	0.0080	0.0070
13	CH <sub>3</sub> OH+Hg	916.4	0.0019	0.001
14	PE+Hg	916.45	0.0035	0.0023
15	Cyclohexane+Hg	916.5	0.0282	0.0259
16	CH <sub>3</sub> OH+HCL 150 ppm+DMM 150	916.55	0.0330	0.032
17	PE+HCl 150 ppm	916.6	0.0100	0.0100

The 4<sup>th</sup> experiment : exposure at 70°C

React <sup>n</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	H <sub>2</sub> O	977.8	0.063	0.0600
2	H <sub>2</sub> O+HCl 200 ppm	977.85	0.2470	0.242
3	CH <sub>3</sub> OH	977.9	0.0018	0.0021
4	Petroleum ether(PE)	977.95	0.0027	0.0014
5	CH <sub>3</sub> OH+DMM 250 ppm	978	0.0017	0.0018
6	CH <sub>3</sub> OH+DMM 200 ppm	978.05	0.0019	0.0016
7	CH <sub>3</sub> OH+DMM 150 ppm	978.10	0.0022	0.0017
8	CH <sub>3</sub> OH+DMM 100 ppm	978.15	0.0019	0.0023
9	PE+DMM 250 ppm	978.2	0.0019	0.0015
10	PE+DMM 200 ppm	978.25	0.0014	0.0016
11	PE+DMM 150 ppm	978.3	0.0013	0.0019
12	PE+DMM100 ppm	978.35	0.0013	0.0012
13	CH <sub>3</sub> OH+HCL 150 +DMM 250 ppm	978.40	0.0121	0.012
14	CH <sub>3</sub> OH+HCL 150 +DMM 200 ppm	978.45	0.0112	0.0122
15	CH <sub>3</sub> OH+HCL 150 +DMM 150 ppm	978.5	0.044	0.030
16	CH <sub>3</sub> OH+HCL 150 +DMM 100 ppm	978.55	0.0126	0.0117
17	PE+HCl 150 ppm+DMM 250 ppm	978.6	0.0023	0.0014
18	PE+HCl 150 ppm+DMM 200 ppm	978.65	0.0018	0.0018
19	PE+HCl 150 ppm+DMM 150 ppm	978.7	0.0031	0.0013
20	PE+HCl 150 ppm+DMM 100 ppm	978.75	0.0014	0.0016
21	CH <sub>3</sub> OH+Hg	978.8	0.0028	0.0025
22	PE+Hg	978.85	0.0035	0.0029
23	Cyclohexane+Hg	978.9	0.0024	0.0029
24	CH <sub>3</sub> OH+HCl 150 ppm	978.95	0.0164	0.0176
25	PE+HCl 150 ppm	979	0.0090	0.0025



## II. Exposure Tests for Aluminium Specimens

The 5<sup>th</sup> experiment : exposure at 10 °C

React <sup>a</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	H <sub>2</sub> O	976	0.0001	0.0001
2	H <sub>2</sub> O+HCl 150 ppm	976.05	0.01	0.0095
3	CH <sub>3</sub> OH	976.1	0.0001	0.0001
4	Petroleum ether(PE)	976.15	0.0001	0.0002
5	CH <sub>3</sub> OH+DMM 250 ppm	976.2	0.0005	0.0002
6	CH <sub>3</sub> OH+DMM 200 ppm	976.25	0.0002	0.0005
7	CH <sub>3</sub> OH+DMM 150 ppm	976.3	0.0004	0.0002
8	CH <sub>3</sub> OH+DMM 100 ppm	976.35	0.0003	0.0002
9	PE+DMM 250 ppm	976.4	0.0001	0.0001
10	PE+DMM 200 ppm	976.45	0.0003	0.0003
11	PE+DMM 150 ppm	976.5	0.0003	0.0003
12	PE+DMM100 ppm	976.55	0.0002	0.0002
13	CH <sub>3</sub> OH+Hg	976.6	0.0004	0.0005
14	PE+Hg	976.65	0.0001	0.0001
15	Cyclohexane+Hg	976.7	0.0001	0.0002
16	CH <sub>3</sub> OH+HCL 150 +DMM 250 ppm	738	0.0067	0.0050
17	CH <sub>3</sub> OH+HCL 150 +DMM 200 ppm	738.05	0.0055	0.0034
18	CH <sub>3</sub> OH+HCL 150 +DMM 150 ppm	738.10	0.0082	0.0029
19	CH <sub>3</sub> OH+HCL 150 +DMM 100 ppm	738.15	0.0059	0.0043
20	PE+HCl 150 ppm+DMM 150 ppm	738.2	0.0134	0.0156
21	CH <sub>3</sub> OH+HCl 150 ppm	738.25	0.0164	0.0191
22	PE+HCl 150 ppm	738.3	0.0108	0.0085

The 6<sup>th</sup> experiment : exposure at 30°C

React <sup>n</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	H <sub>2</sub> O	860.3	0.0024	0.0028
2	H <sub>2</sub> O+HCl 200 ppm	860.35	0.0124	0.0087
3	CH <sub>3</sub> OH	860.4	0.0001	0.0002
4	Petroleum ether(PE)	860.45	0.0003	0.0002
5	CH <sub>3</sub> OH+DMM 250 ppm	860.5	0.0001	0.0001
6	CH <sub>3</sub> OH+DMM 200 ppm	860.55	0.0001	0.0001
7	CH <sub>3</sub> OH+DMM 150 ppm	860.6	0.0003	0.0003
8	CH <sub>3</sub> OH+DMM 100 ppm	860.65	0.0005	0.0004
9	PE+DMM 250 ppm	860.7	0.0001	0.0001
10	PE+DMM 200 ppm	860.75	0.0002	0.0001
11	PE+DMM 150 ppm	860.8	0.0002	0.0001
12	PE+DMM100 ppm	860.85	0.0002	0.0003
13	CH <sub>3</sub> OH+HCL 150 +DMM 250 ppm	860.9	1.2263	1.2205
14	CH <sub>3</sub> OH+HCL 150 +DMM 200 ppm	860.95	1.1708	0.9397
15	CH <sub>3</sub> OH+HCL 150 +DMM 150 ppm	861	2.0160	1.9641
16	CH <sub>3</sub> OH+HCL 150 +DMM 100 ppm	861.05	1.1748	1.2285
17	PE+HCl 150 ppm+DMM 250 ppm	861.1	0.0007	0.0007
18	PE+HCl 150 ppm+DMM 200 ppm	861.15	0.0003	0.0004
19	PE+HCl 150 ppm+DMM 150 ppm	861.2	0.0006	0.0004
20	PE+HCl 150 ppm+DMM 100 ppm	861.25	0.0005	0.0002
21	CH <sub>3</sub> OH+Hg	861.3	0.0006	0.0006
22	PE+Hg	861.35	0.0001	0.0005
23	Cyclohexane+Hg	861.40	0.0002	0.0003
24	CH <sub>3</sub> OH+HCl 150 ppm	861.45	0.0470	0.0420
25	PE+HCl 150 ppm	861.5	0.0096	0.0107

The 7<sup>th</sup> experiment : exposure at 50°C

React <sup>n</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	H <sub>2</sub> O	890.3	0.0013	0.0016
2	H <sub>2</sub> O+HCl 150 ppm+DMM	890.35	0.0255	0.0287
3	CH <sub>3</sub> OH	890.4	0.0012	0.00120
4	PE	890.45	0.0002	0.0001
5	CH <sub>3</sub> OH+DMM 250 ppm	890.5	0.0001	0.0001
6	CH <sub>3</sub> OH+DMM 200 ppm	890.55	0.0005	0.0004
7	CH <sub>3</sub> OH+DMM 150 ppm	890.6	0.0004	0.0005
8	CH <sub>3</sub> OH+DMM 100 ppm	890.65	0.0014	0.0013
9	PE+DMM 250 ppm	890.7	0.0003	0.0005
10	PE+DMM 200 ppm	890.75	0.0004	0.0003
11	PE+DMM 150 ppm	890.8	0.0002	0.0003
12	PE+DMM100 ppm	890.85	0.0013	0.0006
13	CH <sub>3</sub> OH+Hg	890.90	0.0001	0.0001
14	PE+Hg	890.95	0.0006	0.0013
15	Cyclohexane+Hg	891	0.0011	0.0015
16	CH <sub>3</sub> OH+HCL 150 ppm	890.4	0.0450	0.0655
17	PE+HCl 150 ppm	890.45	0.0162	0.0227

The 8<sup>th</sup> experiment : exposure at 70°C

React <sup>n</sup> flask no.	Corrosive solutions	Time (hr)	Weight loss(g)	
			specimn	duplicate
1	H <sub>2</sub> O	756.0	0.0024	0.0033
2	H <sub>2</sub> O+HCl 200 ppm	756.5	0.0248	0.0367
3	CH <sub>3</sub> OH	756.55	0.0004	0.0006
4	Petroleum ether(PE)	756.6	0.0005	0.0002
5	CH <sub>3</sub> OH+DMM 250 ppm	756.65	0.0003	0.0001
6	CH <sub>3</sub> OH+DMM 200 ppm	756.7	0.001	0.0003
7	CH <sub>3</sub> OH+DMM 150 ppm	756.75	0.0005	0.0006
8	CH <sub>3</sub> OH+DMM 100 ppm	756.8	0.0002	0.0005
9	PE+DMM 250 ppm	756.85	0.0009	0.0009
10	PE+DMM 200 ppm	756.9	0.0013	0.0012
11	PE+DMM 150 ppm	756.95	0.0008	0.0008
12	PE+DMM100 ppm	757	0.0008	0.0005
13	CH <sub>3</sub> OH+HCL 150 +DMM 250 ppm	28.75		
14	CH <sub>3</sub> OH+HCL 150 +DMM 200 ppm	28.8		
15	CH <sub>3</sub> OH+HCL 150 +DMM 150 ppm	28.85		
16	CH <sub>3</sub> OH+HCL 150 +DMM 100 ppm	28.9		
17	PE+HCl 150 ppm+DMM 250 ppm	757.05	0.0015	0.001
18	PE+HCl 150 ppm+DMM 200 ppm	757.1	0.0007	0.0009
19	PE+HCl 150 ppm+DMM 150 ppm	757.15	0.0007	0.0005
20	PE+HCl 150 ppm+DMM 100 ppm	757.2	0.0009	0.0006
21	CH <sub>3</sub> OH+Hg	757.25	0.0016	0.0023
22	PE+Hg	757.3	0.0017	0.0018
23	Cyclohexane+Hg	757.35	0.0012	0.0013
24	CH <sub>3</sub> OH+HCl 150 ppm	757.4	0.0599	0.0717
25	PE+HCl 150 ppm	757.45	0.0293	0.0204

### III. The 2<sup>nd</sup> Experiment for Aluminium Specimens (Special tests for Al specimen only)

#### 1. Corrosive solutions with CH<sub>3</sub>OH as solvent

##### The 9<sup>th</sup> Experiment : Weight loss

CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM			CH <sub>3</sub> OH+150 ppm HCl		
Exposure Time (h)	Specimen weight (g)		Exposure Time (h)	Specimen weight (g)	
	Specimen	Duplicate		Specimen	Duplicate
0	1.7142	1.7630	0	1.8821	1.9586
8.58	1.7138	1.7630	8.58	1.8805	1.9556
16.58	1.7088	1.7625	16.58	1.8790	1.9556
24.58	1.6903	1.7620	24.58	1.8768	1.9512
30.08	1.6063	1.7619	30.08	1.8719	1.9459
37.92	1.4648	1.7613	37.52	1.8717	1.9446
49	1.2650	1.7604	49.17	1.8713	1.9431
57.33	1.0918	1.7582	73.17	1.8680	1.9398
71	0.8566	1.7404	96.67	1.8647	1.9362
83.08	0.6547	1.6809	120.67	1.8604	1.9312
96.58	0.4773	1.5059	144.17	1.8562	1.9261
108.58	0.3313	1.2422	160	1.8546	1.9235
123.42	0.2184	0.9565			
141.58	0.0813	0.6496			
153.58	0.0002	0.0405			
159.75	0	0			

##### The 10<sup>th</sup> Experiment : Vary temperature

React <sup>d</sup> flask no.	Corrosive solutions	Exposure temp.	Exposure time
1	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	10°C	381.00
2	CH <sub>3</sub> OH+150 ppm HCl	10°C	381.00
3	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	20°C	214.92
4	CH <sub>3</sub> OH+150 ppm HCl	20°C	214.92
5	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	30°C	142.13
6	CH <sub>3</sub> OH+150 ppm HCl	30°C	142.13
7	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	40°C	53.67
8	CH <sub>3</sub> OH+150 ppm HCl	40°C	53.67
9	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	50°C	29.7
10	CH <sub>3</sub> OH+150 ppm HCl	50°C	29.7
11	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	60°C	6.50
12	CH <sub>3</sub> OH+150 ppm HCl	60°C	6.50

**The 11<sup>th</sup> Experiment : Vary concentration of DMM**

React <sup>n</sup> flask no.	Various corrosive solutions	Time (h)
1	CH <sub>3</sub> OH+150 ppm HCl	452.33
2	CH <sub>3</sub> OH+150 ppm HCl+50 ppm DMM	454.58
3	CH <sub>3</sub> OH+150 ppm HCl+75 ppm DMM	496.35
4	CH <sub>3</sub> OH+150 ppm HCl+100 ppm DMM	454.58
5	CH <sub>3</sub> OH+150 ppm HCl+125 ppm DMM	496.25
6	CH <sub>3</sub> OH+150 ppm HCl+150 ppm DMM	133.58
7	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	133.42
8	CH <sub>3</sub> OH+150 ppm HCl+250 ppm DMM	111.17
9	CH <sub>3</sub> OH+15 ppm HCl	452.67
10	CH <sub>3</sub> OH+15 ppm HCl+15 ppm DMM	452.67
11	CH <sub>3</sub> OH+1.5 ppm HCl	453.00
12	CH <sub>3</sub> OH+1.5 ppm HCl+1.5 ppm DMM	453.00
13	CH <sub>3</sub> OH+0.15 ppm HCl	453.83
14	CH <sub>3</sub> OH+0.15 ppm HCl+0.15 ppm DMM	453.83

**The 12<sup>th</sup> Experiment : Vary solution agitation**

React <sup>n</sup> flask no.	Corrosive solutions	Agitation (rpm)	Exposure Time(h)
1	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	0	126.50
2	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	300	126.67
3	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	600	127.25
4	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	900	127.42
5	CH <sub>3</sub> OH+150 ppm HCl+200 ppm DMM	1200	127.92

## 2. Corrosive solutions with PE as solvent

### The 13<sup>th</sup> Experiment : Vary temperature

React <sup>n</sup> flask no.	Corrosive solutions	Exposure Temp.	Exposure Time (h)
1	PE+150 ppm HCl	30°C	759.92
2	PE+150 ppm HCl+150 ppm DMM	30°C	760.67
3	PE+150 ppm HCl	20°C	762.50
4	PE+150 ppm HCl+150 ppm DMM	20°C	762.58
5	PE+150 ppm HCl	10°C	763.25
6	PE+150 ppm HCl+150 ppm DMM	10°C	763.42
7	PE+150 ppm HCl	0°C	764.45
8	PE+150 ppm HCl+150 ppm DMM	0°C	765.00
9	PE+150 ppm HCl	-10°C	764.00
10	PE+150 ppm HCl+150 ppm DMM	-10°C	764.17

### The 14<sup>th</sup> Experiment : Vary concentration of DMM

React <sup>n</sup> flask no.	Corrosive solutions	Expos. Time(h)	Weigh Loss	
			Speci.	Duplic.
1	PE+150 ppm HCl	674.58	0.0082	0.0094
2	PE+150 ppm HCl+50 ppm DMM	674.75	0.0102	0.0081
3	PE+150 ppm HCl+100 ppm DMM	676.83	0.0116	0.0127
4	PE+150 ppm HCl+150 ppm DMM	677.00	0.0101	0.0110
5	PE+150 ppm HCl+200 ppm DMM	677.67	0.0087	0.0074
6	PE+150 ppm HCl+250 ppm DMM	677.92	0.0129	0.0123
7	PE + 15 ppm HCl	678.42	0.0014	0.0013
8	PE + 15 ppm HCl 15 ppm DMM	680.03	0.0017	0.0016
9	PE + 1.5 ppm HCl	678.75	0.0004	0.0008
10	PE + 1.5 ppm HCl + 1.5 ppm DMM	679.08	0.0004	0.0005
11	PE+0.15 ppm HCl	680.30	0.0002	0.0003
12	PE+0.15 ppm HCl+0.15 ppm DMM	679.42	0.0001	0.0002
13	PE+0.015 ppm HCl	680.90	0.0002	0.0017
14	PE+0.015 ppm HCl+0.015 ppm DMM	679.67	0.0001	0.0004

**The 15<sup>th</sup> Experiment : Vary speed of solution agitation**

React <sup>n</sup> flask no.	Corrosive solutions	Agitation (rpm)	Exposure Time (h)
1	PE + 150 ppm HCl + 200 ppm DMM	0	432.00
2	PE + 150 ppm HCl + 200 ppm DMM	300	443.83
3	PE + 150 ppm HCl + 200 ppm DMM	600	444.28
4	PE + 150 ppm HCl + 200 ppm DMM	900	444.75
5	PE + 150 ppm HCl + 200 ppm DMM	1200	445.17

React <sup>n</sup> flask no.	Corrosive solutions	Weight Specimen	Loss Duplicate
1	PE + 150 ppm HCl + 200 ppm DMM	0.0220	0.0220
2	PE + 150 ppm HCl + 200 ppm DMM	0.0202	0.0198
3	PE + 150 ppm HCl + 200 ppm DMM	0.019	0.0201
4	PE + 150 ppm HCl + 200 ppm DMM	0.0209	0.0209
5	PE + 150 ppm HCl + 200 ppm DMM	0.0197	0.0208

**The 16<sup>th</sup> Experiment : Special experiment**

React <sup>n</sup> flask no.	Corrosive solutions	expos. time(h)	weight loss (g)	
			specim	duplic.
1	PE 100 ml+200 ppm DMM+H <sub>2</sub> O 50 ml+150 ppm HCl	600.00	0.0416	0.0412
2	PE 100 ml+200 ppm DMM+H <sub>2</sub> O 100 ml + saturated H <sub>2</sub> S	817.92	0.0024	0.0019
3	PE 100 ml+200 ppm DMM+300 ppm H <sub>2</sub> O + saturated H <sub>2</sub> S	943.33	0.0002	0.0002
4	PE 140 ml+300 ppm H <sub>2</sub> O+200 ppm DMM+ether 10 ml+saturated H <sub>2</sub> S	943.83	0.0001	0.0001
5	PE 150 ml+300 ppm H <sub>2</sub> O+saturated H <sub>2</sub> S	943.67	0.0001	0.0002



## APPENDIX B

### I. Corrosion Results of Carbon Steel Specimens : Corrosion rates

Result of the 1<sup>st</sup> experiment : exposure at 10°C

expos. time (hr)	specimen				duplicate			
	w. l. (g)	surfacc (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfacc (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
1023.8	0.0392	7.327	12.54	2.128	0.0409	7.461	12.85	2.181
1023.85	0.0681	7.449	21.43	3.637	0.0625	7.222	20.29	3.443
1023.9	0.0009	7.560	0.279	0.047	0.0014	7.775	0.022	0.072
1023.95	0.0012	7.505	0.375	0.063	0.0014	7.698	0.426	0.072
1024	0.0016	7.643	0.491	0.083	0.0015	7.657	0.459	0.078
1024.05	0.0009	7.520	0.281	0.048	0.0008	7.368	0.254	0.043
1024.1	0.0015	7.671	0.458	0.078	0.0004	7.515	0.125	0.021
1024.15	0.0008	7.530	0.250	0.042	0.0015	7.753	0.453	0.077
1024.2	0.0020	7.517	0.623	0.106	0.0009	7.205	0.292	0.050
1024.25	0.0009	7.546	0.279	0.047	0.0022	7.491	0.688	0.117
1024.3	0.0021	7.530	0.653	0.111	0.0012	7.560	0.372	0.063
1024.35	0.0014	7.273	0.451	0.077	0.0019	7.753	0.574	0.097
1024.4	0.0019	7.615	0.585	0.099	0.0017	7.768	0.513	0.087
1024.45	0.0017	7.366	0.541	0.092	0.0016	7.420	0.505	0.086
1024.5	0.0022	8.015	0.643	0.109	0.0022	7.226	0.713	0.121
783.9	0.0121	7.796	4.752	0.810	0.0118	7.795	4.634	0.786
783.95	0.0127	7.712	5.042	0.856	0.0107	7.530	4.350	0.738
784	0.0115	7.685	4.581	0.777	0.0125	7.712	4.962	0.842
784.05	0.0125	7.531	5.081	0.862	0.0130	7.726	5.151	0.874
784.1	0.005	7.491	2.043	0.347	0.0044	7.753	1.737	0.295
784.12	0.1170	7.512	4.770	0.810	0.0117	7.521	4.772	0.810
784.15	0.0147	7.071	6.363	1.080	0.0131	7.546	5.313	0.902
784.2	0.0085	7.796	3.337	0.566	0.0076	7.657	3.038	0.516

**Result of the 2<sup>nd</sup> experiment : exposure at 30°C**

expos. time (hr)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
828.30	0.0005	7.768	0.187	0.032	0.0007	7.643	0.265	0.045
828.35	0.0006	7.903	0.22	0.037	0.0005	7.546	0.192	0.033
828.4	0.0001	7.692	0.038	0.006	0.0002	7.587	0.076	0.013
828.45	0.0006	7.726	0.225	0.038	0.0008	7.474	0.310	0.053
828.5	0.0005	7.105	0.209	0.035	0.0005	7.685	0.189	0.032
828.55	0.0012	7.259	0.479	0.081	0.0009	7.573	0.344	0.058
828.6	0.0007	7.643	0.274	0.026	0.0007	7.408	0.274	0.046
828.65	0.0003	7.085	0.123	0.021	0.0005	7.365	0.197	0.033
828.68	0.0004	7.128	0.156	0.026	0.0004	7.432	0.157	0.027
828.7	0.0007	7.518	0.270	0.046	0.0002	7.30	0.079	0.014
828.75	0.0003	7.586	0.115	0.019	0.0006	7.546	0.230	0.039
828.8	0.0004	7.796	0.149	0.052	0.0007	7.587	0.267	0.045
828.85	0.0004	7.921	0.015	0.025	0.0003	7.440	0.117	0.020
828.87	0.0005	7.635	0.188	0.032	0.0005	7.469	0.185	0.031
828.9	0.0252	7.436	9.776	1.659	0.0252	7.643	9.547	1.620
828.95	0.0181	7.436	7.047	1.196	0.0259	8.053	9.312	1.580
829	0.0250	7.436	9.733	1.652	0.0257	7.436	10.01	1.698
829.05	0.0190	7.259	7.576	1.286	0.0255	7.463	9.891	1.679
829.08	0.0207	7.376	8.107	1.376	0.021	7.501	8.108	1.376
829.1	0.0052	7.435	2.020	0.341	0.0054	7.754	2.082	0.343
829.15	0.0041	7.740	1.538	0.261	0.0040	7.449	1.542	0.26
829.2	0.0043	7.449	1.682	0.284	0.0044	7.573	1.682	0.284
829.25	0.0050	7.463	1.947	0.329	0.0050	7.407	1.947	0.328
829.28	0.0032	7.542	1.213	0.207	0.0032	7.561	1.213	0.206
829.3	0.0006	7.491	0.232	0.039	0.0004	7.893	0.147	0.025
829.35	0.0001	7.437	0.039	0.007	0.0004	7.505	0.154	0.026
829.4	0.0016	7.132	0.629	0.034	0.0015	7.148	0.629	0.041

829.45	0.0189	7.491	7.30	1.239	0.0188	7.449	7.302	1.240
829.50	0.007	7.596	2.666	0.453	0.0071	7.754	2.649	0.450
662.6	0.0328	7.726	15.37	2.610	0.0302	7.824	13.98	2.373
662.7	0.0618	7.838	28.55	4.850	0.0638	7.615	30.34	5.150



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**Result of the 3<sup>rd</sup> experiment : exposure at 50°C**

expos. time (hr)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
915.9	.0450	7.366	16.10	2.072	.0350	8.155	11.12	1.878
915.95	.1550	7.505	54.12	9.185	.2915	8.321	91.78	15.57
916.98	.0012	7.536	0.420	0.071	.0013	8.015	0.418	0.071
916	.0015	7.638	0.520	0.088	.0015	7.962	0.502	0.085
916	.0041	7.367	1.458	0.247	.0038	7.421	1.342	0.228
916.05	.0031	7.740	1.049	0.178	.0052	7.838	1.738	0.295
916.1	.0036	7.735	1.219	0.207	.0033	7.395	1.169	0.198
916.15	.0048	7.587	1.657	0.281	.0042	7.615	1.445	0.245
916.18	0.018	7.416	6.300	1.064	0.018	7.571	6.015	1.031
916.2	.0034	7.657	1.163	0.197	.005	7.047	1.858	0.315
916.25	.0028	7.698	0.953	0.162	.009	7.975	2.956	0.502
916.3	.0030	7.671	1.024	0.174	.0043	7.435	1.515	0.257
916.35	.0036	7.504	1.256	0.213	.008	7.491	2.780	0.475
916.38	.0080	7.640	2.655	0.448	.007	7.831	2.480	0.419
916.4	.0019	8.102	0.614	0.104	.001	7.671	0.341	0.058
916.45	.0035	7.768	1.180	0.200	.0023	7.768	0.775	0.132
916.5	.0282	7.748	9.562	1.617	.0259	7.838	8.653	1.469
916.55	0.033	7.814	11.08	1.871	.032	7.945	10.51	1.775
916.6	0.010	7.546	3.592	0.607	.010	7.841	3.201	0.541

**Result of the 4<sup>th</sup> experiment : exposure at 70°C**

expos. time (hr)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
977.8	0.063	7.335	21.10	3.564	.0600	7.219	20.52	3.466
977.85	0.2470	7.304	83.16	14.05	.2420	7.342	81.06	13.69
977.9	0.0018	7.760	0.569	0.100	.0021	7.453	0.691	0.117
977.95	0.0027	7.301	0.908	0.154	.0018	7.511	0.457	0.078
978	0.0017	7.346	0.568	0.096	.0016	7.494	0.589	0.100
978.05	0.0019	7.397	0.630	0.107	.0017	7.441	0.527	0.089
978.10	0.0022	7.461	0.723	0.123	.0023	7.540	0.553	0.094
978.15	0.0019	7.193	0.648	0.114	.0015	7.102	0.795	0.135
978.2	0.0019	7.376	0.634	0.107	.0016	8.178	0.795	0.076
978.25	0.0014	7.514	0.457	0.078	.0019	8.103	0.450	0.082
978.3	0.0013	7.246	0.440	0.075	.0012	7.470	0.484	0.106
978.35	0.0013	7.912	0.403	0.068	.0012	7.349	0.624	0.068
978.4	0.0121	7.569	3.921	0.666	.0122	7.129	0.401	0.701
978.45	0.0112	7.571	3.628	0.616	.0114	7.445	4.129	0.682
978.5	0.044	7.425	14.33	2.421	.030	7.342	10.15	1.716
978.55	0.0126	7.267	4.253	0.722	.0117	7.587	3.808	0.642
978.6	0.0023	7.452	0.757	0.128	.0014	7.376	3.782	0.079
978.65	0.0018	7.328	0.602	0.102	.0018	7.406	0.465	0.101
978.7	0.0031	7.498	1.014	0.172	.0130	7.555	5.886	0.994
978.75	0.0014	7.345	0.467	0.079	.0016	7.261	0.422	0.092
978.8	0.0028	7.478	0.918	0.156	.0025	7.521	0.540	0.138
978.85	0.0035	7.348	1.168	0.198	0.003	7.411	0.814	0.163
978.9	0.0024	7.542	0.780	0.132	0.003	7.527	0.959	0.160
978.95	0.0164	7.758	5.302	0.869	0.037	7.328	12.48	2.108
979	0.009	7.594	2.965	0.501	.0025	7.458	5.887	0.139

## II. Corrosion Results of Aluminium Specimens : Corrosion Rates

### Results of the 5<sup>th</sup> Experiment : Exposure at 10°C

expos. time (hr)	specimen				duplicate			
	w. 1. (g)	surface (cm <sup>2</sup> )	corro. rate		w. 1. (g)	surface (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
976	0.0001	7.7066	0.0319	0.016	0.0001	7.4866	0.0328	0.016
976.05	0.01	7.6461	3.2159	1.567	0.0095	7.5631	3.0886	1.505
976.1	0.0001	7.3779	0.0333	0.016	0.0001	7.4871	0.0328	0.016
976.15	0.0001	7.460	0.0330	0.016	0.0002	7.5464	0.0651	0.032
976.2	0.0005	8.0515	0.1527	0.074	0.0002	7.6444	0.0643	0.031
976.25	0.0002	7.5949	0.0647	0.032	0.0005	7.4103	0.1659	0.081
976.3	0.0004	7.6163	0.1291	0.063	0.0002	7.9628	0.0617	0.030
976.35	0.0003	7.3064	0.1009	0.049	0.0002	7.5310	0.0653	0.032
976.4	0.0001	7.6306	0.0322	0.016	0.0001	7.4469	0.0330	0.016
976.45	0.0003	7.3089	0.1009	0.049	0.0003	7.5185	0.0981	0.048
976.5	0.0003	7.6306	0.0966	0.047	0.0003	7.2611	0.1015	0.049
976.55	0.0002	7.3131	0.0672	0.033	0.0002	7.5312	0.0653	0.032
976.6	0.0004	7.4192	0.1325	0.065	0.0005	7.3790	0.1665	0.081
976.65	0.0001	7.2649	0.0338	0.016	0.0001	7.2918	0.0337	0.016
976.7	0.0001	7.1283	0.0345	0.017	0.0002	7.3947	0.0665	0.032
738	0.0067	7.5041	2.9036	1.415	0.005	7.8132	2.0811	1.014
738.05	0.0055	7.5476	2.3696	1.155	0.0034	7.9902	1.3837	0.674
738.1	0.0082	7.2546	3.6753	1.791	0.0029	7.7256	1.2207	0.595
738.15	0.0059	8.1591	2.3511	1.146	0.0043	7.6253	1.8335	0.893
738.2	0.0134	7.6695	5.6803	2.768	0.0156	7.4166	6.8384	3.332
738.25	0.0164	7.3343	7.2693	3.542	0.0191	7.5305	8.2455	4.018
738.3	0.0108	7.4762	4.6959	2.288	0.0085	7.9097	3.4933	1.702

Results of the 6<sup>th</sup> Experiment : Exposure at 30°C

expos. time (hr)	specimen				duplicate			
	w. 1. (g)	surface (cm <sup>2</sup> )	corro. rate		w. 1. (g)	surface (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
860.3	0.0024	7.4018	0.0941	0.044	0.0028	7.5288	1.0241	0.499
860.35	0.0124	7.5002	4.6120	2.247	0.0087	7.3343	3.3090	1.612
860.4	0.0001	7.0966	0.0393	0.019	0.0002	7.6026	0.0734	0.036
860.45	0.0003	7.6149	0.1100	0.054	0.0002	7.4592	0.0748	0.036
860.5	0.0001	7.3719	0.0378	0.018	0.0001	7.6439	0.0365	0.018
860.55	0.0001	7.3881	0.0377	0.018	0.0001	7.2944	0.0382	0.018
860.6	0.0003	7.5869	0.1103	0.054	0.0003	7.4187	0.1128	0.055
860.65	0.0005	7.5305	0.1851	0.090	0.0004	7.500	0.0149	0.072
860.7	0.0001	7.6439	0.0365	0.018	0.0001	7.8817	0.035	0.017
860.75	0.0002	7.5026	0.0743	0.036	0.0001	7.39	0.0377	0.018
860.8	0.0002	7.46	0.0747	0.036	0.0001	7.3767	0.0378	0.018
860.85	0.0002	7.4739	0.0746	0.036	0.0003	7.2521	0.1153	0.056
860.9	1.2263	7.4322	459.98	224.1	1.2005	7.4322	450.30	219.4
860.95	1.1708	7.4322	439.14	214.0	0.9397	7.4322	352.46	171.7
861	2.016	7.4322	756.10	368.4	1.9641	7.4322	736.64	359.0
861.05	1.1748	7.4322	440.58	214.7	1.2285	7.4322	460.72	224.5
861.1	0.0007	7.4211	0.2629	0.128	0.0007	7.2786	0.2680	0.131
861.15	0.0003	7.4735	0.1119	0.055	0.0004	7.4735	0.1492	0.073
861.2	0.0006	7.321	0.2284	0.111	0.0004	7.3924	0.1508	0.073
861.25	0.0005	7.5583	0.1843	0.090	0.0002	7.5437	0.0739	0.036
861.3	0.0006	7.3658	0.2270	0.111	0.0006	8.4836	0.1971	0.096
861.35	0.0001	7.5321	0.0370	0.018	0.0005	7.610	0.1831	0.089
861.4	0.0002	7.6115	0.0732	0.036	0.0003	7.6172	0.1097	0.053
861.45	0.0470	7.4372	17.619	8.585	0.0420	7.6013	15.384	7.496
861.5	0.0096	7.6385	3.5193	1.715	0.0107	7.0806	4.2228	2.058

**Results of the 7<sup>th</sup> Experiment : Exposure at 50°C**

expos. time (hr)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro. rate		w. l. (g)	surface (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
890.3	0.0013	7.7145	0.4542	0.221	0.0016	8.0275	0.5373	0.262
890.35	0.0255	7.6182	9.0258	4.398	0.0287	7.4987	10.329	5.033
890.4	0.0012	7.4082	0.4366	0.213	0.0012	7.6272	0.4241	0.207
890.45	0.0002	7.6272	0.0707	0.034	0.0001	7.1323	0.0378	0.018
890.5	0.0001	7.5606	0.0356	0.017	0.0001	7.8052	0.0345	0.017
890.55	0.0005	7.8055	0.1726	0.084	0.0004	7.7328	0.1394	0.068
890.6	0.0004	7.7941	0.1516	0.074	0.0005	7.8614	0.1862	0.091
890.65	0.0014	7.8754	0.4790	0.233	0.0013	7.7756	0.4505	0.220
890.7	0.0003	7.6547	0.1056	0.051	0.0005	7.7471	0.1739	0.085
890.75	0.0004	7.9697	0.1352	0.066	0.0003	7.6452	0.1057	0.052
890.8	0.0002	7.7968	0.0691	0.034	0.0003	7.7688	0.1040	0.051
890.85	0.0013	7.8410	0.4467	0.218	0.0006	7.4964	0.2156	0.105
890.9	0.0001	7.4767	0.0360	0.018	0.0001	7.3763	0.0365	0.018
890.95	0.0006	8.0373	0.2011	0.098	0.0013	7.6470	0.4579	0.223
891	0.0011	7.4337	0.3986	0.194	0.0015	7.8418	0.5152	0.251
890.4	0.0450	7.7624	15.617	7.610	0.0655	8.0947	21.802	10.62
890.45	0.0162	7.9490	5.4929	2.677	0.0227	7.4686	8.1920	3.992

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**Results of the 8<sup>th</sup> Experiment : Exposure at 70°C**

expos. time (hr)	specimen				duplicate			
	w. 1. (g)	surface (cm <sup>2</sup> )	corro. rate		w. 1. (g)	surface (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
756	0.0024	7.5089	1.0326	0.503	0.0033	7.6120	1.3730	0.669
756.5	0.0248	7.6224	10.311	5.025	0.0367	7.5238	15.495	7.551
756.55	0.0004	7.4958	0.1693	0.082	0.0006	7.4235	0.2564	0.125
756.6	0.0005	7.6097	0.2084	0.102	0.0002	7.2042	0.0881	0.043
756.65	0.0003	7.3324	0.1283	0.062	0.0001	7.3038	0.0429	0.021
756.7	0.001	7.2761	0.4359	0.212	0.0003	7.1073	0.1339	0.065
756.75	0.0005	7.3838	0.2148	0.105	0.0006	7.4389	0.2558	0.125
756.8	0.0002	7.3644	0.0861	0.042	0.0005	7.2992	0.2172	0.106
756.85	0.0009	7.2992	0.3910	0.191	0.0009	7.4580	0.3827	0.186
756.9	0.0013	7.4807	0.5510	0.269	0.0012	7.4818	0.5086	0.248
756.95	0.0008	7.7212	0.3285	0.160	0.0008	7.3588	0.3447	0.168
757	0.0008	7.4223	0.3417	0.167	0.0005	7.1631	0.2213	0.108
28.75		7.4394				7.4394		
28.8		7.4394				7.4394		
28.85		7.4394				7.4394		
28.9		7.4394				7.4394		
757.05	0.0015	7.0212	0.6773	0.330	0.001	7.5665	0.4190	0.204
757.1	0.0007	7.2618	0.3056	0.149	0.0009	7.5385	0.3785	0.184
757.15	0.0007	7.5662	0.2933	0.143	0.0005	7.2582	0.2184	0.106
757.2	0.0009	7.582	0.3762	0.183	0.0006	7.5118	0.2532	0.123
757.25	0.0016	7.1187	0.7123	0.347	0.0023	7.5119	0.9704	0.473
757.3	0.0017	7.5241	0.7160	0.349	0.0018	7.6929	0.7415	0.361
757.35	0.0012	7.3972	0.5141	0.251	0.0013	7.3301	0.5620	0.274
757.4	0.0599	7.5615	25.108	12.23	0.0717	7.3118	31.093	15.15
757.45	0.0293	7.6569	12.104	5.898	0.0204	7.9132	8.1590	3.976

### III. Results of the 2<sup>nd</sup> Experiments for Al Specimen (Special tests for Al specimens only)

#### 1. Corrosive solutions with CH<sub>3</sub>OH as solvent

Result of 9<sup>th</sup> the experiment : Weight loss

Exposure time (I) (hr)	Wight loss (I) (g)		Expoure time (II) (hr)	Weight loss (II) (g)	
	specimen	duplicate		specimen	duplicate
0	0	0	0	0	0
8.58	0.0004	0	8.58	0.0016	0.003
16.58	0.0054	0.0005	16.58	0.0031	0.003
24.58	0.0239	0.001	24.58	0.0053	0.0074
30.08	0.1079	0.0011	30.08	0.0102	0.0127
37.92	0.2494	0.0017	37.92	0.0104	0.014
49	0.4492	0.0026	49.17	0.0108	0.0155
57.33	0.6224	0.0048	73.17	0.0141	0.0188
71	0.8576	0.0226	96.67	0.0174	0.0224
83.08	1.0595	0.0821	120.67	0.0217	0.0274
96.58	1.2369	0.2571	144.17	0.0259	0.0325
108.58	1.3829	0.5208	160	0.0275	0.0351
123.42	1.4958	0.8065			
141.58	1.6329	1.1134			
153.58	1.714	1.7225			
159.75	1.7142	1.763			

I. means immersion in the CH<sub>3</sub>OH+DMM 200 ppm+HCl 150 ppm solution

II. means immersion in the CH<sub>3</sub>OH+HCl 150 ppm solution

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**Result of the 10<sup>th</sup> experiment : Vary exposed temperature**

expos. time (h)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
381.00	0.0048	7.7272	3.913	1.907	0.0075	7.3960	6.388	3.113
381.00	0.0479	7.3513	41.04	20.00	0.0513	7.6212	42.40	20.66
214.92	1.1933	7.5376	1768	961.5	1.1966	7.5376	1773	863.8
214.92	0.0228	7.9232	32.13	15.66	0.0314	7.3897	47.45	23.12
142.13	1.167	7.5376	26.14	1274	1.2220	7.5376	2738	1334
142.13	0.0299	7.3684	68.52	33.39	0.0328	7.5831	73.04	35.59
53.67	0.9110	7.5376	5404	2634	0.9058	7.5376	5374	2619
53.67	0.0226	7.3074	138.3	67.39	0.0257	6.9928	164.3	80.08
29.70	1.4849	7.5376	15919	7757	0.8770	5.5376	12798	6236
29.70	0.0161	7.5472	172.4	84.00	0.0168	7.3221	185.4	90.35
6.50	0.9004	7.5376	44106	21492	1.2039	7.5376	58973	28737
6.50	0.0092	7.6269	445.4	217.0	0.0095	7.6061	461.4	224.9

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**Result of the 11<sup>th</sup> experiment : Vary concentration of DMM**

expos. time (h)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
452.33	0.0783	7.5222	55.23	26.91	0.0580	7.6283	40.34	19.66
454.58	0.0217	7.5934	15.09	7.352	0.0176	7.4961	12.40	6.040
496.35	0.0204	7.7613	12.71	6.193	0.0179	7.9797	10.85	5.285
454.58	0.0312	7.7308	21.31	10.38	0.0248	7.7040	17.00	8.282
496.25	0.0234	7.8536	14.41	7.022	0.0259	7.8578	15.94	7.768
133.58	1.1962	7.5425	2849.	1388	1.0078	7.5425	2400	1169
133.42	0.9272	7.5425	2211	1077	0.9212	7.5425	2197	1070
111.17	1.0891	7.5425	3117	1519	1.1529	7.5425	3300	1607
452.67	0.0293	7.5368	20.61	10.04	0.0346	7.5728	24.22	11.80
452.67	0.0653	7.6847	45.05	21.95	0.0717	7.5255	50.51	24.61
453.00	0.0091	7.6167	6.330	3.084	0.0055	7.5526	3.858	1.880
453.00	0.0059	7.5843	4.121	2.008	0.0084	7.5613	5.886	2.868
453.83	0.0014	7.5423	0.982	0.478	0.0018	7.6771	1.240	0.604
453.83	0.0013	7.5289	0.913	0.445	0.0012	7.4767	0.849	0.414

**Result of the 12<sup>th</sup> experiment : Vary speed of solution agitation**

expos. time (h)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
126.50	1.1492	7.0861	3077	1499	1.1012	7.0861	2948	1437
126.67	0.9272	7.0861	2479	1208	0.9097	7.0861	2432	1185
127.25	0.9388	7.0861	2499	1218	0.9145	7.0861	2434	1186
127.42	0.8668	7.0861	2304	1123	0.8682	7.0861	2308	1124
127.92	0.9094	7.0861	2408	1173	0.9794	7.0861	2593	1264

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## 2. Corrosive solutions with PE as solvent

Result of the 13<sup>th</sup> experiment : Vary exposed temperature

expos. time (hr)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
759.92	0.0095	7.6068	3.944	1.922	0.0089	7.5512	3.722	1.814
760.67	0.0133	7.6942	5.454	2.658	0.0127	7.5106	5.335	2.600
762.50	0.0113	7.3717	4.825	2.351	0.0131	7.4744	5.517	2.688
762.58	0.0104	7.4913	4.369	2.129	0.0097	7.397	4.127	2.011
763.25	0.015	7.4810	6.304	3.072	0.0162	7.6678	6.643	3.237
763.42	0.0251	7.4446	10.60	5.165	0.0244	7.507	10.22	4.979
764.45	0.0072	7.557	2.991	1.458	0.0078	7.467	3.280	1.598
765	0.00910	7.4184	3.848	1.875	0.0093	7.4861	3.897	1.899
764	0.01230	7.6694	5.038	2.455	0.0132	7.394	5.608	2.733
764.17	0.0183	7.3991	7.768	3.785	0.0186	7.304	7.998	3.897

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**Result of the 14<sup>th</sup> experiment : Vary concentration of DMM**

expos. time (hr)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
674.58	0.0082	7.4873	4.060	1.978	0.0094	7.4873	4.467	2.177
674.75	0.0102	7.1848	4.873	2.374	0.0081	7.1848	4.010	1.954
676.83	0.0116	7.4154	5.689	2.772	0.0127	7.4154	6.073	2.959
677.00	0.0101	7.3236	5.030	2.451	0.0110	7.3236	5.325	2.595
677.67	0.0087	7.4085	4.305	2.098	0.0027	7.4085	3.537	1.724
677.92	0.0129	7.3176	6.348	3.093	0.0123	7.3176	5.951	2.899
678.42	0.0014	6.8599	0.731	0.356	0.0013	6.8599	0.670	0.327
678.75	0.0004	6.8585	0.208	0.101	0.0008	6.8585	0.412	0.201
679.08	0.0004	6.8175	0.051	0.025	0.0005	6.8175	0.103	0.050
679.42	0.0001	6.8277	0.052	0.025	0.0002	6.8277	0.206	0.100
679.67	0.0001	6.8664	0.205	0.100	0.0004	6.8664	0.259	0.126
680.03	0.0017	6.8663	4.467	0.426	0.0016	6.8663	0.822	0.401
680.30	0.0002	6.822	0.110	0.054	0.0003	6.912	0.144	0.070
680.90	0.0002	6.931	0.080	0.039	0.0017	6.8132	0.090	0.044

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**Result of the 15<sup>th</sup> experiment : Vary speed of solution agitation**

expos. time (h)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
432.0	0.0220	7.0830	17.26	8.409	0.0220	7.2342	16.90	8.233
433.83	0.0202	7.5286	14.51	7.070	0.0198	7.6163	14.06	6.850
444.28	0.0190	7.4954	13.69	6.673	0.0201	7.7644	13.98	6.814
444.75	0.0209	7.5844	14.87	7.246	0.0209	7.5202	15.00	7.308
445.17	0.0197	7.6110	13.95	6.800	0.0208	7.7036	14.56	7.093

**Result of the 16<sup>th</sup> experiment : Special experiments**

expos. time (h)	specimen				duplicate			
	w. l. (g)	surface (cm <sup>2</sup> )	corro.rate		w. l. (g)	surfac (cm <sup>2</sup> )	corro. rate	
			mdd	mpy			mdd	mpy
600.0	0.0416	7.6350	21.79	10.62	0.0412	7.4562	22.10	10.77
817.92	0.0024	7.8338	0.899	0.438	0.0019	7.5807	0.735	0.358
943.33	0.0002	7.5401	0.067	0.033	0.0002	7.6763	0.066	0.032
943.83	0.0001	7.7250	0.033	0.016	0.0001	7.8128	0.033	0.016
943.67	0.0001	7.9603	0.032	0.016	0.0002	8.1462	0.062	0.030



## APPENDIX C

## Processed Data for Graphes

## I. Corrosion Rates of Carbon Steel Specimens

Table 1 Relationship between corrosion rate of carbon steel specimens and exposure temperature

Corrosive solutions	Exposure Temperature (°C)			
	10°C	30°C	50°C	70°C
H <sub>2</sub> O	12.6956	14.6595	16.1113	20.811
H <sub>2</sub> O + HCl 150 ppm	20.8576	29.4480	71.4599	82.1078
CH <sub>3</sub> OH	0.3576	0.0764	0.4185	0.6304
PE	0.3747	0.3101	0.5112	0.6825
CH <sub>3</sub> OH + HCl 150 ppm	5.8382	7.3012	6.2019	8.3924
PE + HCl 150 ppm	3.1872	2.6577	3.3965	4.4258
CH <sub>3</sub> OH + H <sub>2</sub> O 150 ppm		0.2260		0.8064
PE + H <sub>2</sub> O 150 ppm		1.2240		0.8064

Table 2. Relationship between corrosion rate and exposure temperature for observe the effect of corrosive media on corrosion rate

Corrosive solution	Exposure temperature			
	10°C	30°C	50°C	70°C
CH <sub>3</sub> OH	0.3576	0.0764	0.4185	0.6304
Petroleum ether	0.3747	0.3101	0.5112	0.6825
CH <sub>3</sub> OH+DMM 150ppm	0.2915	0.2737	1.1690	1.1252
PE+DMM 150 ppm	0.3719	0.2672	1.0244	1.0358
CH <sub>3</sub> OH+DMM 150 ppm+HCl 150 ppm	4.7713	9.8690	10.796	12.0453
PE+DMM 150 ppm+HCl150 ppm	1.8901	1.6815	2.5579	3.45
Hg in cyclohexane	0.6781	0.6296	1.0922	1.8624

Table 3 Relationship between corrosion rates and the exposure temperature for observe the effect Hcl added into DMM corrosive solution

Corrosive solution	Exposure temperature			
	10°C	30°C	50°C	70°C
CH <sub>3</sub> OH	0.3576	0.0764	0.4185	0.6304
Petroleum ether	0.3747	0.3101	0.5112	0.6825
CH <sub>3</sub> OH+HCl 150ppm	5.8382	7.3012	6.2019	8.3924
PE+HCl 150 ppm	3.1872	2.6577	3.3965	4.4258
CH <sub>3</sub> OH+DMM 150 ppm+HCl 150 ppm	4.7713	9.8690	10.796	12.0453
PE+DMM 150 ppm+HCl150 ppm	1.8901	1.6815	2.5579	3.45

Table 4 Relationship between corrosion rate of carbon steel specmens and concentration of DMM (corrosive media) at 30°C.  
CH<sub>3</sub>OH is solvent

Corrosive solutions	concentration of DMM(ppm)					
	0	50	100	150	200	250
CH <sub>3</sub> OH+DMM 150 ppm	0.0764	0.1568	0.1966	0.2737	0.3442	0.2039
CH <sub>3</sub> OH+DMM 150 ppm +HCl 150	7.3012	8.1075	8.7339	9.8690	8.1795	9.6614

Table 5 Relationship between corrosion rate (mdd) of carbon steel specimens and concentration of DMM at 30°C  
PE is solvent

Corrosive solutions	concentration of DMM(ppm)					
	0	50	100	150	200	250
PE+ DMM 150 ppm	0.3101	0.1867	0.1315	0.2079	0.1724	0.1744
PE+DMM 150 ppm+HCl 150 ppm	2.6577	0.3747	0.2918	0.2510	0.2293	0.3035

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## II. Corrosion Rates of Aluminium Specimens

### I. Corrosion by various corrosive solution

Table 1 Relationship between corrosion rate obtained by various corrosive media and the exposure temperature

Corrosive solutions	Exposure temperature			
	10°C	30°C	50°C	70°C
H <sub>2</sub> O	0.0324	0.9641	0.4958	1.2028
H <sub>2</sub> O+HCl 150 ppm	3.1522	3.9605	9.6774	12.9032
CH <sub>3</sub> OH	0.0331	0.05630.	0.4303	0.2188
Petroleum ether	0.0491	0.0923.	0.0542	0.1482
CH <sub>3</sub> OH+HCl 150 ppm	7.7514	16.5014	18.7096	28.1012
PE+HCl 150 ppm	4.0946	3.8710	6.8425	10.1315

Table 2 Relationship between corrosion rates obtained by DMM solution and the exposure temperature

Corrosive solutions	Exposure temperature			
	10°C	30°C	50°C	70°C
CH <sub>3</sub> OH	0.0331	0.05630.	0.4303	0.2188
Petroleum ether	0.0491	0.0923.	0.0542	0.1482
CH <sub>3</sub> OH+DMM 150 ppm	0.0991	0.1115	0.1689	0.2353
PE+DMM 150 ppm	0.0991	0.0747	0.0866	0.3366

## II. Corrosion by the corrosive solution with PE as solvent

Table 3 Relationship between corrosion rates obtained by the PE+DMM 200 ppm+HCl 150 ppm solution the exposure temperature

Exposure temperature (Kelvin)	Corrosion rate(mdd)	
	no DMM	with DMM
263	5.3230	7.8828
273	3.1354	3.8729
283	6.4741	10.4088
293	5.1709	4.2481
303	3.8333	5.3945

Table 4 Relationship between corrosion rates and concentration of DMM in PE+HCL 150 ppm+DMM x ppm solution

Concentration of DMM (ppm)	Corrosion rates	
	mdd	mpy
0	4.2631	2.0774
50	4.4413	2.1642
100	5.8810	2.8657
150	5.1773	2.5229
200	3.9211	1.9107
250	6.1491	2.9964

Table 5 Relationship between corrosion rates and concentration of DMM in PE+HCl x ppm+DMM x ppm solution with conc. of DMM lower than ppm and  $[DMM] : [HCl] = 1.1$  always fixed

concentration of DMM (ppm)	ln(conc.)	Corrosion rate(mdd)	
		no DMM	with DMM
0.015	-4.20	0.0850	0.0772
0.15	-1.8971	0.1268	0.1287
1.5	0.4055	0.3101	0.2323
15	2.7081	0.7009	0.8484
150	5.0106	4.2631	5.0987

Table 6 Relationship between corrosion rates and RPM agitating the PE+HCL150 ppm+DMM 200 ppm solution

Agitation (rpm)	Corrosion rates	
	mdd	mpy
0	17.0754	8.3206
300	14.2833	6.9601
600	13.8389	6.7435
900	14.9338	7.2771
1200	14.2554	6.9465

### III. Corrosion by the corrosive solutions with absolute CH<sub>3</sub>OH

Table 7 Relationship between specimen weight loss by the the DMM 200 ppm solution in comparison to that by the CH<sub>3</sub>OH+HCl 150 ppm solution and exposure time

Exposure time (I) (hr)	Wight loss (I) (g)		Expoure time (II) (hr)	Weight loss (II) (g)	
	specimen	duplicate		specimen	duplicate
0	0	0	0	0	0
8.58	0.0004	0	8.58	0.0016	0.003
16.58	0.0054	0.0005	16.58	0.0031	0.003
24.58	0.0239	0.001	24.58	0.0053	0.0074
30.08	0.1079	0.0011	30.08	0.0102	0.0127
37.92	0.2494	0.0017	37.92	0.0104	0.014
49	0.4492	0.0026	49.17	0.0108	0.0155
57.33	0.6224	0.0048	73.17	0.0141	0.0188
71	0.8576	0.0226	96.67	0.0174	0.0224
83.08	1.0595	0.0821	120.67	0.0217	0.0274
96.58	1.2369	0.2571	144.17	0.0259	0.0325
108.58	1.3829	0.5208	160	0.0275	0.0351
123.42	1.4958	0.8065			
141.58	1.6329	1.1134			
153.58	1.714	1.7225			
159.75	1.7142	1.763			

I. means immersion in the CH<sub>3</sub>OH+DMM 200 ppm+HCl 150 ppm solution

II. means immersion in the CH<sub>3</sub>OH+HCl 150 ppm solution

Table 8 Relationship between corrosion rates obtained by the  $\text{CH}_3\text{OH}+\text{HCl}$  150 ppm+DMM 200 ppm solution and the exposure temperature

Exposure temperature (°C)	Corrosion rate(mdd)	
	no DMM	with DMM
10°	41.7231	5.1504
20°	39.7922	1770.3180
30°	70.7798	2675.9540
40°	151.3240	5389.1930
50°	178.8956	14358.420
60°	453.4172	51539.77

Table 9 Relationship between corrosion rates and concentration of DMM in  $\text{CH}_3\text{OH}+\text{HCl}$  150 ppm+DMM x ppm solution

Concentration of DMM (ppm)	Corrosion rates	
	mdd	mpy
0	47.7858	23.2855
50	13.7418	6.6962
75	11.7779	5.7392
100	19.1515	9.3323
125	15.1753	7.3947
150	2625.041	1279.151
200	2204.149	1074.056
250	3208.588	1563.507

Table 10 Relationship between corrosion rates and concentration of DMM in  $\text{CH}_3\text{OH}+\text{HCl}$  x ppm+DMM x ppm solution with conc. of DMM lower than ppm and with  $[\text{DMM}] : [\text{HCl}] = 1.1$  always fixed

concentration of DMM (ppm)	ln(conc.)	Corrosion rate(mdd)	
		no DMM	with DMM
0.15	-1.8971	1.1108	0.8805
1.5	0.4055	5.0940	5.0036
15	2.7081	22.4179	47.7832
150	5.0106	47.7858	2625.041

Table 11 Relationship between corrosion rates and RPM agitating the  $\text{CH}_3\text{OH}+\text{HCL}$  150 ppm+DMM 200 ppm solution

Agitation (rpm)	Corrosion rates	
	mdd	mpy
0	3012.612	1468.01
300	2455.759	1196.663
600	2466.391	1201.843
900	2305.876	1123.626
1200	2500.469	1216.449

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## APPENDIX D

### EXAMPLE OF CALCULATION

#### Calculation of Corrosion Rate(according to ASTM G 1 - 72)

The initial surface area of the specimens(making allowances for the change in area due to mounting holes) and mass loss during the test are determined. The average corrosion rate may then be obtained as follow :

$$\text{corrosion rate} = (K*W)/(A*T*D)$$

where K = a constant which are

2.40\*10<sup>6</sup> for unit of milligrams/sq. decimetre/day

and 3.45\*10<sup>6</sup> for unit of mils/year

T = time of exposure in hours to the nearest to 0.01 h

A = area in cm<sup>2</sup> to the nearest 0.01 cm<sup>2</sup>

W = mass loss in g, to the nearest 1 mg and

D = density in g/cm<sup>3</sup>, which are

2.95 g/cm<sup>3</sup> for aluminium and

8.48 g/cm<sup>3</sup> for carbon steel

Density of both kinds of metals were obtained by measuring surface area of the specimen with certain geometrical shape and weighing of that directly.

### Example of Corrosion Rate Calculation

1) Corrosion rate of carbon steel specimen corroded by CH<sub>3</sub>OH+150 ppm DMM at 10°C.

$$T = \text{exposure time} = 1024.1 \text{ h.}$$

$$A = \text{surface area} = 7.671 \text{ cm}^2$$

$$W = \text{mass loss} = 0.0015 \text{ g}$$

$$K = 3.45 \cdot 10^6 \text{ for unit of mpy, and} \\ 2.40 \cdot 10^6 \text{ for unit of mdd}$$

$$D = \text{density of CS} = 8.48 \text{ g/cm}^3$$

$$\begin{aligned} * \text{ corrosion rate (mpy)} &= (3.45 \cdot 10^6 \cdot 0.0015) / (7.671 \cdot 1024.1 \cdot 8.48) \\ &= 0.0776 \text{ mils/year.} \end{aligned}$$

$$\begin{aligned} * \text{ corrosion rate (mdd)} &= (2.40 \cdot 10^6 \cdot 0.0015) / (7.671 \cdot 1024.1) \\ &= 0.458 \text{ milligrams/sq. decimetre/day.} \end{aligned}$$

2) Corrosion rate of aluminium specimen corroded by CH<sub>3</sub>OH+150 ppm DMM at 10°C

$$T = \text{exposure time} = 976.3 \text{ h.}$$

$$A = \text{surface area} = 7.6163 \text{ cm}^2$$

$$W = \text{mass loss} = 0.0004 \text{ g}$$

$$K = 3.45 \cdot 10^6 \text{ for unit of mpy, and} \\ 2.40 \cdot 10^6 \text{ for unit of mdd}$$

$$D = 2.95 \text{ g/cm}^3$$

$$\begin{aligned} * \text{ Corrosion Rate (mpy)} &= (3.45 \cdot 10^6 \cdot 0.0004) / (7.6163 \cdot 976.3 \cdot 2.95) \\ &= 0.063 \text{ mils/year} \end{aligned}$$

$$\begin{aligned} * \text{ Corrosion Rate (mdd)} &= (2.40 \cdot 10^6 \cdot 0.0004) / (7.6163 \cdot 976.3) \\ &= 0.1291 \text{ milligrams/sq. decimetre/day} \end{aligned}$$

## VITA

Mr. Aran Wasantakorn was born on March, 31, 1959 at Trat province, educated in bachelor degree of Engineering from King Mongkut's Institute of Technology Thonburi. Since 1991, he has been a graduate student studying Petrochemistry in Chulalongkorn University.



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