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APPENDICES

Appendix A Metal Dissolution Results

Table A1 The dissolution of catalyst by hydrochloric acid

Condition			% Catalyst dissolved		RBM
Temp.(°C)	HCl Conc. (M)	Time (hr)	Co	Mo	
70	10	1	83.230	41.206	Y
70	10	3	84.096	42.714	Y
70	10	5	83.807	42.536	Y
70	10	7	84.384	42.891	Y
70	1	3	80.058	30.740	Y
70	3	3	81.210	37.329	Y
70	5	3	82.224	42.541	Y
70	8	3	82.654	42.954	Y
70	10	3	82.937	42.834	Y
30	6	3	82.081	42.312	Y
40	6	3	83.367	43.899	Y
50	6	3	83.948	43.984	Y
70	6	3	84.100	44.613	Y

Appendix B Froth Flotation Results (After dissolved catalyst particles)

Table A2 The percentage of carbon purity after froth flotation process, after dissolved catalyst particle, by sodium benzensulfonate surfactant.

SDBS conc. (CMC)	pH solution	Air flow rate (ml/min)	% Carbon purity
0.05	3	120	6.23
0.1	3	120	6.08
0.3	3	120	5.34
0.5	3	120	5.06
0.05	3	170	6.66
0.1	3	170	6.82
0.3	3	170	5.72
0.5	3	170	4.98
0.05	3	220	6.03
0.1	3	220	6.22
0.3	3	220	5.15
0.5	3	220	4.15
0.05	3	270	5.63
0.1	3	270	5.72
0.3	3	270	4.86
0.5	3	270	4.11
0.05	5	120	6.12
0.1	5	120	5.88
0.3	5	120	5.61
0.5	5	120	5.42
0.05	5	170	6.32
0.1	5	170	6.45
0.3	5	170	5.87
0.5	5	170	4.88
0.05	5	220	6.12
0.1	5	220	6.33
0.3	5	220	5.48
0.5	5	220	4.72
0.05	5	270	5.82
0.1	5	270	6.02
0.3	5	270	4.25

SDBS conc. (CMC)	pH solution	Air flow rate (ml/min)	% Carbon purity
0.5	5	270	4.52
0.05	7	120	5.55
0.1	7	120	5.16
0.3	7	120	4.71
0.5	7	120	4.35
0.05	7	170	6.17
0.1	7	170	6.37
0.3	7	170	5.42
0.5	7	170	4.76
0.05	7	220	6.23
0.1	7	220	6.12
0.3	7	220	5.53
0.5	7	220	4.71
0.05	7	270	4.89
0.1	7	270	5.12
0.3	7	270	4.62
0.5	7	270	4.55

Appendix C Silica Dissolution Results

Table A3 The dissolution of silica by sodium hydroxide

Condition			% Silica dissolved	RBM
Temp.(°C)	NaOH Conc. (M)	Time (hr)		
70	10	1	47.069	Y
70	10	3	54.625	Y
70	10	5	55.236	Y
70	10	7	55.209	Y
70	1	3	31.699	Y
70	3	3	49.233	Y
70	5	3	54.163	Y
70	8	3	54.394	Y
70	10	3	54.625	Y
30	5	3	44.371	Y
40	5	3	51.148	Y
50	5	3	53.864	Y
70	5	3	53.968	Y

Appendix D Froth Flotation Results (After dissolved catalyst and silica particles)

Table A4 The percentage of carbon purity after froth flotation process, after dissolved catalyst and silica particle, by sodium benzensulfonate surfactant.

SDBS conc. (CMC)	pH solution	Air flow rate (ml/min)	% Carbon purity
0.05	3	120	69.56
0.1	3	120	68.79
0.3	3	120	63.48
0.5	3	120	58.73
0.05	3	170	68.55
0.1	3	170	70.62
0.3	3	170	67.98
0.5	3	170	60.45
0.05	3	220	60.24
0.1	3	220	63.58
0.3	3	220	61.05
0.5	3	220	55.66
0.05	3	270	57.15
0.1	3	270	55.12
0.3	3	270	51.24
0.5	3	270	52.48
0.05	5	120	68.57
0.1	5	120	71.08
0.3	5	120	65.78
0.5	5	120	61.48
0.05	5	170	69.47
0.1	5	170	66.34
0.3	5	170	64.71
0.5	5	170	57.97
0.05	5	220	57.48
0.1	5	220	60.11
0.3	5	220	59.8
0.5	5	220	53.64
0.05	5	270	56.48
0.1	5	270	58.49

SDBS conc. (CMC)	pH solution	Air flow rate (ml/min)	% Carbon purity
0.3	5	270	53.19
0.5	5	270	51.08
0.05	7	120	60.24
0.1	7	120	63.48
0.3	7	120	61.42
0.5	7	120	56.56
0.05	7	170	59.67
0.1	7	170	63.54
0.3	7	170	60.59
0.5	7	170	55.61
0.05	7	220	58.17
0.1	7	220	60.81
0.3	7	220	56.72
0.5	7	220	50.97
0.05	7	270	57.18
0.1	7	270	54.68
0.3	7	270	53.48
0.5	7	270	50.14

Appendix E Foam Ability and Foam Stability

Table A5 Foam ability and Foam stability by varied pH solution and used sodium benzenesulfonate surfactant.

Condition	pH	Foam ability	Foam stability
SDBS conc. 0.5CMC Time 6 min	3	3.897	4.1
	5	3.823	4.25
	7	3.367	7.15

Appendix F Calculation the Amount of The Carbon by Temperature Programmed Oxidation (TPO)

The temperature programmed oxidation technique was used to determine the amount of carbon. It can be calculated from the area under peak of the TPO profile. The carbon dioxide gas was used as the reference peak (so-called A) which was 100 μl. On the other hand, the sample peak was called B.

From $$PV = nRT \quad (1)$$

As, P = Pressure (atm), 1 atm

V = Volume (cm^3), 100μl (0.1 cm^3)

n = Number of mole (mole)

R = Gas constant (cm^3.atm/gmole.K), 82.058 cm^3.atm/gmole.K

T = Temperature (K), 31°C (304 K)

Therefore, $$n = 4x10^{-6} \text{ gmole}$$

The carbon dioxide 1 mole gave 1 mole of carbon. So, the carbon dioxide $4x10^{-6}$ mole gave the equal mole of carbon.

Let, Area A has the amount of carbon $4x10^{-6}$ mole. So, the area B has the amount of carbon

The amount of sample's carbon $4x10^{-6}$*B/A

Example: Carbon nanotubes were oxidized at 250°C for 12 hours.

Area under pulse peaks of carbon dioxide were

1^{st} peak	2^{nd} peak	3^{rd} peak
$8.50x10^5$	$8.83x10^5$	$8.40x10^5$
Avergae (A)	$8.57x10^5$	

Area under peak of sample, which has weight 2.16 mg, was $1.64x10^7$ (B).

Then, the amount of sample's carbon was $7.65x10^{-5}$ mole, $9.18x10^{-4}$ grams.

The percentage of carbon was $(9.18x10^{-4}/0.0216)*100 = 4.25$ wt%.

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