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APPENDICES

Appendix A Specifications of the adsorbents

Table A1 Specifications of the commercial activated carbons

Activated carbon	Iodine Number (mg/g)	Moisture (%)	Ash (%)	Hardness Number (%)	Apparent Density (g/cc)
A (IN1100)	1100	8.00	3.50	98.00	0.48
B (IN 1067)	1067	1.30	6.00	97.50	0.51
C (IN 1100)	1100	8.00	5.00	98.00	0.48
D (IN 937)	973	2.70	7.50	96.00	0.49
E (IN 1035)	1035	1.70	7.30	98.00	0.48
F (IN 879)	879	1.44	8.90	97.00	0.49
G (IN 987)	987	1.70	8.70	96.10	0.51

Table A2 Physical properties of adsorbents (Kumpoomee, 2012)

Adsorbents	BET surface area (m^2/g)	V_{DR} (cc/g)	Total pore volume (cc/g)	DR micropore (Å)	Average pore diameter (Å)
Basolite C300	2434	1.27	1.33	13.9	21.9
Basolite Z1200	1449	0.78	0.88	12.1	24.3
Calgon	877.8	0.48	0.53	22.3	24.3
Coconut Shell Granular Activated Carbon	865.4	0.47	0.49	18.9	22.3
Eucalyptus Powder Activated Carbon	861	0.47	0.61	25.2	28.2
Coconut Shell Powder Activated Carbon	713.5	0.39	0.42	17.1	23.5

Appendix B The Amount of Methane Adsorbed on all Adsorbents

Table B1 The amount of methane adsorption on A (IN 1100) at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
48.75	2.317
99.38	3.337
150.00	3.981
202.50	4.379
300.00	4.977
401.25	5.293
498.75	5.583
600.00	5.746
696.38	5.922
801.88	6.121
900.00	6.230
1000.00	6.282

Table B2 The amount of methane adsorption on A (IN 1100) at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
13.13	0
50.53	2.251
101.26	3.216
150.01	3.865
202.51	4.285
300.01	4.854
401.26	5.189
500.63	5.381
598.13	5.594
695.63	5.713
800.63	5.855
898.26	5.930
998.51	5.992

Table B3 The amount of methane adsorption on A (IN 1100) at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
54.38	2.063
103.13	3.002
153.75	3.524
202.50	3.974
301.88	4.451
401.25	4.772
496.88	5.106
598.38	5.278
693.75	5.452
802.50	5.534
900.00	5.636
997.50	5.682

Table B4 The amount of methane adsorption on B (IN 1067) at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
50.63	1.773
100.63	2.611
148.13	3.177
199.38	3.538
294.38	4.015
399.38	4.413
500.00	4.649
600.00	4.836
697.50	4.966
799.38	5.066
898.38	5.166
1000.00	5.212

Table B5 The amount of methane adsorption on B (IN 1067) at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
50.63	1.771
101.25	2.585
150.00	3.072
200.00	3.475
301.88	4.012
403.13	4.270
502.50	4.453
600.00	4.618
701.25	4.785
802.50	4.909
896.25	4.979
995.63	5.157

Table B6 The amount of methane adsorption on B (IN 1067) at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
54.38	1.643
105.00	2.372
151.88	2.869
200.63	3.337
301.88	3.902
403.75	4.189
503.25	4.393
602.50	4.534
703.13	4.668
804.38	4.765
896.25	4.863
997.50	4.956

Table B7 The amount of methane adsorption on C (IN 1100) at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
48.75	2.116
99.38	2.999
150.00	3.485
198.75	3.894
298.13	4.343
397.50	4.630
498.75	4.834
598.13	4.959
695.63	5.067
800.63	5.094
898.25	5.142
999.38	5.161

Table B8 The amount of methane adsorption on C (IN 1100) at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
16.88	0
52.51	2.035
103.13	2.850
150.01	3.371
200.63	3.705
300.01	4.193
399.38	4.497
500.63	4.708
600.01	4.826
697.51	4.872
802.51	4.885
899.13	4.899
999.38	4.918

Table B9 The amount of methane adsorption on C (IN 1100) at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
16.88	0
54.38	2.001
103.13	2.790
153.76	3.248
206.26	3.564
304.38	4.077
405.01	4.366
504.38	4.633
607.51	4.733
704.13	4.787
803.76	4.866
901.26	4.855
1003.26	4.868

Table B10 The amount of methane adsorption on D (IN 937) at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
48.75	1.630
99.38	2.274
148.13	2.752
196.88	3.132
296.25	3.570
395.63	3.940
495.00	4.163
594.38	4.396
697.50	4.532
796.88	4.678
892.50	4.837
995.63	4.938

Table B11 The amount of methane adsorption on D (IN 937) at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
16.88	0
52.51	1.549
103.13	2.312
155.63	2.745
204.38	3.083
298.13	3.464
403.13	3.858
504.38	4.072
600.01	4.320
701.88	4.490
800.03	4.665
901.88	4.757
1001.88	4.881

Table B12 The amount of methane adsorption on D (IN 937) at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
54.38	1.566
103.13	2.207
150.00	2.721
202.25	3.040
301.88	3.429
406.13	3.769
501.88	3.999
601.38	4.182
703.75	4.372
803.25	4.499
901.38	4.601
1001.25	4.725

Table B13 The amount of methane adsorption on E (IN 1035) at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
50.63	1.633
97.50	2.410
148.13	2.924
198.75	3.283
296.25	3.787
399.38	4.099
500.00	4.315
600.88	4.496
698.75	4.665
798.25	4.748
900.00	4.783
1000.38	4.841

Table B14 The amount of methane adsorption on E (IN 1035) at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
50.63	1.468
99.38	2.167
148.25	2.645
200.63	2.966
296.25	3.456
399.38	3.907
498.75	4.124
598.13	4.358
695.63	4.552
800.13	4.664
896.25	4.736
997.50	4.758

Table B15 The amount of methane adsorption on E (IN 1035) at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
50.63	1.487
101.25	2.166
151.88	2.577
202.50	2.885
299.38	3.315
402.25	3.682
499.88	3.963
600.00	4.200
697.50	4.405
796.38	4.540
897.50	4.633
1000.00	4.689

Table B16 The amount of methane adsorption on F (IN 879) at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
16.88	0
48.76	1.647
99.38	2.361
151.88	2.839
200.63	3.183
298.13	3.651
400.01	4.015
499.38	4.246
596.88	4.411
700.26	4.499
798.76	4.600
896.26	4.666
995.63	4.816

Table B17 The amount of methane adsorption on F (IN 879) at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
48.75	1.610
97.50	2.340
150.00	2.808
200.63	3.153
296.25	3.626
398.13	4.000
500.63	4.196
598.13	4.382
701.25	4.430
800.63	4.499
898.13	4.585
997.50	4.710

Table B18 The amount of methane adsorption on F (IN 879) at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
52.50	1.457
101.25	2.163
151.88	2.626
200.63	2.993
298.13	3.427
398.38	3.806
499.38	3.978
595.00	4.199
697.50	4.281
797.25	4.329
897.50	4.337
997.50	4.390

Table B19 The amount of methane adsorption on G (IN 987) at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
16.88	0
52.51	1.527
99.38	2.274
150.01	2.749
202.51	3.147
300.01	3.688
403.26	3.972
502.51	4.226
602.51	4.399
704.38	4.495
802.63	4.606
901.26	4.646
1003.13	4.743

Table B20 The amount of methane adsorption on G (IN 987) at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
52.50	1.520
101.25	2.185
150.00	2.636
202.50	2.960
298.75	3.384
399.38	3.712
498.75	3.939
601.88	4.047
701.25	4.167
800.00	4.278
896.25	4.385
998.13	4.488

Table B21 The amount of methane adsorption on G (IN 987) at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
52.50	1.435
99.38	2.072
148.13	2.518
200.63	2.852
298.13	3.324
399.38	3.698
500.63	3.863
600.00	4.034
701.13	4.113
798.13	4.253
896.13	4.300
998.38	4.342

Table B22 The amount of methane adsorption on Co-K_2CO_3/1h at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
33.75	1.214
90.00	1.679
148.13	1.908
200.63	2.034
301.88	2.148
399.38	2.249
498.75	2.287
599.38	2.326
697.50	2.384
798.25	2.411
899.38	2.430
1001.25	2.443

Table B23 The amount of methane adsorption on Co-K_2CO_3/1h at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
46.88	0.740
95.63	1.164
150.00	1.401
198.75	1.612
300.00	1.787
399.38	1.899
498.75	1.962
600.00	2.007
699.38	2.031
798.75	2.046
900.00	2.055
1001.25	2.078

Table B24 The amount of methane adsorption on Co-K_2CO_3/1h at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
48.75	0.668
97.50	1.046
150.00	1.302
200.63	1.457
301.88	1.605
401.25	1.693
498.75	1.796
600.00	1.870
700.00	1.901
800.00	1.921
900.75	1.935
1003.13	1.972

Table B25 The amount of methane adsorption on Co-K_2CO_3/2h at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
33.75	1.183
87.25	1.741
146.33	2.002
200.63	2.109
301.88	2.246
399.38	2.369
500.63	2.404
600.00	2.456
699.38	2.477
798.75	2.502
900.00	2.520
1001.25	2.552

Table B26 The amount of methane adsorption on Co-K_2CO_3/2h at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
41.25	0.948
88.13	1.577
148.13	1.796
200.63	1.930
301.88	2.076
399.38	2.220
499.38	2.294
600.00	2.364
699.38	2.413
799.38	2.457
900.63	2.474
1001.25	2.490

Table B27 The amount of methane adsorption on Co-K_2CO_3/2h at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
48.75	0.730
97.50	1.151
151.88	1.376
202.50	1.509
301.88	1.719
401.25	1.842
498.75	1.983
601.88	2.022
701.25	2.074
800.63	2.132
900.00	2.173
1005.00	2.197

Table B28 The amount of methane adsorption on Co-K_2CO_3/3h at 35 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
41.25	0.931
93.75	1.345
150.00	1.542
200.63	1.677
301.25	1.802
399.38	1.908
498.75	1.977
600.00	2.024
699.38	2.057
798.75	2.100
900.00	2.127
1001.25	2.163

Table B29 The amount of methane adsorption on Co-K_2CO_3/3h at 40 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
50.63	0.590
99.38	0.924
151.88	1.142
200.63	1.311
301.88	1.460
401.25	1.564
498.75	1.674
601.88	1.700
701.25	1.736
800.63	1.777
900.00	1.874
1003.13	1.916

Table B30 The amount of methane adsorption on $Co-K_2CO_3$/3h at 45 °C

Equilibrium pressure (psia)	Methane adsorption (mmol/g)
15.00	0
61.88	0.2482
105.00	0.5366
153.75	0.7608
204.38	0.8489
301.88	1.0603
401.25	1.1834
500.63	1.2636
601.88	1.3196
701.25	1.3481
800.00	1.4054
901.88	1.4248
1005.00	1.4447

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