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APPENDICES

Appendix A The CO₂/CH₄ separation results for bacterial cellulose membranes with the weight ratio of 1:7

Table A1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:7

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.15	2.55	689781.16	818112.53	1.19
15	2.15	2.55	689781.16	818112.53	1.19
30	2.15	2.55	689781.16	818112.53	1.19
45	2.15	2.55	689781.16	818112.53	1.19
60	2.15	2.55	689781.16	818112.53	1.19
75	2.15	2.55	689781.16	818112.53	1.19
90	2.15	2.55	689781.16	818112.53	1.19
105	2.15	2.55	689781.16	818112.53	1.19
120	2.15	2.55	689781.16	818112.53	1.19

Table A2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:7

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.00	2.50	641656.89	802071.11	1.25
15	2.00	2.50	641656.89	802071.11	1.25
30	2.00	2.50	641656.89	802071.11	1.25
45	2.00	2.50	641656.89	802071.11	1.25
60	2.00	2.50	641656.89	802071.11	1.25
75	2.00	2.50	641656.89	802071.11	1.25
90	2.00	2.50	641656.89	802071.11	1.25
105	2.00	2.50	641656.89	802071.11	1.25
120	2.00	2.50	641656.89	802071.11	1.25

Table A3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:7

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.10	2.70	673739.73	866236.80	1.29
15	2.10	2.70	673739.73	866236.80	1.29
30	2.10	2.70	673739.73	866236.80	1.29
45	2.10	2.70	673739.73	866236.80	1.29
60	2.10	2.70	673739.73	866236.80	1.29
75	2.10	2.70	673739.73	866236.80	1.29
90	2.10	2.70	673739.73	866236.80	1.29
105	2.10	2.70	673739.73	866236.80	1.29
120	2.10	2.70	673739.73	866236.80	1.29

Appendix B The CO₂/CH₄ separation results for bacterial cellulose membranes with the weight ratio of 1:10

Table B1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:10

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.30	3.40	737905.42	1090816.71	1.48
15	2.30	3.40	737905.42	1090816.71	1.48
30	2.30	3.40	737905.42	1090816.71	1.48
45	2.30	3.40	737905.42	1090816.71	1.48
60	2.30	3.40	737905.42	1090816.71	1.48
75	2.30	3.40	737905.42	1090816.71	1.48
90	2.30	3.40	737905.42	1090816.71	1.48
105	2.30	3.40	737905.42	1090816.71	1.48
120	2.30	3.40	737905.42	1090816.71	1.48

Table B2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:10

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.30	3.50	737905.42	1122899.56	1.52
15	2.30	3.50	737905.42	1122899.56	1.52
30	2.30	3.50	737905.42	1122899.56	1.52
45	2.30	3.50	737905.42	1122899.56	1.52
60	2.30	3.50	737905.42	1122899.56	1.52
75	2.30	3.50	737905.42	1122899.56	1.52
90	2.30	3.50	737905.42	1122899.56	1.52
105	2.30	3.50	737905.42	1122899.56	1.52
120	2.30	3.50	737905.42	1122899.56	1.52

Table B3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:10

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.35	3.50	753946.84	1122899.56	1.50
15	2.35	3.50	753946.84	1122899.56	1.50
30	2.35	3.50	753946.84	1122899.56	1.50
45	2.35	3.50	753946.84	1122899.56	1.50
60	2.35	3.50	753946.84	1122899.56	1.50
75	2.35	3.50	753946.84	1122899.56	1.50
90	2.35	3.50	753946.84	1122899.56	1.50
105	2.35	3.50	753946.84	1122899.56	1.50
120	2.35	3.50	753946.84	1122899.56	1.50

Appendix C The CO₂/CH₄ separation results for bacterial cellulose membranes with the weight ratio of 1:13

Table C1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:13

time (min)	CO₂ (L/min)	CH₄ (L/min)	Permeance CO₂ (GPU)	Permeance CH₄ (GPU)	Selectivity
0	2.60	3.60	834153.96	1154982.40	1.38
15	2.60	3.60	834153.96	1154982.40	1.38
30	2.60	3.60	834153.96	1154982.40	1.38
45	2.60	3.60	834153.96	1154982.40	1.38
60	2.60	3.60	834153.96	1154982.40	1.38
75	2.60	3.60	834153.96	1154982.40	1.38
90	2.60	3.60	834153.96	1154982.40	1.38
105	2.60	3.60	834153.96	1154982.40	1.38
120	2.60	3.60	834153.96	1154982.40	1.38

Table C2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:13

time (min)	CO₂ (L/min)	CH₄ (L/min)	Permeance CO₂ (GPU)	Permeance CH₄ (GPU)	Selectivity
0	2.60	3.70	834153.96	1187065.25	1.42
15	2.60	3.70	834153.96	1187065.25	1.42
30	2.60	3.70	834153.96	1187065.25	1.42
45	2.60	3.70	834153.96	1187065.25	1.42
60	2.60	3.70	834153.96	1187065.25	1.42
75	2.60	3.70	834153.96	1187065.25	1.42
90	2.60	3.70	834153.96	1187065.25	1.42
105	2.60	3.70	834153.96	1187065.25	1.42
120	2.60	3.70	834153.96	1187065.25	1.42

Table C3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:13

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.70	3.55	866236.80	1138940.98	1.31
15	2.70	3.55	866236.80	1138940.98	1.31
30	2.70	3.55	866236.80	1138940.98	1.31
45	2.70	3.55	866236.80	1138940.98	1.31
60	2.70	3.55	866236.80	1138940.98	1.31
75	2.70	3.55	866236.80	1138940.98	1.31
90	2.70	3.55	866236.80	1138940.98	1.31
105	2.70	3.55	866236.80	1138940.98	1.31
120	2.70	3.55	866236.80	1138940.98	1.31

Appendix D The CO₂/CH₄ separation results for bacterial cellulose membranes with the weight ratio of 1:15

Table D1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:15

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	3.00	3.95	962485.33	1267272.36	1.32
15	3.00	3.95	962485.33	1267272.36	1.32
30	3.00	3.95	962485.33	1267272.36	1.32
45	3.00	3.95	962485.33	1267272.36	1.32
60	3.00	3.95	962485.33	1267272.36	1.32
75	3.00	3.95	962485.33	1267272.36	1.32
90	3.00	3.95	962485.33	1267272.36	1.32
105	3.00	3.95	962485.33	1267272.36	1.32
120	3.00	3.95	962485.33	1267272.36	1.32

Table D2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:15

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.95	3.80	946443.91	1219148.09	1.29
15	2.95	3.80	946443.91	1219148.09	1.29
30	2.95	3.80	946443.91	1219148.09	1.29
45	2.95	3.80	946443.91	1219148.09	1.29
60	2.95	3.80	946443.91	1219148.09	1.29
75	2.95	3.80	946443.91	1219148.09	1.29
90	2.95	3.80	946443.91	1219148.09	1.29
105	2.95	3.80	946443.91	1219148.09	1.29
120	2.95	3.80	946443.91	1219148.09	1.29

Table D3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:15

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	3.00	3.70	962485.33	1187065.25	1.23
15	3.00	3.70	962485.33	1187065.25	1.23
30	3.00	3.70	962485.33	1187065.25	1.23
45	3.00	3.70	962485.33	1187065.25	1.23
60	3.00	3.70	962485.33	1187065.25	1.23
75	3.00	3.70	962485.33	1187065.25	1.23
90	3.00	3.70	962485.33	1187065.25	1.23
105	3.00	3.70	962485.33	1187065.25	1.23
120	3.00	3.70	962485.33	1187065.25	1.23

Appendix E The CO₂/CH₄ separation results for bacterial cellulose membranes with the weight ratio of 1:17

Table E1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:17

time (min)	CO₂ (L/min)	CH₄ (L/min)	Permeance CO₂ (GPU)	Permeance CH₄ (GPU)	Selectivity
0	3.50	4.50	1122899.56	1443728.00	1.29
15	3.50	4.50	1122899.56	1443728.00	1.29
30	3.50	4.50	1122899.56	1443728.00	1.29
45	3.50	4.50	1122899.56	1443728.00	1.29
60	3.50	4.50	1122899.56	1443728.00	1.29
75	3.50	4.50	1122899.56	1443728.00	1.29
90	3.50	4.50	1122899.56	1443728.00	1.29
105	3.50	4.50	1122899.56	1443728.00	1.29
120	3.50	4.50	1122899.56	1443728.00	1.29

Table E2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:17

time (min)	CO₂ (L/min)	CH₄ (L/min)	Permeance CO₂ (GPU)	Permeance CH₄ (GPU)	Selectivity
- 0	3.70	4.55	1187065.25	1459769.42	1.23
15	3.70	4.55	1187065.25	1459769.42	1.23
30	3.70	4.55	1187065.25	1459769.42	1.23
45	3.70	4.55	1187065.25	1459769.42	1.23
60	3.70	4.55	1187065.25	1459769.42	1.23
75	3.70	4.55	1187065.25	1459769.42	1.23
90	3.70	4.55	1187065.25	1459769.42	1.23
105	3.70	4.55	1187065.25	1459769.42	1.23
120	3.70	4.55	1187065.25	1459769.42	1.23

Table E3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:17

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	3.70	4.55	1187065.25	1459769.42	1.23
15	3.70	4.55	1187065.25	1459769.42	1.23
30	3.70	4.55	1187065.25	1459769.42	1.23
45	3.70	4.55	1187065.25	1459769.42	1.23
60	3.70	4.55	1187065.25	1459769.42	1.23
75	3.70	4.55	1187065.25	1459769.42	1.23
90	3.70	4.55	1187065.25	1459769.42	1.23
105	3.70	4.55	1187065.25	1459769.42	1.23
120	3.70	4.55	1187065.25	1459769.42	1.23

Appendix F The CO₂/CH₄ separation results for bacterial cellulose membranes with the weight ratio of 1:20

Table F1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:20

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	3.90	4.80	1251230.93	1539976.53	1.23
15	3.90	4.80	1251230.93	1539976.53	1.23
30	3.90	4.80	1251230.93	1539976.53	1.23
45	3.90	4.80	1251230.93	1539976.53	1.23
60	3.90	4.80	1251230.93	1539976.53	1.23
75	3.90	4.80	1251230.93	1539976.53	1.23
90	3.90	4.80	1251230.93	1539976.53	1.23
105	3.90	4.80	1251230.93	1539976.53	1.23
120	3.90	4.80	1251230.93	1539976.53	1.23

Table F2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:20

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	4.00	4.90	1283313.78	1572059.38	1.23
15	4.00	4.90	1283313.78	1572059.38	1.23
30	4.00	4.90	1283313.78	1572059.38	1.23
45	4.00	4.90	1283313.78	1572059.38	1.23
60	4.00	4.90	1283313.78	1572059.38	1.23
75	4.00	4.90	1283313.78	1572059.38	1.23
90	4.00	4.90	1283313.78	1572059.38	1.23
105	4.00	4.90	1283313.78	1572059.38	1.23
120	4.00	4.90	1283313.78	1572059.38	1.23

Table F3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane with the weight ratio of 1:20

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	3.85	5.00	1235189.51	1604142.22	1.30
15	3.85	5.00	1235189.51	1604142.22	1.30
30	3.85	5.00	1235189.51	1604142.22	1.30
45	3.85	5.00	1235189.51	1604142.22	1.30
60	3.85	5.00	1235189.51	1604142.22	1.30
75	3.85	5.00	1235189.51	1604142.22	1.30
90	3.85	5.00	1235189.51	1604142.22	1.30
105	3.85	5.00	1235189.51	1604142.22	1.30
120	3.85	5.00	1235189.51	1604142.22	1.30

Appendix G The CO₂/CH₄ separation results for bacterial cellulose membrane (weight ratio 1:10) with 0.1M silver ions (0.1M Ag⁺-BC)

Table G1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 0.1M silver ions (0.1M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.10	3.60	673739.73	1154982.40	1.71
15	2.10	3.60	673739.73	1154982.40	1.71
30	2.10	3.60	673739.73	1154982.40	1.71
45	2.10	3.60	673739.73	1154982.40	1.71
60	2.10	3.60	673739.73	1154982.40	1.71
75	2.10	3.60	673739.73	1154982.40	1.71
90	2.10	3.60	673739.73	1154982.40	1.71
105	2.10	3.60	673739.73	1154982.40	1.71
120	2.10	3.60	673739.73	1154982.40	1.71

Table G2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 0.1M silver ions (0.1M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.00	3.60	641656.89	1154982.40	1.80
15	2.00	3.60	641656.89	1154982.40	1.80
30	2.00	3.60	641656.89	1154982.40	1.80
45	2.00	3.60	641656.89	1154982.40	1.80
60	2.00	3.60	641656.89	1154982.40	1.80
75	2.00	3.60	641656.89	1154982.40	1.80
90	2.00	3.60	641656.89	1154982.40	1.80
105	2.00	3.60	641656.89	1154982.40	1.80
120	2.00	3.60	641656.89	1154982.40	1.80

Table G3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 0.1M silver ions (0.1M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	2.00	3.50	641656.89	1122899.56	1.75
15	2.00	3.50	641656.89	1122899.56	1.75
30	2.00	3.50	641656.89	1122899.56	1.75
45	2.00	3.50	641656.89	1122899.56	1.75
60	2.00	3.50	641656.89	1122899.56	1.75
75	2.00	3.50	641656.89	1122899.56	1.75
90	2.00	3.50	641656.89	1122899.56	1.75
105	2.00	3.50	641656.89	1122899.56	1.75
120	2.00	3.50	641656.89	1122899.56	1.75

Appendix H The CO₂/CH₄ separation results for bacterial cellulose membrane (weight ratio 1:10) with 0.5M silver ions (0.5M Ag⁺-BC)

Table H1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 0.5M silver ions (0.5M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	1.50	2.80	481242.67	898319.64	1.87
15	1.50	2.80	481242.67	898319.64	1.87
30	1.50	2.80	481242.67	898319.64	1.87
45	1.50	2.80	481242.67	898319.64	1.87
60	1.50	2.80	481242.67	898319.64	1.87
75	1.50	2.80	481242.67	898319.64	1.87
90	1.50	2.80	481242.67	898319.64	1.87
105	1.50	2.80	481242.67	898319.64	1.87
120	1.50	2.80	481242.67	898319.64	1.87

Table H2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 0.5M silver ions (0.5M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	1.50	2.80	481242.67	898319.64	1.87
15	1.50	2.80	481242.67	898319.64	1.87
30	1.50	2.80	481242.67	898319.64	1.87
45	1.50	2.80	481242.67	898319.64	1.87
60	1.50	2.80	481242.67	898319.64	1.87
75	1.50	2.80	481242.67	898319.64	1.87
90	1.50	2.80	481242.67	898319.64	1.87
105	1.50	2.80	481242.67	898319.64	1.87
120	1.50	2.80	481242.67	898319.64	1.87

Table H3 The first run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 0.5M silver ions (0.5M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	1.50	2.85	481242.67	914361.07	1.90
15	1.50	2.85	481242.67	914361.07	1.90
30	1.50	2.85	481242.67	914361.07	1.90
45	1.50	2.85	481242.67	914361.07	1.90
60	1.50	2.85	481242.67	914361.07	1.90
75	1.50	2.85	481242.67	914361.07	1.90
90	1.50	2.85	481242.67	914361.07	1.90
105	1.50	2.85	481242.67	914361.07	1.90
120	1.50	2.85	481242.67	914361.07	1.90

Appendix I The CO₂/CH₄ separation results for bacterial cellulose membrane (weight ratio 1:10) with 1.0M silver ions (1.0M Ag⁺-BC)

Table I1 The first run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 1.0M silver ions (1.0M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	1.10	2.50	352911.29	802071.11	2.27
15	1.10	2.50	352911.29	802071.11	2.27
30	1.10	2.50	352911.29	802071.11	2.27
45	1.10	2.50	352911.29	802071.11	2.27
60	1.10	2.50	352911.29	802071.11	2.27
75	1.10	2.50	352911.29	802071.11	2.27
90	1.10	2.50	352911.29	802071.11	2.27
105	1.10	2.50	352911.29	802071.11	2.27
120	1.10	2.50	352911.29	802071.11	2.27

Table I2 The second run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 1.0M silver ions (1.0M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	1.15	2.50	368952.71	802071.11	2.17
15	1.15	2.50	368952.71	802071.11	2.17
30	1.15	2.50	368952.71	802071.11	2.17
45	1.15	2.50	368952.71	802071.11	2.17
60	1.15	2.50	368952.71	802071.11	2.17
75	1.15	2.50	368952.71	802071.11	2.17
90	1.15	2.50	368952.71	802071.11	2.17
105	1.15	2.50	368952.71	802071.11	2.17
120	1.15	2.50	368952.71	802071.11	2.17

Table I3 The third run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 1.0M silver ions (1.0M Ag⁺-BC)

time (min)	CO ₂ (L/min)	CH ₄ (L/min)	Permeance CO ₂ (GPU)	Permeance CH ₄ (GPU)	Selectivity
0	1.10	2.50	352911.29	802071.11	2.27
15	1.10	2.50	352911.29	802071.11	2.27
30	1.10	2.50	352911.29	802071.11	2.27
45	1.10	2.50	352911.29	802071.11	2.27
60	1.10	2.50	352911.29	802071.11	2.27
75	1.10	- 2.50	352911.29	802071.11	2.27
90	1.10	2.50	352911.29	802071.11	2.27
105	1.10	2.50	352911.29	802071.11	2.27
120	1.10	2.50	352911.29	802071.11	2.27

Example of Calculation

$$\left(\frac{P}{\delta}\right)_i = \frac{Q_i \times 14.7 \times 10^6}{(A) \times (\Delta P) \times 76}$$

Where $\left(\frac{P}{\delta}\right)_i$ = permeance of gas "i" (GPU),

P = permeability of gas 'i' (10^{-10} cm³ (STP) cm/cm² s cm Hg)

(1 Barrer = 10^{-10} cm³ (STP) cm/cm² s cm Hg = 7.5×10^{-18} m² s⁻¹ Pa⁻¹),

δ = thickness of membrane (μ m),

Q_i = volumetric flow rate of gas 'i' (cm³/sec),

A = membrane area (cm²), and

ΔP = pressure difference between the feed side and the permeating side (psi).

Solⁿ : The third run of CO₂/CH₄ separation for bacterial cellulose membrane (weight ratio 1:10) with 1.0M silver ions (1.0M Ag⁺-BC)

Permeance of CO₂ (GPU)

$$Q_{CO_2} = 1.10 \text{ L/min}$$

$$= (1.10 \text{ L/min} \times 1000 \text{ cm}^3/\text{L} \times (1 \text{ min}/60 \text{ s})) = 18.33333333 \text{ cm}^3/\text{s}$$

$$A = \pi r^2 = (3.14 \times 0.4 \times 0.4) \text{ cm}^2 = 0.5024 \text{ cm}^2$$

$$\Delta P = 34.7 - 14.7 \text{ psi} = 20 \text{ psi}$$

$$\left(\frac{P}{\delta}\right) = \frac{18.33 \times 14.7 \times 10^6}{0.5024 \times 20 \times 76} = 352911.29 \text{ GPU}$$

Permeance of CH₄ (GPU)

$$Q_{\text{CH}_4} = 2.50 \text{ L/min}$$

$$= (2.50 \text{ L/min} \times 1000 \text{ cm}^3/\text{L} \times (1 \text{ min}/60 \text{ s})) = 41.66666667 \text{ cm}^3/\text{s}$$

$$A = \pi r^2 = (3.14 \times 0.4 \times 0.4) \text{ cm}^2 = 0.5024 \text{ cm}^2$$

$$\Delta P = 34.7 - 14.7 \text{ psi} = 20 \text{ psi}$$

$$\left(\frac{P}{\delta}\right) = \frac{41.67 \times 14.7 \times 10^6}{0.5024 \times 20 \times 76} = 802071.11 \text{ GPU}$$

CH₄/CO₂ Selectivity

$$S_{A/B} = \frac{P_A}{P_B} = 802071.11/352911.29 = 2.27$$

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Presentations:

1. Hosakun, Y.; Wongkasemjit, S.; Chaisuwan, T. (2014, February 27-28) Preparation of bacterial cellulose membranes from Nata de coco for CO₂/CH₄ separation, Paper presented at ICCEE 2014 : International Conference on Chemical and Environmental Engineering, Barcelona, Spain.
2. Hosakun, Y.; Wongkasemjit, S.; Chaisuwan, T. (2014, April 22) Preparation of bacterial cellulose membranes from Nata de coco with and without silver ions for CO₂/CH₄ separation, Paper presented at the 5th Research Symposium on Petrochemical and Materials Technology and The 20th PPC Symposium on Petroleum, Petrochemicals and Polymers, Bangkok, Thailand.