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APPENDICES

APPENDIX A The critical temperature and kinetic diameter of the gases used

Table A.1 The critical temperature and kinetic diameter of the gases used

Gas	Critical Temperature (K)	Kinetic Diameter (°A)
C ₂ H ₆	305.4	4.443
C ₂ H ₄	282.4	4.163
N ₂	126.2	3.798

APPENDIX B

These results were carried out by a mistake experimental procedure. The line-purging step was incomplete. Therefore, there were some gases left in the membrane-testing unit resulting in a mixed gas formation which gave an unreliable.

Table B.1 Silicone rubber coated on porous polysulfone (SR/PS)

Gas	Time ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	117.39	0.511	0.001	0.510	6.897E-07	1.414E-09	6.885E-07
	117.51	0.511			6.890E-07		
	117.56	0.510			6.887E-07		
	117.35	0.511			6.899E-07		
	117.1	0.512			6.914E-07		
	117.89	0.509			6.868E-07		
	117.93	0.509			6.865E-07		
	117.73	0.510			6.877E-07		
	117.56	0.510			6.887E-07		
	117.76	0.510			6.875E-07		
	117.78	0.509			6.874E-07		
	117.67	0.510			6.881E-07		

C ₂ H ₆	15.75	3.810	0.025	3.820	5.141E-06	3.418E-08	5.155E-06
	15.76	3.807			5.137E-06		
	15.79	3.800			5.128E-06		
	15.59	3.849			5.193E-06		
	15.89	3.776			5.095E-06		
	15.63	3.839			5.180E-06		
	15.68	3.827			5.164E-06		
	15.56	3.856			5.203E-06		
	15.71	3.819			5.154E-06		

C ₂ H ₄	13.78	4.354	0.031	4.354	5.875E-06	4.182E-08	5.876E-06
	13.76	4.360			5.884E-06		
	13.69	4.383			5.914E-06		
	13.75	4.364			5.888E-06		
	13.63	4.402			5.940E-06		
	13.89	4.320			5.829E-06		
	13.81	4.345			5.863E-06		
	13.93	4.307			5.812E-06		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min)

^c Standard deviation of flux

^d Average flux (ml/min)

^e Permeability (cm³/(cm²-cm-cmHg))

^f Standard deviation of permeability

^g Average permeability
(cm³/(cm²-cm-cmHg))

Permeability N₂

Permeability C₂H₆

Permeability C₂H₄

Selectivity of C₂H₄/C₂H₆

Selectivity of C₂H₄/N₂

Selectivity of C₂H₆/N₂

6.885E-07

5.155E-06

5.876E-06

1.13982

8.53463

7.48769

Table B.2 Silicone rubber/PEG coated on porous polysulfone (SR/PEG/PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	1469.48	0.041	0.001	0.041	5.510E-08	1.856E-09	5.341E-08
	1469.72	0.041			5.509E-08		
	1470.12	0.041			5.507E-08		
	1469.56	0.041			5.509E-08		
	1494.76	0.040			5.417E-08		
	1582.4	0.038			5.117E-08		
	1537.4	0.039			5.266E-08		
	1583.2	0.038			5.114E-08		
	1581.92	0.038			5.118E-08		

C ₂ H ₆	341.24	0.176	0.003	0.172	2.373E-07	4.466E-09	2.322E-07
	341.45	0.176			2.371E-07		
	341.67	0.176			2.370E-07		
	352.54	0.170			2.297E-07		
	358.66	0.167			2.257E-07		
	358.28	0.167			2.260E-07		
	348.18	0.172			2.325E-07		
	348.44	0.172			2.324E-07		
	348.41	0.172			2.324E-07		

C ₂ H ₄	162.24	0.370	0.001	0.369	4.990E-07	7.590E-10	4.986E-07
	162.32	0.370			4.988E-07		
	162.76	0.369			4.974E-07		
	162.25	0.370			4.990E-07		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min) Permeability N₂ 5.341E-08

^c Standard deviation of flux Permeability C₂H₆ 2.322E-07

^d Average flux (ml/min) Permeability C₂H₄ 4.986E-07

^e Permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₄/C₂H₆ 2.14695

^f Standard deviation of permeability Selectivity of C₂H₄/N₂ 9.33525

^g Average permeability Selectivity of C₂H₆/N₂ 4.34814
(cm³/(cm²-cm-cmHg))

Table B.3 Silicone rubber/Ag-LZ coated on porous polysulfone (SR/Ag-LZ/PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	145.07	0.414	0.001	0.414	5.58105E-07	1.755E-09	5.582E-07
	145.07	0.414			5.58105E-07		
	145.07	0.414			5.58105E-07		
	145.07	0.414			5.58105E-07		
	145.07	0.414			5.58105E-07		
	144.91	0.414			5.58721E-07		
	145.44	0.413			5.56685E-07		
	145.59	0.412			5.56111E-07		
	145.56	0.412			5.56226E-07		
	144.33	0.416			5.60966E-07		
	145.23	0.413			5.5749E-07		
	144.05	0.417			5.62057E-07		

C ₂ H ₆	24.97	2.403	0.009	2.414	3.24246E-06	1.2631E-08	3.258E-06
	24.74	2.425			3.27261E-06		
	24.95	2.405			3.24506E-06		
	24.83	2.416			3.26074E-06		
	24.88	2.412			3.25419E-06		
	24.79	2.420			3.266E-06		
	24.81	2.418			3.26337E-06		
	24.72	2.427			3.27525E-06		
	24.97	2.403			3.24246E-06		

C ₂ H ₄	25.78	2.327	0.006	2.319	3.14058E-06	8.4039E-09	3.1297E-06
	25.83	2.323			3.1345E-06		
	25.99	2.309			3.11521E-06		
	25.87	2.319			3.12966E-06		
	25.87	2.319			3.12966E-06		
	25.88	2.318			3.12845E-06		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min)

Permeability N₂

5.582E-07

^c Standard deviation of flux

Permeability C₂H₆

3.258E-06

^d Average flux (ml/min)

Permeability C₂H₄

3.1297E-06

^e Permeability (cm³/(cm²-cm-cmHg))

Selectivity of C₂H₄/C₂H₆

0.96061

^f Standard deviation of permeability

Selectivity of C₂H₄/N₂

5.60641

^g Average permeability

Selectivity of C₂H₆/N₂

5.83632

(cm³/(cm²-cm-cmHg))

Table B.4 Silicone rubber/Ag-X coated on porous polysulfone (SR/Ag-X/PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	144.59	0.415	0.0005	0.415	5.600E-07	6.625E-10	5.605E-07
	144.19	0.416			5.615E-07		
	144.53	0.415			5.602E-07		
	144.46	0.415			5.605E-07		
	144.67	0.415			5.596E-07		
	144.27	0.416			5.612E-07		
	144.47	0.415			5.604E-07		

C ₂ H ₆	23.59	2.543	0.013	2.506	3.432E-06	1.767E-08	3.445E-06
	23.59	2.543			3.432E-06		
	23.67	2.535			3.421E-06		
	23.52	2.551			3.442E-06		
	23.35	2.570			3.467E-06		
	23.43	2.561			3.456E-06		
	23.38	2.566			3.463E-06		

C ₂ H ₄	27.57	2.176	0.010	2.181	2.937E-06	1.411E-08	2.943E-06
	27.39	2.191			2.956E-06		
	27.48	2.183			2.946E-06		
	27.61	2.173			2.932E-06		
	27.8	2.158			2.912E-06		
	27.5	2.182			2.944E-06		
	27.42	2.188			2.953E-06		
	27.5	2.182			2.944E-06		
	27.37	2.192			2.958E-06		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min) Permeability N₂ 5.605E-07

^c Standard deviation of flux Permeability C₂H₆ 3.445E-06

^d Average flux (ml/min) Permeability C₂H₄ 2.943E-06

^e Permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₄/C₂H₆ 0.85422

^f Standard deviation of permeability Selectivity of C₂H₄/N₂ 5.25002

^g Average permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₆/N₂ 6.14600

Table B.5 Silicone rubber/Ag-A coated on porous polysulfone (SR/Ag-A/PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	136.05	0.441	0.003	0.436	5.951E-07	4.512E-09	5.887E-07
	136.77	0.439			5.920E-07		
	136.69	0.439			5.923E-07		
	136.87	0.438			5.915E-07		
	139.95	0.429			5.785E-07		
	136	0.441			5.953E-07		
	137.31	0.437			5.896E-07		
	138.09	0.434			5.863E-07		
	137.89	0.435			5.872E-07		
	139.05	0.431			5.823E-07		
	137.14	0.438			5.904E-07		
	137.61	0.436			5.884E-07		
	137.99	0.435			5.867E-07		
	138.17	0.434			5.860E-07		
	137.61	0.436			5.884E-07		

C ₂ H ₆	20.59	2.914	0.007	2.923	3.932E-06	9.277E-09	3.944E-06
	20.62	2.910			3.926E-06		
	20.49	2.928			3.951E-06		
	20.52	2.924			3.946E-06		
	20.52	2.924			3.946E-06		
	20.5	2.927			3.949E-06		
	20.49	2.928			3.951E-06		
	20.51	2.925			3.948E-06		

C ₂ H ₄	23.27	2.578	0.010	2.582	3.479E-06	1.346E-08	3.484E-06
	23.32	2.573			3.472E-06		
	23.17	2.590			3.494E-06		
	23.36	2.568			3.466E-06		
	23.15	2.592			3.497E-06		
	23.2	2.586			3.490E-06		
	23.33	2.572			3.470E-06		
	23.13	2.594			3.500E-06		

^a Time to reach 0.25 mL in volume (sec)^b Flux (ml/min) Permeability N₂ 5.887E-07^c Standard deviation of flux Permeability C₂H₆ 3.944E-06^d Average flux (ml/min) Permeability C₂H₄ 3.484E-06^e Permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₄/C₂H₆ 0.88335^f Standard deviation of permeability Selectivity of C₂H₄/N₂ 5.91794^g Average permeability Selectivity of C₂H₆/N₂ 6.69942
(cm³/(cm²-cm-cmHg))

Table B.6 Silicone rubber/Ag-LZ coated on treated polysulfone (SR/Ag-LZ/PEG-PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	237.29	0.063	0.00005	0.243	8.530E-08	6.319E-11	8.526E-08
	237.33	0.063			8.529E-08		
	237.3	0.063			8.530E-08		
	237.29	0.063			8.530E-08		
	237.81	0.063			8.511E-08		
	237.34	0.063			8.528E-08		
	237.48	0.063			8.523E-08		
	237.53	0.063			8.521E-08		
	237.28	0.063			8.530E-08		

C ₂ H ₆	55.33	0.271	0.001	0.271	3.658E-07	7.077E-10	3.661E-07
	55.09	0.272			3.674E-07		
	55.27	0.271			3.662E-07		
	55.31	0.271			3.660E-07		
	55.44	0.271			3.651E-07		
	55.28	0.271			3.662E-07		
	55.35	0.271			3.657E-07		

C ₂ H ₄	37.02	0.405	0.003	0.401	5.468E-07	4.248E-09	5.411E-07
	37.19	0.403			5.443E-07		
	37.29	0.402			5.428E-07		
	37.33	0.402			5.422E-07		
	37.38	0.401			5.415E-07		
	37.59	0.399			5.385E-07		
	37.19	0.403			5.443E-07		
	37.9	0.396			5.341E-07		
	37.8	0.397			5.355E-07		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min) Permeability N₂ 8.526E-08

^c Standard deviation of flux Permeability C₂H₆ 3.661E-07

^d Average flux (ml/min) Permeability C₂H₄ 5.411E-07

^e Permeability (cm³/(cm²-cm-Hg)) Selectivity of C₂H₄/C₂H₆ 1.47818

^f Standard deviation of permeability Selectivity of C₂H₄/N₂ 6.34639

^g Average permeability Selectivity of C₂H₆/N₂ 4.29339
(cm³/(cm²-cm-Hg))

Table B.7 Silicone rubber/Ag-X coated on treated polysulfone (SR/Ag-X/PEG-PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	190.68	0.079	0.002	0.078	1.062E-07	2.183E-09	1.056E-07
	190.36	0.079			1.063E-07		
	190.39	0.079			1.063E-07		
	190.37	0.079			1.063E-07		
	190.73	0.079			1.061E-07		
	203.7	0.074			9.937E-08		
	190.33	0.079			1.063E-07		
	190.69	0.079			1.061E-07		
	190.29	0.079			1.064E-07		
	190.49	0.079			1.063E-07		

C ₂ H ₆	50.28	0.298	0.001	0.297	4.026E-07	1.041E-09	4.006E-07
	50.67	0.296			3.995E-07		
	50.52	0.297			4.007E-07		
	50.5	0.297			4.008E-07		
	50.45	0.297			4.012E-07		
	50.47	0.297			4.011E-07		
	50.67	0.296			3.995E-07		
	50.62	0.296			3.999E-07		

C ₂ H ₄	31.78	0.472	0.004	0.478	6.369E-07	5.772E-09	6.453E-07
	31.46	0.477			6.434E-07		
	31.07	0.483			6.515E-07		
	31.29	0.479			6.469E-07		
	31.07	0.483			6.515E-07		
	31.55	0.475			6.416E-07		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min)

Permeability N₂

1.056E-07

^c Standard deviation of flux

Permeability C₂H₆

4.006E-07

^d Average flux (ml/min)

Permeability C₂H₄

6.453E-07

^e Permeability (cm³/(cm²-cm-cmHg))

Selectivity of C₂H₄/C₂H₆

1.61063

^f Standard deviation of permeability

Selectivity of C₂H₄/N₂

6.11214

^g Average permeability
(cm³/(cm²-cm-cmHg))

Selectivity of C₂H₆/N₂

3.79487

Table B.8 Silicone rubber/Ag-A coated on treated polysulfone (SR/Ag-A/PEG-PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N2	289.54	0.052	0.0002	0.052	6.991E-08	2.565E-10	7.024E-08
	289.57	0.052			6.990E-08		
	289.65	0.052			6.988E-08		
	287.37	0.052			7.044E-08		
	287.35	0.052			7.044E-08		
	287.33	0.052			7.045E-08		
	287.76	0.052			7.034E-08		
	287.57	0.052			7.039E-08		
	287.59	0.052			7.038E-08		

C2H6	78.37	0.191	0.008	0.181	2.583E-07	1.070E-08	2.438E-07
	78.81	0.190			2.568E-07		
	85.49	0.175			2.368E-07		
	85.54	0.175			2.366E-07		
	85.33	0.176			2.372E-07		
	85.47	0.176			2.368E-07		

C2H4	44.3	0.339	0.004	0.345	4.569E-07	5.359E-09	4.661E-07
	43.29	0.347			4.676E-07		
	43.23	0.347			4.682E-07		
	42.94	0.349			4.714E-07		
	42.93	0.349			4.715E-07		
	43.41	0.346			4.663E-07		
	43.89	0.342			4.612E-07		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min)

Permeability N₂

7.024E-08

^c Standard deviation of flux

Permeability C₂H₆

2.438E-07

^d Average flux (ml/min)

Permeability C₂H₄

4.661E-07

^e Permeability (cm³/(cm²-cm-cmHg))

Selectivity of C₂H₄/C₂H₆

1.91235

^f Standard deviation of permeability

Selectivity of C₂H₄/N₂

6.63690

^g Average permeability
(cm³/(cm²-cm-cmHg))

Selectivity of C₂H₆/N₂

3.47055

Table B.9 Silicone rubber/Ag-LZ/H₂O coated on treated polysulfone (SR/Ag-LZ(H₂O)/PEG-PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	171.68	0.087	0.001	0.172	1.179E-07	1.074E-09	1.189E-07
	171.37	0.088			1.181E-07		
	171.41	0.088			1.181E-07		
	171.43	0.087			1.181E-07		
	171.47	0.087			1.180E-07		
	171.41	0.088			1.181E-07		
	168.49	0.089			1.201E-07		
	168.5	0.089			1.201E-07		
	168.57	0.089			1.201E-07		
	168.43	0.089			1.202E-07		

C ₂ H ₆	51.82	0.289	0.004	0.293	3.906E-07	4.816E-09	3.954E-07
	51.27	0.293			3.948E-07		
	51.39	0.292			3.939E-07		
	49.88	0.301			4.058E-07		
	51.25	0.293			3.949E-07		
	51.29	0.292			3.946E-07		
	51.47	0.291			3.933E-07		

C ₂ H ₄	38.94	0.385	0.004	0.388	5.198E-07	5.549E-09	5.237E-07
	39.4	0.381			5.137E-07		
	38.11	0.394			5.311E-07		
	38.07	0.394			5.317E-07		
	38.67	0.388			5.234E-07		
	38.5	0.390			5.257E-07		
	38.74	0.387			5.225E-07		
	38.63	0.388			5.240E-07		
	38.85	0.386			5.210E-07		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min) Permeability N₂ 1.189E-07

^c Standard deviation of flux Permeability C₂H₆ 3.954E-07

^d Average flux (ml/min) Permeability C₂H₄ 5.237E-07

^e Permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₄/C₂H₆ 1.32434

^f Standard deviation of permeability Selectivity of C₂H₄/N₂ 4.40495

^g Average permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₆/N₂ 3.32615

Table B.10 Silicone rubber/Ag-X/H₂O coated on treated polysulfone (SR/Ag-X(H₂O)/PEG-PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	96.53	0.155	0.003	0.153	2.097E-07	3.698E-09	2.065E-07
	96.68	0.155			2.094E-07		
	96.59	0.155			2.096E-07		
	99.81	0.150			2.028E-07		
	99.44	0.151			2.036E-07		
	99.59	0.151			2.032E-07		
	99.29	0.151			2.039E-07		
	99.36	0.151			2.037E-07		
	98.27	0.153			2.060E-07		
	95.41	0.157			2.121E-07		
	99.85	0.150			2.027E-07		
	95.55	0.157			2.118E-07		

C ₂ H ₆	36.87	0.407	0.003	0.411	5.490E-07	3.721E-09	5.542E-07
	36.62	0.410			5.527E-07		
	36.67	0.409			5.520E-07		
	36.07	0.416			5.612E-07		
	36.62	0.410			5.527E-07		
	36.43	0.412			5.556E-07		
	36.33	0.413			5.571E-07		
	36.6	0.410			5.530E-07		

C ₂ H ₄	18.5	0.811	0.009	0.813	1.094E-06	1.153E-08	1.097E-06
	18.19	0.825			1.113E-06		
	18.72	0.801			1.081E-06		
	18.43	0.814			1.098E-06		
	18.61	0.806			1.088E-06		
	18.31	0.819			1.105E-06		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min) Permeability N₂ 2.065E-07

^c Standard deviation of flux Permeability C₂H₆ 5.542E-07

^d Average flux (ml/min) Permeability C₂H₄ 1.097E-06

^e Permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₄/C₂H₆ 1.97877

^f Standard deviation of permeability Selectivity of C₂H₄/N₂ 5.30938

^g Average permeability (cm³/(cm²-cm-cmHg)) Selectivity of C₂H₆/N₂ 2.68317

Table B.11 Silicone rubber/Ag-A/H₂O coated on treated polysulfone (SR/Ag-A(H₂O)/PEG-PS)

Gas	Delta T ^a	Flux ^b	Std Dev ^c	Ave flux ^d	Permeability ^e	Std Dev ^f	Average ^g
N ₂	253.43	0.059	0.003	0.054	7.987E-08	3.516E-09	7.339E-08
	266.77	0.056			7.587E-08		
	266.31	0.056			7.601E-08		
	266.52	0.056			7.595E-08		
	266.53	0.056			7.594E-08		
	266.65	0.056			7.591E-08		
	288.42	0.052			7.018E-08		
	288.37	0.052			7.019E-08		
	288.36	0.052			7.019E-08		
	288.48	0.052			7.016E-08		
	288.4	0.052			7.018E-08		
	288.31	0.052			7.021E-08		

C ₂ H ₆	66.72	0.225	0.001	0.225	3.034E-07	3.043E-07	3.043E-07
	66.37	0.226			3.050E-07		
	66.23	0.226			3.056E-07		
	66.43	0.226			3.047E-07		
	66.65	0.225			3.037E-07		
	66.43	0.226			3.047E-07		
	66.82	0.224			3.029E-07		

C ₂ H ₄	43.5	0.345	0.006	0.336	4.653E-07	8.164E-09	4.539E-07
	43.54	0.345			4.649E-07		
	45.31	0.331			4.467E-07		
	44.27	0.339			4.572E-07		
	44.37	0.338			4.562E-07		
	44.43	0.338			4.556E-07		
	45.22	0.332			4.476E-07		
	44.34	0.338			4.565E-07		
	44.94	0.334			4.504E-07		
	46.1	0.325			4.391E-07		

^a Time to reach 0.25 mL in volume (sec)

^b Flux (ml/min)

Permeability N₂

7.339E-08

^c Standard deviation of flux

Permeability C₂H₆

3.043E-07

^d Average flux (ml/min)

Permeability C₂H₄

4.539E-07

^e Permeability (cm³/(cm²-cm-cmHg))

Selectivity of C₂H₄/C₂H₆

1.49187

^f Standard deviation of permeability

Selectivity of C₂H₄/N₂

6.18553

^g Average permeability
(cm³/(cm²-cm-cmHg))

Selectivity of C₂H₆/N₂

4.14616

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