

Supporting Information

High-pressure solubility of CO₂ in glymes

Monique Amaral[†], Emanuel A. Crespo[‡], Claudio Dariva[†], Lourdes F. Vega[‡], Pedro J. Carvalho^{‡*} and João A. P. Coutinho[‡]

[†] NUESC- Instituto de Tecnologia de Pesquisa, Universidade Tiradentes, 49031-490, Aracaju, Brazil

[‡] CICECO – Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

[‡] Gas Research Center and Chemical Engineering Department - Khalifa University of Science and Technology (KUST) -The Petroleum Institute, P.O. Box 2533, Abu Dhabi, United Arab Emirates.

*Corresponding author E-mail address: quijorge@ua.pt (P.J. Carvalho).

Table S1: Bubble point data of the system CO₂ + DEGEE.

293 K				323 K			
CPD		CEP		CPD		CEP	
x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa
0.08	0.80	0.13	1.00	0.08	1.28	0.13	1.70
0.17	1.42	0.21	1.57	0.17	2.20	0.21	2.83
0.21	1.58	0.29	2.05	0.21	2.99	0.29	3.70
0.75	4.88	0.33	2.32	0.75	8.84	0.33	4.30
0.32	2.39	0.40	2.87	0.32	4.42	0.40	5.04
0.47	3.24	0.48	3.47	0.47	6.20	0.48	6.29
		0.55	4.05			0.55	7.40
		0.60	4.30			0.60	7.99
303 K				333 K			
CPD		CEP		CPD		CEP	
x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa
0.08	0.81	0.13	1.19	0.08	1.52	0.13	2.00
0.17	1.56	0.21	1.95	0.17	2.52	0.21	3.34
0.21	2.01	0.29	2.48	0.21	3.31	0.29	4.30
0.75	5.93	0.33	2.84	0.75	10.76	0.33	4.80
0.32	2.87	0.40	3.55	0.32	4.82	0.40	5.98
0.47	4.00	0.48	4.34	0.47	7.20	0.48	7.28
		0.55	5.01			0.55	8.67
		0.60	5.42			0.60	9.32
313 K				343 K		353 K	
CPD		CEP		CEP		CEP	
x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa
0.08	0.98	0.13	1.46	0.13	2.29	0.13	2.57
0.17	1.87	0.21	2.37	0.21	3.64	0.21	4.05
0.21	2.48	0.29	3.09	0.29	4.81	0.29	5.38
0.75	7.29	0.33	3.68	0.33	5.41	0.33	6.06
0.32	3.60	0.40	4.34	0.40	6.86	0.40	7.66
0.47	4.92	0.48	5.12	0.48	8.34	0.48	9.40
		0.55	6.13	0.55	9.96	0.55	11.23
		0.60	6.50	0.60	10.74	0.60	12.16

Standard uncertainties u are $u(T) = 0.15$ K, $u(x) = 0.0002$ and $u(p) = 0.004$ MPa. CPD - Constant Pressure Decay, CEP – Constant Equilibrium Pressure

Table S2: Bubble point data of the system CO₂ + DEGDEE. Data measured using CEP methodology.

293 K		313 K		333 K		353 K	
<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa
0.07	0.67	0.07	0.96	0.07	1.14	0.07	1.34
0.13	0.83	0.13	1.14	0.13	1.47	0.13	1.83
0.20	1.16	0.20	1.64	0.20	2.19	0.20	2.97
0.32	1.76	0.32	2.59	0.32	3.51	0.32	4.53
0.42	2.36	0.42	3.48	0.42	4.62	0.42	6.01
0.50	2.84	0.50	4.12	0.50	5.72	0.50	7.36
0.56	3.12	0.56	4.70	0.56	6.36	0.56	8.41
0.65	3.77	0.65	5.57	0.65	7.83	0.65	10.19
303 K		323 K		343 K			
<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa		
0.07	0.79	0.07	1.02	0.07	1.22		
0.13	0.98	0.13	1.31	0.13	1.66		
0.20	1.39	0.20	1.88	0.20	2.59		
0.32	2.15	0.32	3.08	0.32	4.04		
0.42	2.78	0.42	3.92	0.42	5.33		
0.50	3.48	0.50	4.88	0.50	6.58		
0.56	3.86	0.56	5.57	0.56	7.39		
0.65	4.55	0.65	6.72	0.65	8.90		

Standard uncertainties *u* are $u(T) = 0.15$ K, $u(x) = 0.0002$ and $u(p) = 0.004$ MPa.

Table S3: Bubble point data of the system CO₂ + DEGME.

293 K				323 K			
CPD		CEP		CPD		CEP	
x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa
0.10	1.00			0.10	1.40		
0.20	1.80	0.12	1.25	0.20	2.70	0.12	1.80
0.23	1.95	0.21	1.89	0.23	3.17	0.21	2.96
0.34	2.70	0.27	2.24	0.34	4.71	0.27	3.72
0.46	3.28	0.40	2.98	0.46	6.04	0.40	5.12
0.58	4.00	0.50	3.80	0.58	7.14	0.50	6.78
0.69	4.63	0.60	4.33	0.69	8.56	0.60	7.92
0.78	5.06			0.78	9.59		
0.89	5.30			0.89	11.03		
303 K				333 K			
CPD		CEP		CPD		CEP	
x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa
0.10	1.18			0.10	1.62		
0.20	2.10	0.12	1.40	0.20	3.12	0.12	2.00
0.23	2.30	0.21	2.20	0.23	3.78	0.21	3.35
0.34	3.12	0.27	2.74	0.34	5.36	0.27	4.25
0.46	4.10	0.40	3.66	0.46	7.00	0.40	5.95
0.58	5.19	0.50	4.63	0.58	8.77	0.50	7.94
0.69	5.68	0.60	5.43	0.69	10.39	0.60	9.35
0.78	6.05			0.78	11.59		
0.89	6.67			0.89	12.54		
313 K				343 K		353 K	
CPD		CEP		CEP		CEP	
x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa	x_{CO_2}	p /MPa
0.10	1.29						
0.20	2.40	0.12	1.60	0.12	2.20	0.12	2.42
0.23	2.60	0.21	2.55	0.21	3.80	0.21	4.16
0.34	3.88	0.27	3.16	0.27	4.85	0.27	5.34
0.46	4.94	0.40	4.50	0.40	6.68	0.40	7.72
0.58	6.00	0.50	5.71	0.50	9.09	0.50	10.22
0.69	7.08	0.60	6.60	0.60	10.95	0.60	12.31
0.78	7.98						
0.89	8.87						

Standard uncertainties u are $u(T) = 0.15$ K, $u(x) = 0.0002$ and $u(p) = 0.004$ MPa. CPD - Constant Pressure Decay, CEP – Constant Equilibrium Pressure

Table S4: Bubble point data of the system CO₂ + DEGDME.

293 K				323 K			
CPD		CEP		CPD		CEP	
<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa
0.06	0.45	0.04	0.44	0.06	0.65	0.04	0.73
0.19	1.40	0.11	0.80	0.19	2.00	0.11	1.10
0.32	1.95	0.14	0.98	0.32	3.15	0.14	1.40
0.56	3.26	0.33	2.00	0.56	5.50	0.33	3.28
0.79	4.16	0.50	2.89	0.79	7.36	0.50	5.05
0.88	4.56	0.56	3.25	0.88	8.48	0.56	5.60
303 K				333 K			
CPD		CEP		CPD		CEP	
<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa
0.06	0.50	0.04	0.54	0.06	0.75	0.04	0.84
0.19	1.60	0.11	0.90	0.19	2.22	0.11	1.30
0.32	2.30	0.14	1.10	0.32	3.56	0.14	1.60
0.56	3.81	0.33	2.36	0.56	6.30	0.33	3.76
0.79	5.16	0.50	3.42	0.79	8.44	0.50	5.90
0.88	5.86	0.56	3.99	0.88	10.12	0.56	6.55
313 K				343 K		353 K	
CPD		CEP		CEP		CEP	
<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa	<i>x</i> _{CO2}	<i>p</i> /MPa
0.06	0.55	0.04	0.65	0.04	1.04	0.04	1.11
0.19	1.78	0.11	1.00	0.11	1.40	0.11	1.55
0.32	2.63	0.14	1.20	0.14	1.70	0.14	1.90
0.56	4.70	0.33	2.87	0.33	4.29	0.33	4.74
0.79	6.1	0.50	4.17	0.50	6.62	0.50	7.54
0.88	6.87	0.56	4.83	0.56	7.74	0.56	8.67

Standard uncertainties *u* are $u(T) = 0.15$ K, $u(x) = 0.0002$ and $u(p) = 0.004$ MPa. CPD - Constant Pressure Decay, CEP – Constant Equilibrium Pressure