

P-V-T Relations of Propane in the Range 373.15–423.15 K and 0.2–4.0

MPa

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Propane ($T_c = 369.82$ K, $P_c = 4.250$ MPa, $Z_c = 0.2766$) is an important constituent of Liquefied Natural Gas. Reliable data on the P-V-T relations of propane under moderate temperature and pressure conditions are useful in the extraction of molecular information through Virial Coefficients, the preparation of thermodynamic tables for propane and in the prediction of the behaviour of propane mixtures.

APPARATUS AND EXPERIMENTAL PROCEDURE

The apparatus works on Bunnett's series expansion techniques and is described briefly by Prasad and Viswanath (1980). Pressure

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measurements are accurate to 1 part in 10,000 for a major part of the range and temperatures recorded are within ± 0.01 K on the IPTS-68 scale. The compressibility factor measurement reported here are estimated to be accurate to $\pm 0.1\%$.

Research purity propane, supplied by Matheson Gas Company is collected into the cell compartment by maintaining the evacuated apparatus at about 273.15 K. The apparatus is gradually heated to the required isothermal level of each experiment. During the heating process, the vapor pressures are recorded at each of the temperatures reported in this study. The multiple observations at any temperature differ by less than 0.0001 MPa and the average of about 10 measurements is the value recorded as the observed value.

An MS-10 mass spectrometer with Dempster's type 5 cm radius permanent magnetic analyser confirmed the purity of the sample to be 99.99% propane.

TABLE 1. COMPRESSIBILITY OF PROPANE

Temp.: 373.15 K		Temp.: 383.15 K		Temp.: 393.15 K	
Pressure MPa	Compressibility Factor	Pressure MPa	Compressibility Factor	Pressure MPa	Compressibility Factor
4.035	0.5201	3.668	0.6654	4.658	0.5817
3.310	0.6399	2.790	0.7587	3.727	0.6981
2.578	0.7476	2.036	0.8306	2.823	0.7935
1.901	0.8269	1.444	0.8835	2.041	0.8593
1.350	0.8805	1.003	0.9203	1.432	0.9055
0.937	0.9173	0.687	0.9457	0.988	0.9363
0.643	0.9437	0.466	0.9629	0.672	0.9568
0.437	0.9615	0.315	0.9745	0.455	0.9715
0.295	0.9743	0.211	0.9813	0.306	0.9805
0.198	0.9815	0.131	0.9876	0.206	0.9875
3.759	0.5679	2.475	0.7933	4.310	0.6236
3.022	0.6849	1.783	0.8574	3.381	0.7335
2.300	0.7817	1.254	0.8876	2.514	0.8182
1.667	0.8498	0.864	0.9349	1.796	0.8762
1.172	0.8961	0.590	0.9581	1.252	0.9166
0.810	0.9289	0.399	0.9723	0.859	0.9431
0.553	0.9519	0.269	0.9826	0.584	0.9626
0.375	0.9670	0.180	0.9868	0.395	0.9752
0.253	0.9778			0.265	0.9823
				0.177	0.9865
3.896	0.7165	4.033	0.7437	4.263	0.7467
2.907	0.7992	2.966	0.8202	3.146	0.8265
2.091	0.8661	2.118	0.8787	2.251	0.8873
1.465	0.9098	1.476	0.9187	1.569	0.9278
1.008	0.9395	1.013	0.9450	1.074	0.9697
0.686	0.9582	0.688	0.9637	0.729	0.9697
0.464	0.9718	0.465	0.9763	0.490	0.9785
0.311	0.9785	0.312	0.9822	0.329	0.9847
0.209	0.9865	0.209	0.9881	0.221	0.9914
4.331	0.6848	3.704	0.7719	3.677	0.7843
3.280	0.7786	2.698	0.8434	2.674	0.8556
2.394	0.8517	1.911	0.8959	1.890	0.9020
1.697	0.9056	1.325	0.9321	1.305	0.9397
1.168	0.9345	0.906	0.9560	0.890	0.9606
0.767	0.9569	0.615	0.9725	0.601	0.9741
0.540	0.9723	0.413	0.9808	0.404	0.9822
0.363	0.9811	0.277	0.9876	0.271	0.9822
0.244	0.9870	0.186	0.9916	0.182	0.9924

TABLE 2. VAPOR PRESSURE OF PROPANE

Temp., K	Vapor Pressure MPa
298.15	0.9413
303.15	1.0621
308.15	1.2027
313.15	1.3883
318.15	1.5426
323.15	1.7343
328.15	1.9252
333.15	2.1356
338.15	2.3657
348.15	2.5561
353.15	3.1477
358.15	3.4690
363.15	3.7792
368.15	4.0699

TABLE 3. VIRIAL COEFFICIENTS OF PROPANE

Temp., K	$C_m^{3B} \text{ mol}^{-1}$	$C_m^{6C} \text{ mol}^{-2}$
373.15	-245.08	-0.96821
383.15	-229.36	-0.59873
393.15	-215.73	-0.14958
403.15	-201.11	+0.53923
413.15	-192.35	+1.20822
423.15	-186.46	+1.95680

RESULTS AND DISCUSSION

Compressibility factor and vapor pressure observations are given in Tables 1 and 2, while values of the second and third Virial Coefficients derived from the measurements below 1.5 MPa are given in Table 3.

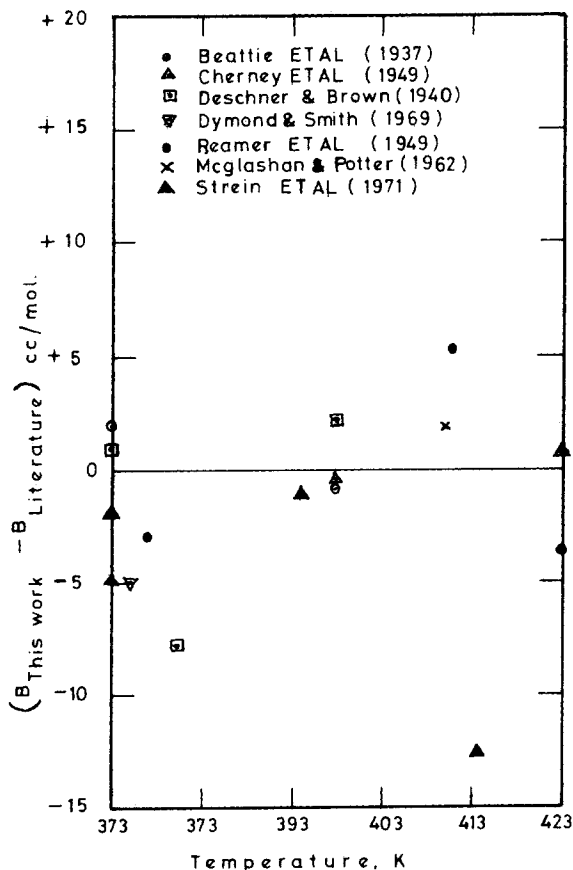


Figure 1. Comparison of second virial coefficient with literature values.

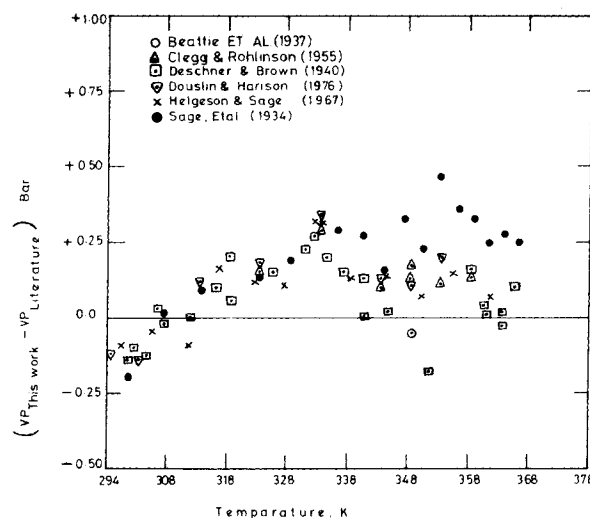


Figure 2. Comparison of vapor pressure with literature experimental data.

Second Virial Coefficients of this work compare with literature data as shown in Figure 1, while Figure 2 compares the vapor pressures of the present work with literature experimental data. In view of the fact that the measurements are in the super critical region of 373.15–423.15 K, the agreement with the earlier works is considered satisfactory.

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