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Second Virial Coefficient for C_2H_4 Gas at High Temperature

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ABSTRACT

We study second virial coefficient B(T) for the Gas(C_2H_4). The virial coefficients give the deviations from ideality in terms of the forces between molecules. PV=RT, PV/RT = 1B(T) / V+C(T)/V@+D(T)/V_3+.... This is virial equation of state and describe the behavior of an imperfect gas. The first virial coefficients is simply unity.

INTRODUCTION

The word "Virial is derived from the latin which means "Force". The virial is a quantity defined in terms of the forces acting on the moelecules. The virial coefficients give the deviations from ideality in terms of the forces between molecules.

The study of virial coefficients becomes very important because they are related with interaction energy and as such responsible for the deviation of gases from ideal to non-ideal.

A simple form of the kinetic theory of gases leads to well known equation of state PV=RT which describes the behavior of a perfect gas but most real or imperfect gases do not obey this equation closely even at room temperature. One way of dealing with an imperfect gas is to modify the ideal gas equation

$$\frac{PV}{RT} = 1 + \frac{B(T)}{V} + \frac{C(T)}{V^2} + \frac{D(T)}{V^3} + \ldots\ldots\ldots\ldots$$

This is called a virial equation of state and describe the behavior of an imperfect gas. The first virial coefficient is simply unity so that for a perfect gas all the virial coefficients are zero (apart from the first). Thus the coefficient B.C. etc. are measure of how much the behavior of a imperfect gas departs from that of a perfect gas

Lennard Zone Potential

$$B = -2\pi N \int_0^\infty \left(e^{-\phi(r)/kT^{-1}}\right) r^2\, dr$$

where $\phi(r) = 4 \in \left[\left(\frac{\sigma}{\alpha}\right)^{12} - \left(\frac{\sigma}{\alpha}\right)^{6} \right]$ - Lennard Zone Potential

Table-1

Gas	Temp.	Range	Nature of the Curve
C_2H_4	59.76	99.6	Straight Line
	109.56	1394.4	Hyperboile
	1593.60	5976.0	Straight Line

Table-2

C_2H_4

Shape of the Portion of the curve	Mathematical Relation for B(T)	Value of Constants
Straight Line	$B(T) = a_0 + a_1T$	$a_0 = -6189.571$ $a_1 = 54.27113$
Hyperboile	$B(T) = b_0 + b_1/T + b_2/T^2$	$b_0 = 76.71004$ $b_1 = -43323.15$ $b_2 = -6235752$
Straight Line	$B(T) = c_0 + c_1T$	$c_0 = 58.64264$ $c_1 = -2.01895 \times 10^{-4}$

Table-3

C_2H_4

T*	B*(T*)	T^0K	B(T) Experimental	B(T) Calculated
0.30	– 27.8806	59.7600	– 3253.6600	– 2946.2090
0.35	– 18.7549	69.7200	– 2188.7000	– 2405.6480
0.40	– 13.7988	79.6800	– 1610.3200	– 1865.8880
0.45	– 10.7550	89.6400	– 1255.1100	– 1324.5280
0.50	– 8.7202	99.6000	– 1017.6500	– 783.9673
0.55	– 7.2741	109.5600	– 848.8900	– 838.2750
0.60	– 6.1980	119.5200	– 723.3000	– 722.2898
0.65	– 5.3682	129.4800	– 626.4700	– 629.8324
0.70	– 4.7100	139.4400	– 549.6600	– 554.6950
0.75	– 4.1759	149.4000	– 487.3300	– 492.6460
0.80	– 3.7342	159.3600	– 435.7800	– 440.6916
0.85	– 3.3631	169.3200	– 392.4800	– 396.6620
0.90	– 3.0471	179.2800	– 355.6000	– 358.9512
0.95	– 2.7749	189.2400	– 323.8300	– 326.3480
1.00	– 2.5381	199.2000	– 296.1900	– 297.9242
1.05	– 2.3302	209.1600	– 271.9400	– 272.9572
1.10	– 1.9826	219.1200	– 250.4800	– 250.8790
1.15	– 1.8359	229.0800	– 231.3800	– 231.2348
1.20	– 1.8359	249.0000	– 214.2600	– 213.6590
1.25	– 1.7304	258.9600	– 198.8300	– 197.6335
1.30	– 1.5842	268.9200	– 184.8700	– 183.5739
1.35	– 1.4753	278.8800	– 172.1600	– 170.6173
1.40	– 1.3758	288.8400	– 160.5600	– 158.8147
1.45	– 1.2847	298.8000	– 149.9300	– 148.9237
1.50	– 1.2009	245.7200	– 140.1400	– 138.1242
1.55	– 1.1235	308.7600	– 131.1100	– 129.0137

Table-3

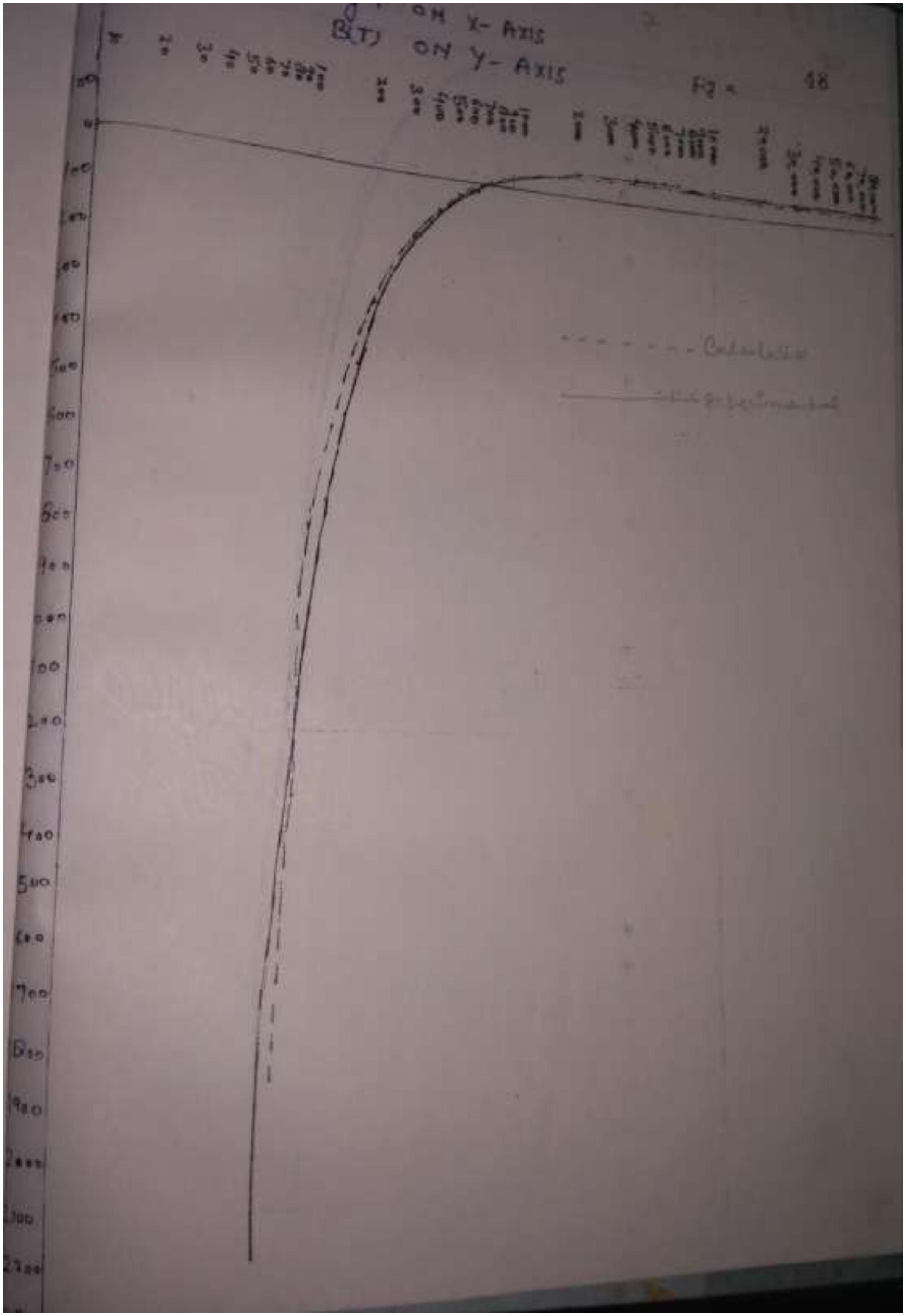
C_2H_4

T*	B*(T*)	T^0K	B(T) Experimental	B(T) Calculated
1.60	– 1.0519	318.7200	– 122.7600	– 120.6046
1.65	– 9.9850	328.6800	– 115.0000	– 112.8216
1.70	– 0.9236	38.6940	– 107.7900	– 105.5994
1.75	– 0.8650	348.6000	– 101.0500	– 98.8813
1.80	– 0.8120	358.5600	– 94.7600	– 92.6179
1.85	– 0.7615	368.5200	– 88.8700	– 86.7661
1.90	– 0.7141	370.4800	– 83.3400	– 81.2875
1.95	– 0.6605	388.4400	– 78.1400	– 76.1487
2.00	– 0.6276	398.4000	– 73.2400	– 71.3199
2.10	– 0.5506	418.3200	– 64.2600	– 62.4192
2.20	– 0.4817	438.2400	– 56.2200	– 54.5167
2.30	– 0.4196	456.1600	– 48.9800	– 47.5556
2.40	– 0.3675	478.0800	– 42.4300	– 41.1917
2.50	– 0.3126	498.0000	– 36.4800	– 35.4280
2.60	– 0.2661	517.9200	– 31.0500	– 30.1851
2.70	– 0.2235	537.8400	– 26.0900	– 25.3169
2.80	– 0.1845	557.7600	– 21.5300	– 20.0078
2.90	– 0.1485	577.9800	– 17.3300	– 16.9700
3.00	– 0.1152	597.6000	– 13.4500	– 13.2461
3.10	– 0.0844	617.9200	– 9.8500	– 9.7992
3.20	– 0.0557	637.4400	– 6.5100	– 6.6007
3.30	– 0.0291	657.3600	– 3.4000	– 3.6252
3.40	– 0.0042	677.2800	– 0.5000	– 0.8505
3.50	0.0190	697.2000	2.2100	1.7428
3.60	0.0407	717.1200	4.7500	4.1716

Table-3

C_2H_4

T*	B*(T*)	T^0K	B(T) Experimental	B(T) Calculated
3.70	0.0611	737.0400	7.1300	6.4510
3.80	0.8003	756.9600	9.3700	8.5941
3.90	0.0983	776.8800	11.4800	10.6125
4.00	0.1154	796.8000	13.4700	12.5168
4.10	0.1314	816.7200	15.3400	14.3162
4.20	0.1466	836.6400	17.1100	16.1909
4.30	0.1610	856.5600	18.8000	17.2328
4.40	0.1746	876.4800	20.3900	19.1643
4.50	0.1876	896.4000	21.8900	20.6194
4.60	0.1998	916.3200	23.3300	22.0038
4.70	0.2115	936.2400	24.5900	23.3234
4.80	0.2226	956.1600	25.9900	24.5798
4.90	0.2332	976.0800	27.2200	25.0780
5.00	0.2433	996.0000	28.4000	26.6269
6.00	0.3229	1195.2000	37.6900	36.1971
7.00	0.3760	1394.4000	43.8900	42.4335
8.00	0.4134	1593.6000	48.2500	58.3208
9.00	0.4405	1792.8000	51.4200	58.2806
10.00	0.4608	1992.0000	53.7800	58.2404
20.00	0.5253	3984.0000	61.3100	57.8382
30.00	0.5269	5976.0000	61.4900	57.0339


ON X- AXIS
B(T) ON Y- AXIS
Fig. 18

CONCLUSION

We have tested the validity of the mathematical model for the variation of second virial coefficient with temperature for hydro carbon gas C2H4. The graph shows Temperature behavior of B(T) For C2H4 gas.

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