ISOBARIC VAPOUR LIQUID EQUILIBRIUM OF DI (iso) PROPYL ETHER-BENZENE SYSTEM

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ABSTRACT

Vapour liquid equilibrium data for the system di (iso) propyl ether-benzene have been reported, The thermodynamic consistency of the data is tested with Chao's modified Redlich-Kister equation.

Vapour liquid equilibrium data for the system di (iso) propyl ether-benzene are not available in the literature. Hence the system has been studied under isobaric condition at 684 ± 5 mm of Hg.

EXPERIMENTAL

The equilibrium still has been described earlier[1] and is a modified Ellis and Garbett still[2]. Since the system is a miscible one, the still was operated without stirrers for three hours to attain equilibrium and samples were drawn for analysis.

Di (iso) propyl ether of BDH laboratory reagent grade and benzene of Merck laboratory reagent grade were used. The density and refractive index of reagents used and also the literature values are given in table I.

TABLE I

Properties of pure components

| Compound | Density | | Refractive Index | |
	Exptl.	Lit.[5]	Exptl.	Lit.[5]
Di(iso)propyl ether	$0.7250^{20°C}$	$0.7258^{20°C}$	$1.3672^{23°C}$	$1.3678^{23°C}$
Benzene	$0.87368^{25°C}$	$0.87368^{25°C}$	$1.5011^{20°C}$	$1.5011^{20°C}$

Samples were analysed by the determination of refractive index using Abbe's refractometer at $25 \pm 0.1°C$.

Thermodynamic Consistency

The experimental vapour liquid equilibrium data are presented in table II. Liquid phase activity coefficients are calculated from equation.

$$\gamma_i = \frac{y_i \, \pi}{x_i \, P_i}$$

Table II

Vapour-liquid equilibrium data (Pressure 684 ± 5 mm.)

No.	Temp.°C	Mole per cent of di(iso)propyl ether in		γ_1	γ_2
		liquid	vapour		
1	74.9	5.1	9.2	1.321	1.010
2	73.3	12.0	19.6	1.247	1.017
3	72.6	15.6	24.2	1.210	1.023
4	71.8	20.5	30.1	1.167	1.026
5	70.9	27.5	37.7	1 120	1.035
6	69.7	38.6	48.4	1.068	1.052
7	69.0	44.4	54.0	1.044	1.060
8	67.7	57.8	65.5	1.016	1.095
9	67.0	65.4	72.1	1.004	1.103
10	66.2	74.3	79.6	1.002	1.119
11	65.0	89.3	91.9	1.001	1.124
12	64.7	94.5	95.8	0.992	1.129

The vapour pressures for various temperatures for benzene are calculated from the following equation[5]:

$$\log_{10} P \, (mm) = 6.89745 - \frac{1206.350}{220.237 + t}$$

Since equation of Antoine type for calculating vapour pressure at different temperatures for di (iso) propyl ether is not available, the following equation has been formulated with the data available[5]:

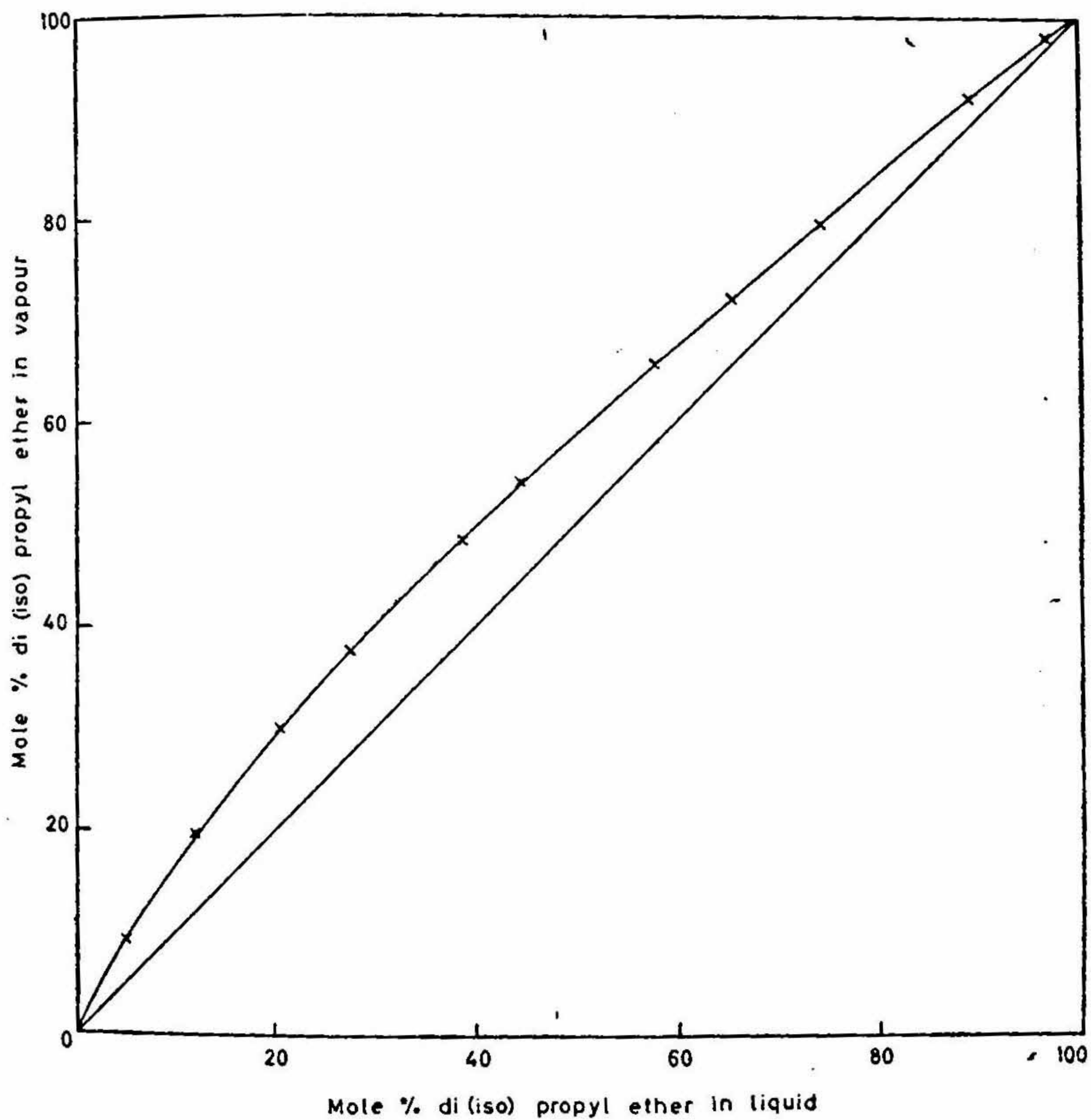$$\log_{10} P(mm) = -\frac{1581.0}{t + 273.2} + 7.5218$$

FIG. 1

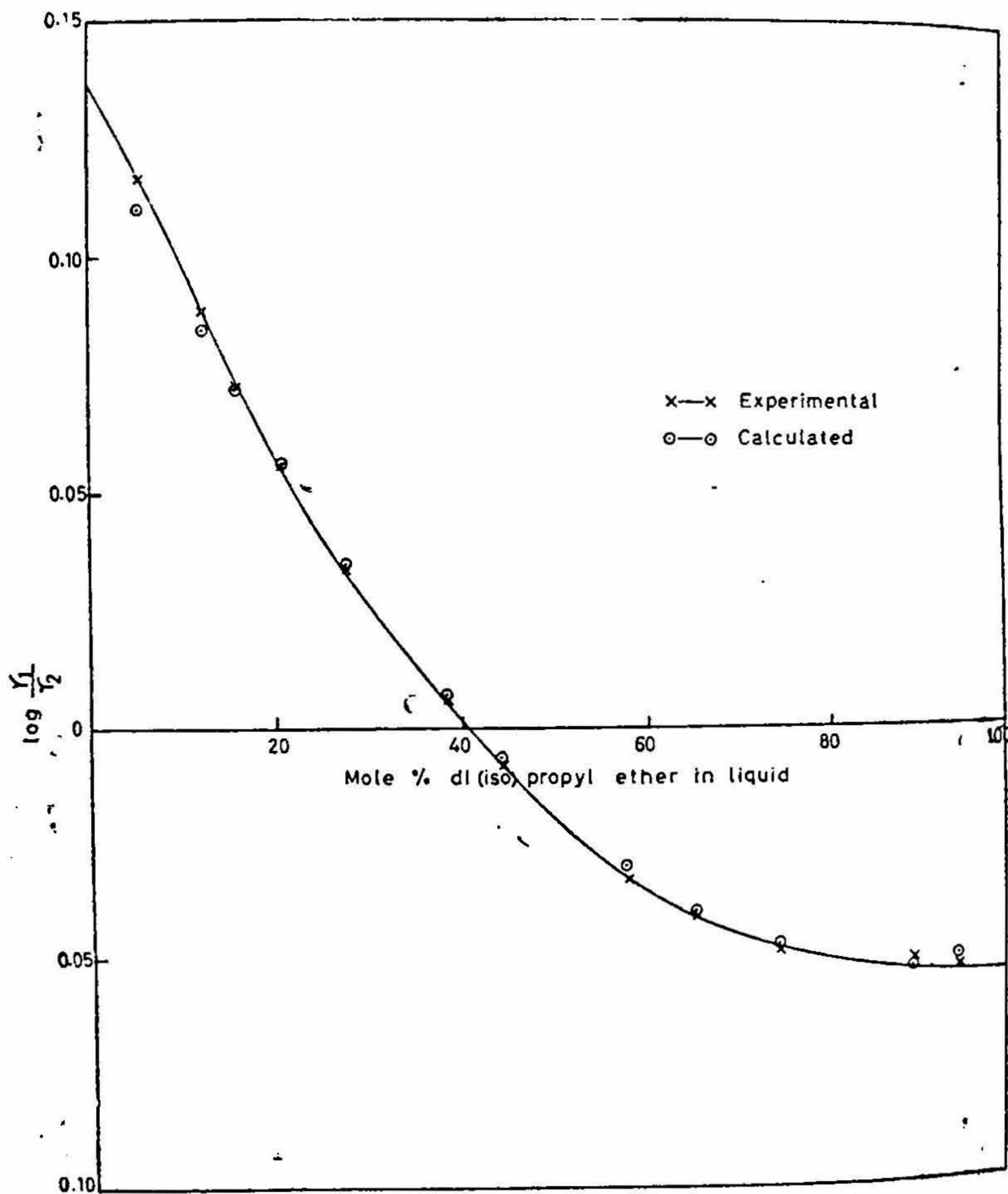Di (iso) propyl ether—Benzene
x Vs. y

FIG. II

Di (iso) propyl ether—Benzene
$\log (\gamma_1)/(\gamma_2)$ Vs. x

The system does not form an azeotrope. As can be seen from the table II, the values of activity coefficients do not differ very much from the value of 1.0. But for correlation, the system has been considered as non-ideal.

The thermodynamic consistency of the data obtained was tested by Chao's modified Redlich-Kister equation[3]. The values of constants in equation,

$$\log\left(\gamma_1/\gamma_2\right) = a + b\left(x_2 - x_1\right) + c\left(6x_1 x_2 - 1\right) + d\left(x_2 - x_1\right)\left(1 - 8x_1 x_2\right)$$

are as follows:

$$a = 0.0025, \quad b = 0.0897, \quad c = -0.0385, \text{ and } d = -0.0015$$

The area test of Redlich-Kister is highly satisfactory. The experimental and calculated values of $\log\left(\gamma_1/\gamma_2\right)$ are in good agreement with each other as seen from Fig. II. The data satisfy the Herington's test[4] for the consistency since the experimental $D - J = -1.646 < 0$.

NOMENCLATURE

a, b, c, d = Constants in Chao's equation

P = Vapour pressure of pure component

x = Mole fraction in liquid phase

y = Mole fraction in vapour phase

γ = Activity coefficient

π = Total pressure

t = Temperature, °C

SUBSCRIPTS

1   = Di (iso) propyl ether

2   = Benzene

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