JOURNAL OF

THE

INDIAN INSTITUTE OF SCIENCE

Volume 47 JANUARY 1965 Number 1

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

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Received on November 19, 1964

ABSTRACT

Vapour liquid equilibrium data for the system di (iso) propyl ether-toluene 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-toluene 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 completely miscible one, the still is operated without stirrers for three hours to attain equilibrium and samples are drawn for analysis.

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

Samples are analysed by the determination of refractive index at $25 \pm 0.1^{\circ}C$ using Abbe's refractometer.

TABLE I

Properties of pure components

Compounds	Density		Refractive Index	
	Exptl.	Lit.[5]	Exptl.	Lit.[5]
Di (iso) propyl ether	$0.7250^{20°C}$	$0.7258^{20°C}$	$1.3672^{23°C}$	$1.3678^{23°C}$
Toluene	$0.8620^{25°C}$	$0.8623^{25°C}$	$1.4966^{20°C}$	$1.4969^{20°C}$

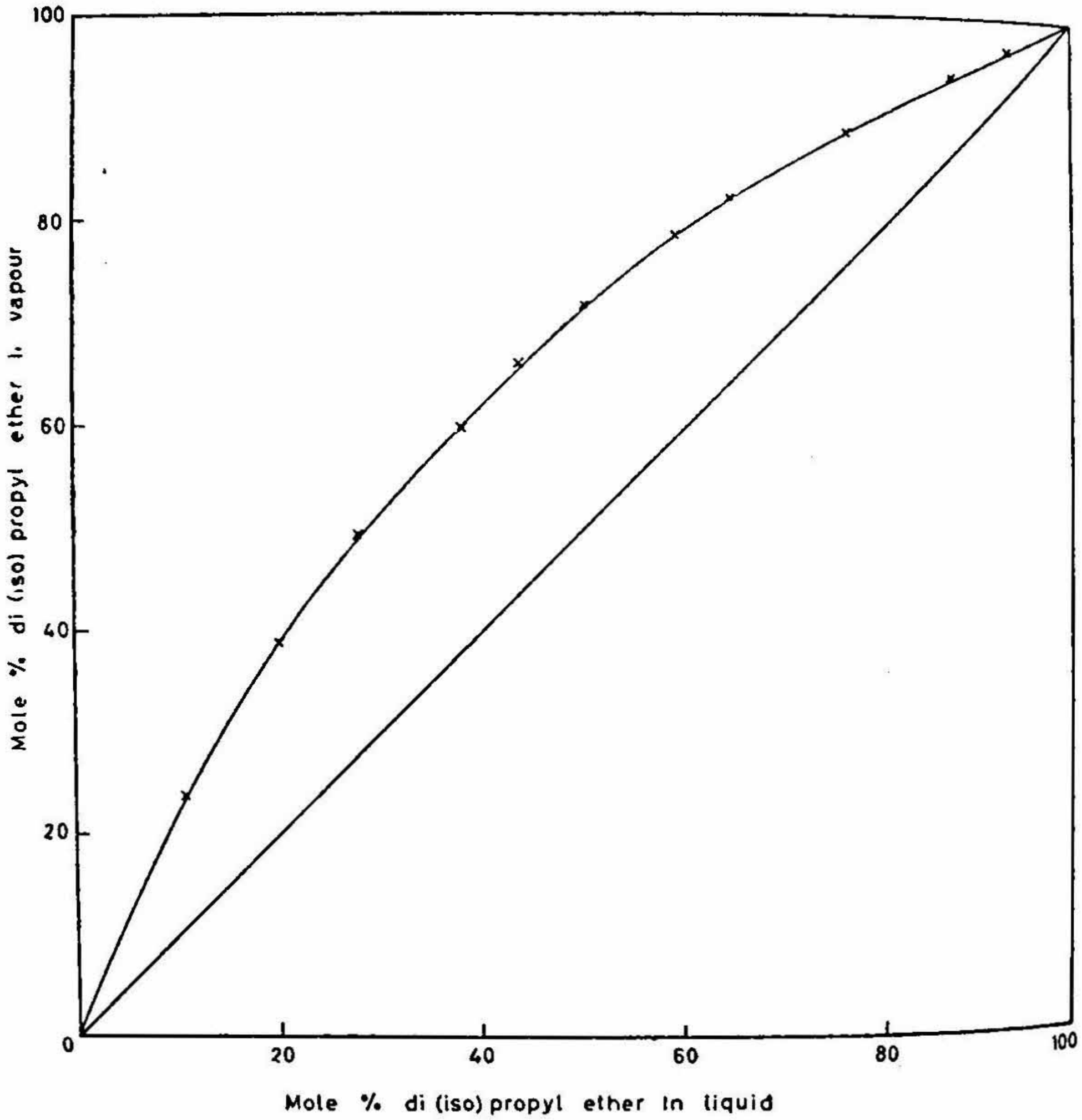

FIG. I

Di (iso) Propyl Ether—Toluene
x Vs. y

THERMODYNAMIC CONSISTENCY

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

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

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

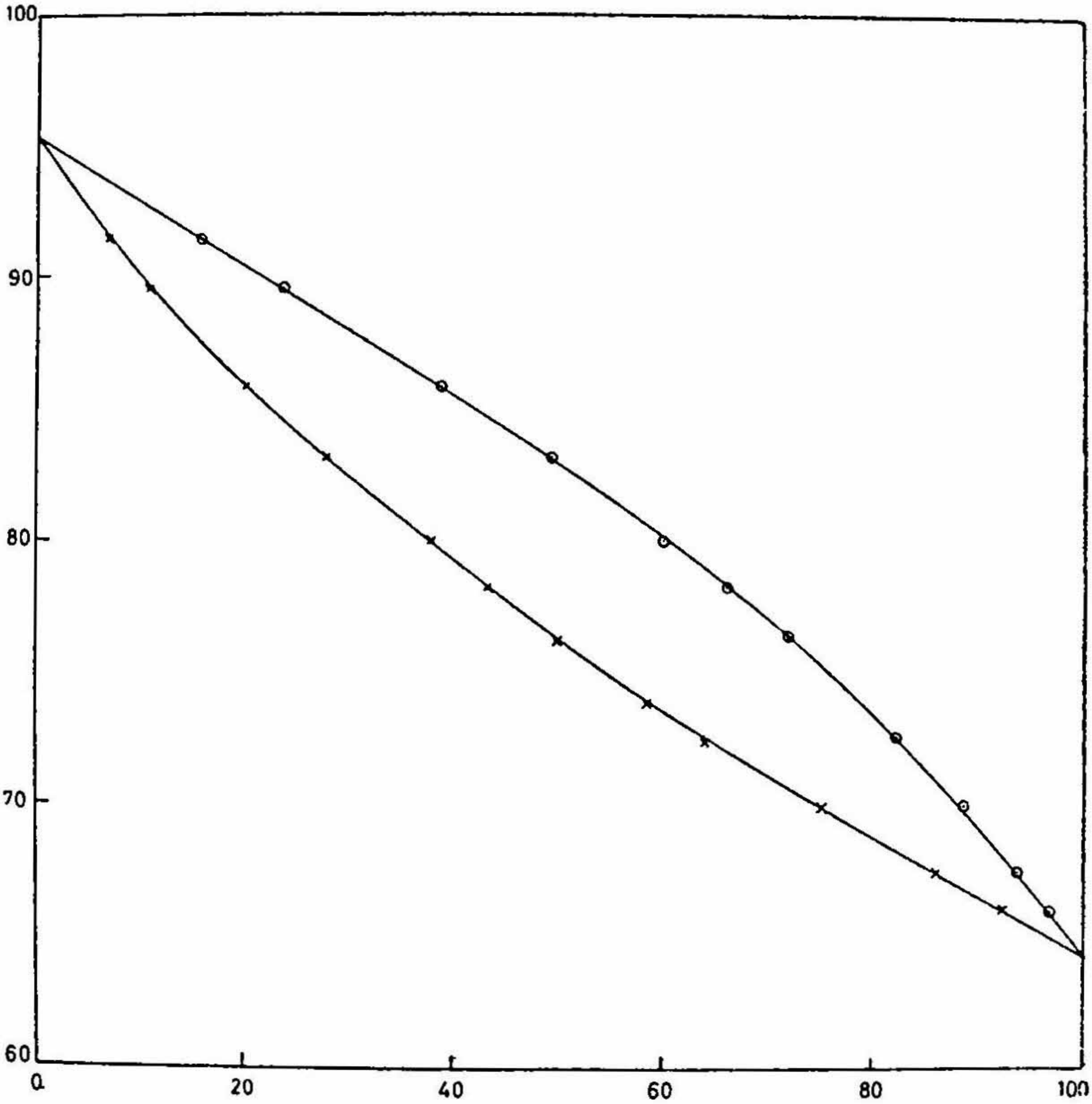

FIG. II

Di (iso) Propyl Ether - Toluene

t—x—y

$$\log_{10} P\,(mm) = 6.95334 - \frac{1343.943}{219.377 + t}$$

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].

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

The system does not form an azeotrope. As can be seen from 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 is tested by Chao's modified Redlich-Kister equation[3]. The values of constants in equation,

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

are as follows:

$$a = -0.0011,\ b = +0.0771,\ c = -0.0070,\ \text{and}\ d = -0.0030$$

The area test of Redlich-Kister is highly satisfactory. The experimental and calculated values of log (γ_1/γ_2) are in good agreement with each other as seen from Fig. IV The data satisfy the Herington's test[4] for the consistency since the experimental $D - J = -16{\cdot}33 < 0$.

TABLE II

Vapour-liquid equilibrium data (Pressure $684 \pm 5\,mm$).

No.	Temp. °C	Mole % of di (iso) propyl ether in liquid	vapour	γ_1	γ_2
1	101.8	5.1	17 8	1 1834	1.00 0
2	97.4	10.4	32.1	1.1768	1.0109
3	95.2	13.0	37.5	1.1664	1.0247
4	92.4	16.5	44.1	1.1594	1.0386
5	87.4	25.0	57.2	1.1438	1.0459
6	84.0	32.2	64.8	1.1078	1.0654
7	80.1	41.1	72.7	1.0893	1.0853
8	75.6	53.3	81.3	1.0734	1.0977
9	71.8	65.4	87.6	1.0537	1.1230
10	69.4	75.0	91.7	1.0363	1.1355
11	68.3	80.1	93.6	1.0235	1.1459
12	65.2	96.2	98.9	0.9936	1.1602

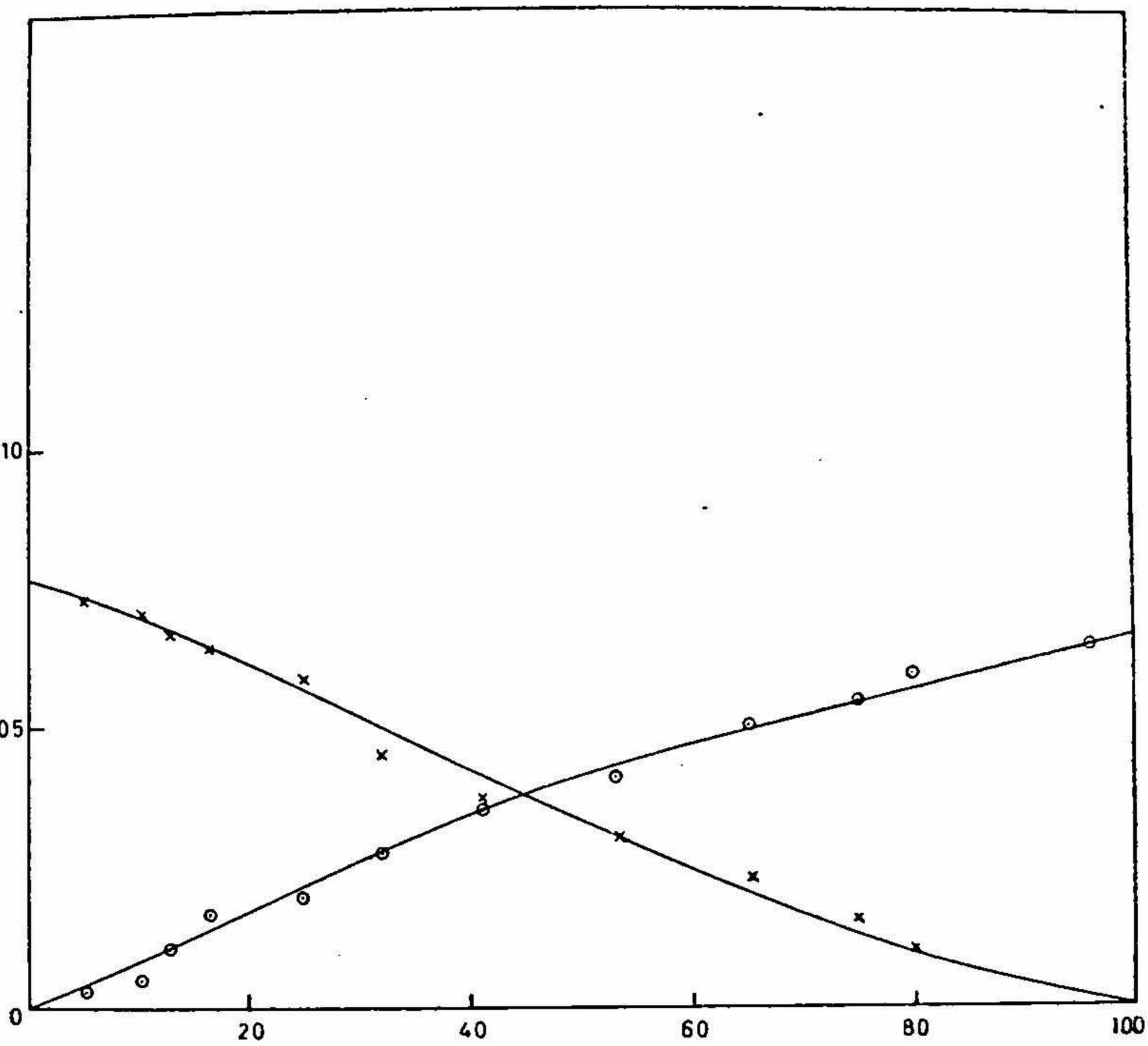

FIG. III

Di (iso) Propyl Ether—Toluene
Logarithm of activity coefficient vs. composition

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

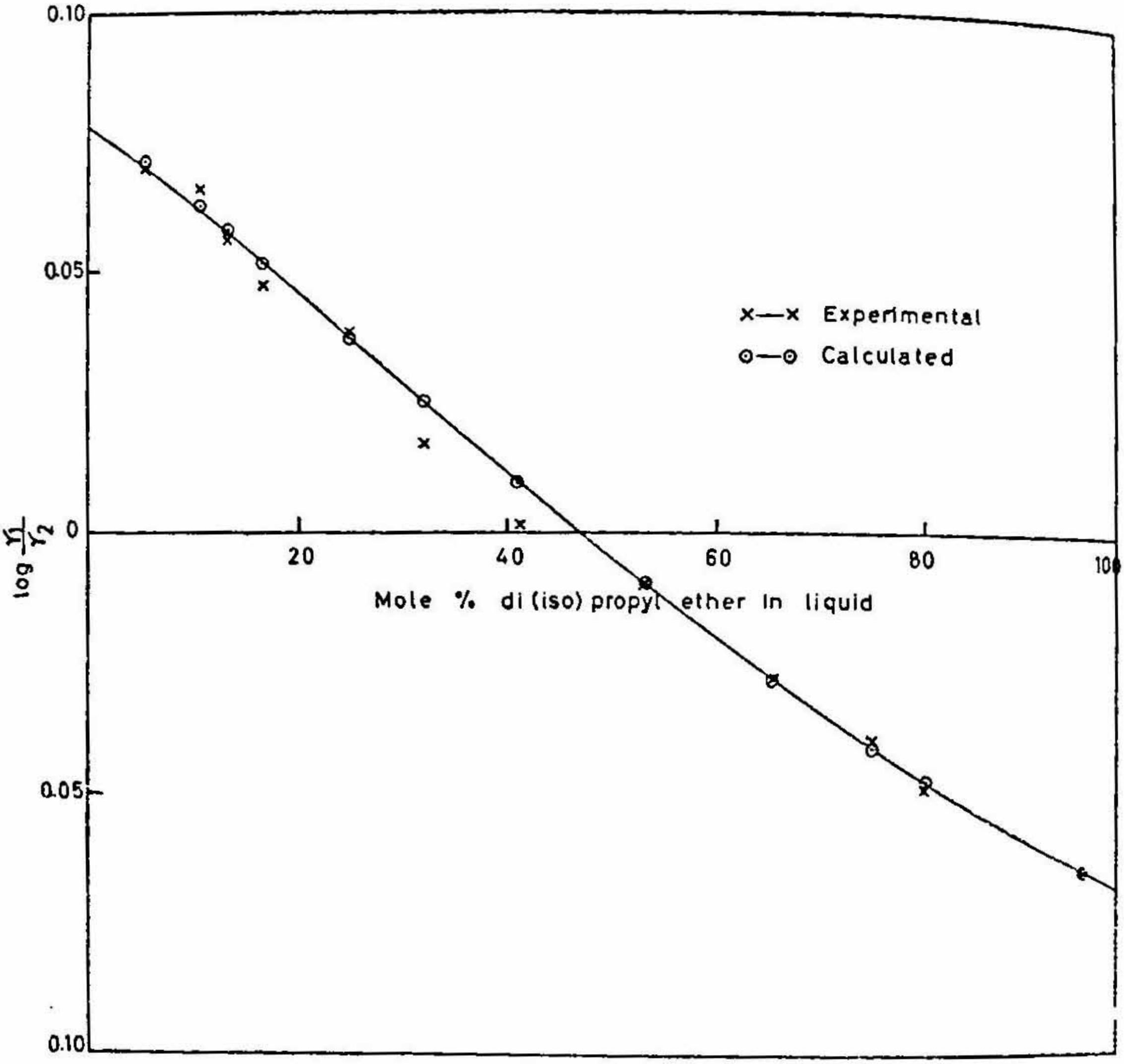

FIG. IV

Di (iso) Propyl Ether—Toluene

$\log \frac{\gamma_1}{\gamma_2}$ *vs.* composition

Subscripts

1 = Di (iso) propyl ether

2 = Toluene

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