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ISOBARIC VAPOUR LIQUID EQUILIBRIUM STUDIES ON
DI (iso) PROPYL ETHER-CYCLOHEXANE SYSTEM

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ABSTRACT

Vapour-liquid equilibrium data for the system di (iso) propyl ether-cyclohexane are 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-cyclohexane are not available in the literature. Hence the system has been studied under isobaric condition at 684 ± 2.5 mm of Hg.

EXPERIMENTAL

The equilibrium still has been described earlier¹ and is a modified Ellis and Garbett still². As the system is completely miscible, the still is operated without stirrers for three hours to attain equilibrium and samples are drawn for analysis.

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

Di (iso) propyl ether and cyclohexane of BDH laboratory reagent quality are used. The density and refractive index of reagents used and also literature values⁵ are given in table I.

TABLE I
Properties of pure components

Compound	Density		Refractive index		Boiling points °C, 685 mm	
	Exptl.	Lit. ⁵	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}	64.4	64.3
Cyclohexane	0.7780 ^{20°C}	0.7786 ^{20°C}	1.4262 ^{20°C}	1.4262 ^{20°C}	77.1	77.3

THERMODYNAMIC CONSISTENCY

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

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

TABLE II
Vapour-liquid equilibrium data (Pressure: 684 ± 2.5 mm).

No.	Temp.°C	Mole % of di (iso) propyl ether in		γ_1	γ_2	γ_1 calculated
		liquid	vapour			
1	75.6	5.4	9.4	1.189	1.004	9.34
2	73.9	12.6	19.7	1.152	1.015	19.36
3	72.8	17.8	26.1	1.121	1.033	25.71
4	71.8	23.7	32.9	1.096	1.044	32.29
5	70.4	32.5	42.4	1.074	1.060	41.32
6	69.6	39.3	49.0	1.053	1.071	48.90
7	68.9	45.5	55.1	1.044	1.073	54.90
8	68.3	52.1	61.0	1.031	1.084	59.94
9	67.2	64.2	71.6	1.014	1.093	70.82
10	66.5	72.8	78.5	1.003	1.115	78.35
11	65.6	84.3	87.7	0.995	1.138	88.10
12	65.2	90.4	92.5	0.989	1.147	92.55

The vapour pressure of cyclohexane for various temperatures is calculated from the equation⁵:

$$\log_{10} P(mm) = 6.84498 - \frac{1203.526}{222.863 + t}$$

Since such an equation is not available for di (iso) propyl ether, an equation has been formulated with the data available⁵:

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

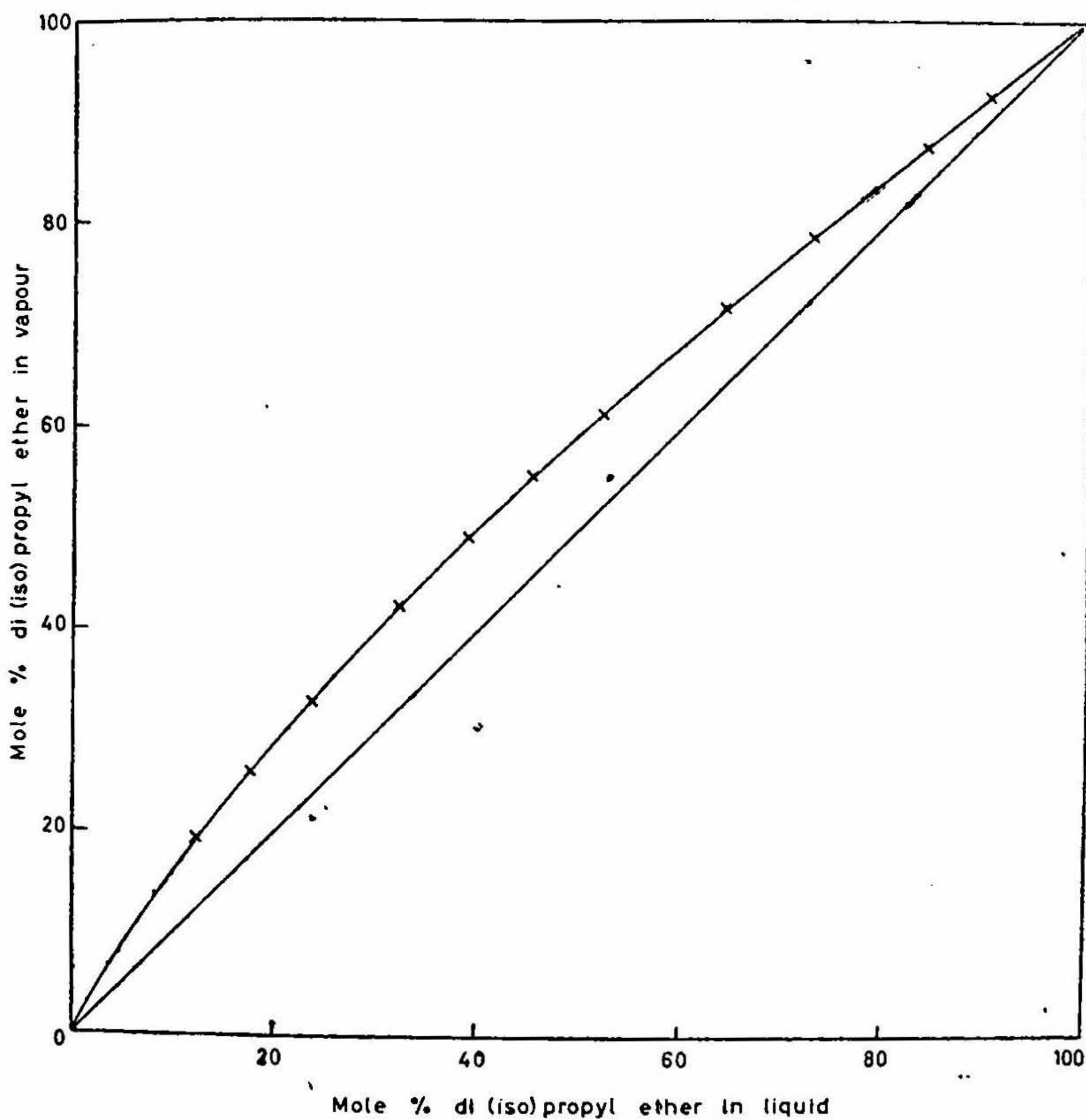


FIG. I

Di (iso) propyl ether—Cyclohexane
x Vs. y

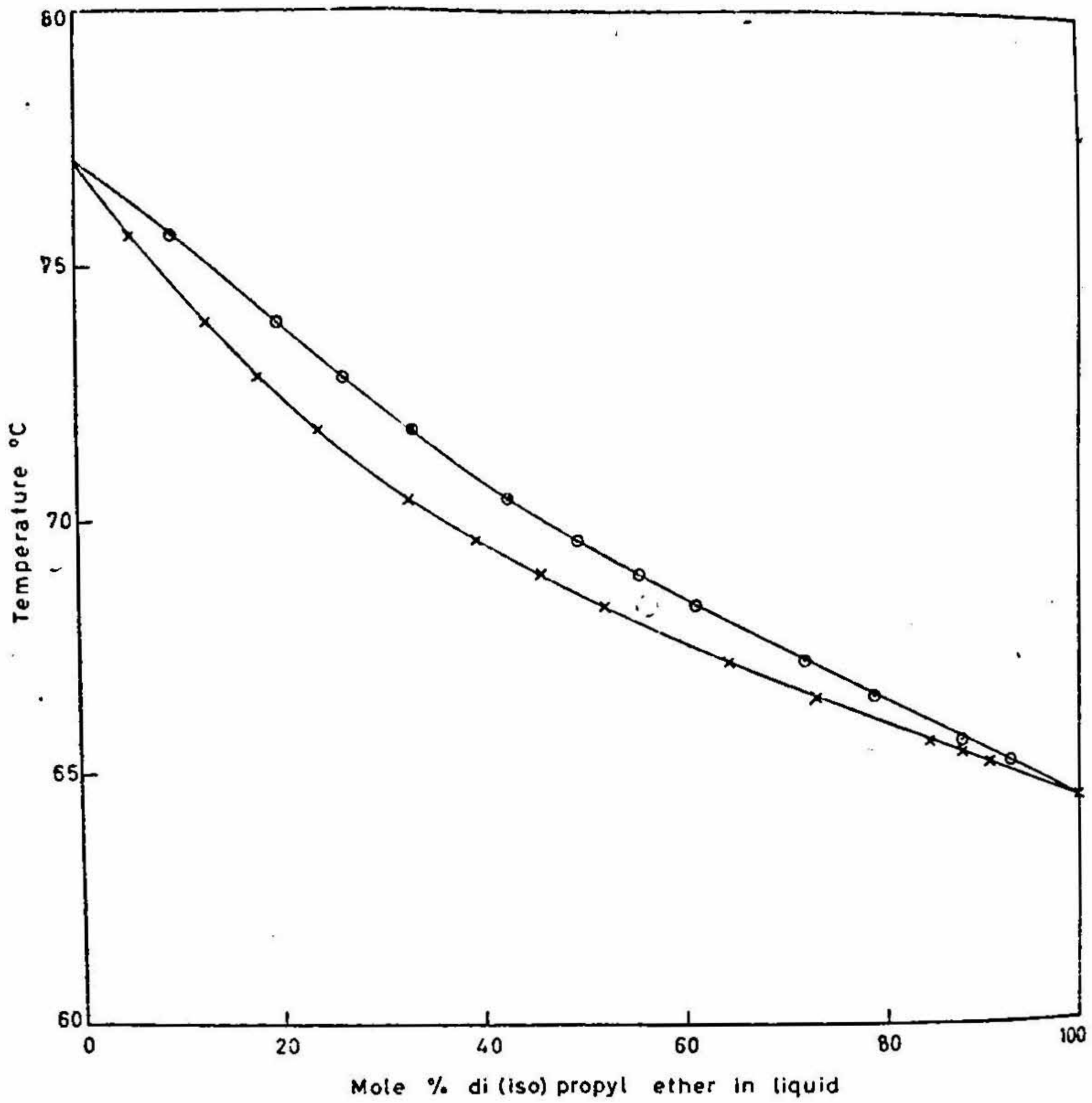


FIG. II

Di (iso) propyl ether—Cyclohexane
t-x-y

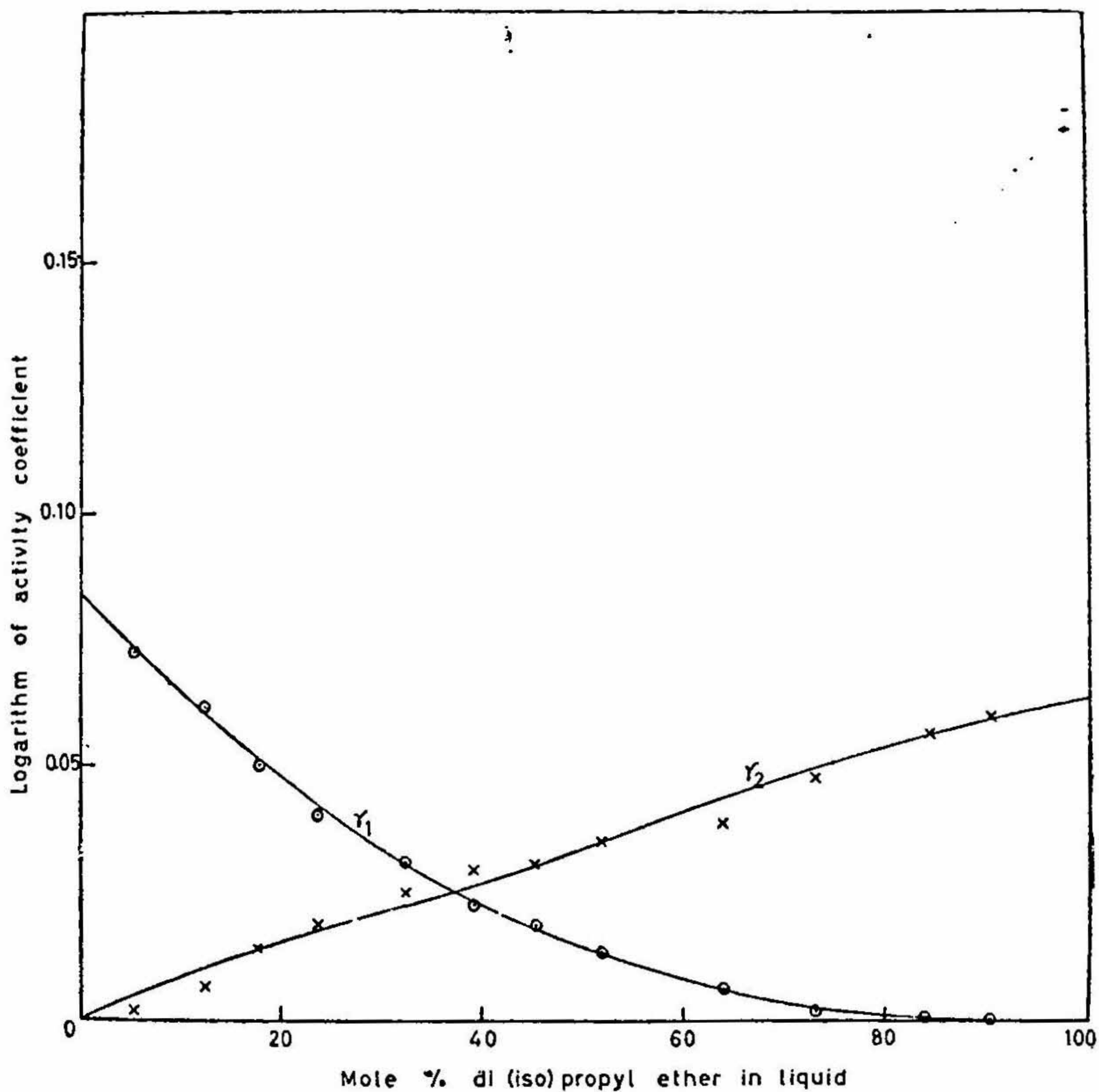


FIG. III

Di (iso) propyl ether—Cyclohexane
 $\log \gamma$ Vs. x

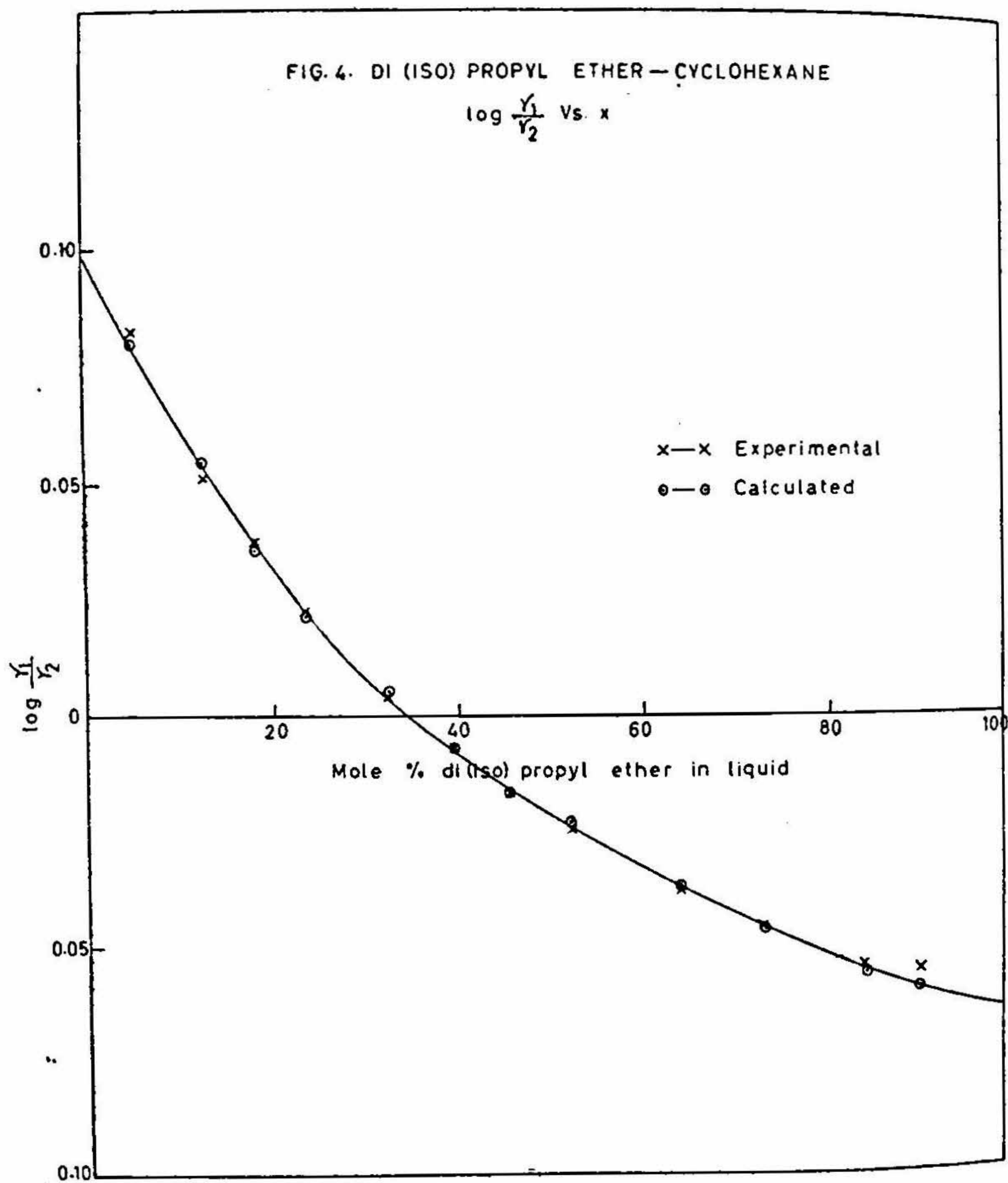


FIG. IV

Di (isc) propyl ether—Cyclohexane
 $\log (\gamma_1)/(\gamma_2)$ Vs. x

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 equation³. The values of constants in equation,

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

are as follows :

$$a = -0.0107 ; b = +0.0708 ; c = -0.0242 ; d = +0.0052$$

The average value of $(y_1 \text{ experimental} - y_1 \text{ calculated}) / (y_1 \text{ experimental})$ is 1.07%.

The data satisfy the Herington's test⁴ for the consistency, since the experimental $D - J = -3.594 < 0$.

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	= Cyclohexane

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