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

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Received on January 9, 1965

ABSTRACT

Vapour-liquid equilibrium data for the system di(iso)propyl ether-acetone 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-acetone 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 earlier[1] and is a modified Ellis and Garbett still[2]. 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 specific gravity at a temperature of 25 ± 0.1°C.

Di(iso)propyl ether of BDH laboratory reagent grade and acetone of BDH analar grade are used. The density and refractive index of reagents used and also literature values[5] 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	$0.7250^{20°C}$	$0.7258^{20°C}$	$1.3672^{23°C}$	$1.3678^{23°C}$
Acetone	$0.7910^{20°C}$	$0.7898^{20°C}$	$1.3598^{20°C}$	$1.3591^{20°C}$

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 per cent of di(iso) propyl ether in		γ_1	γ_2	y_1 calculated
		liquid	vapour			
1	51.9	6.2	9.6	2.3153	1.0010	9.62
2	51.2	14.0	18.3	2.0060	1.0371	18.67
3	51.0	22.0	24.2	1.7016	1.0447	24.52
4	50.9	25.0	26.0	1.6133	1.0623	26.43
5	51.0	30.1	29.5	1.5161	1.0842	28.95
6	51·3	38.5	33.2	1.3231	1.1581	33.87
7	52.0	49.2	39.2	1.1948	1.2447	39.37
8	52.9	58.5	45.8	1.1356	1.3396	45.01
9	53.8	66.0	50.9	1.0876	1.4124	50.03
10	56.2	77 4	62 0	1.0415	1.5094	62.20
11	60.0	90.5	80.0	1.0133	1.6690	79.58
12	61.9	95.1	88.7	1.0055	1.7183	88.48

The vapour pressure of acetone at various temperatures is calculated from the equation[5]:

$$\log_{10} P(mm) = 7.02442 - \frac{1161.0}{224.0 + t}.$$

The vapour pressure of di(iso)propyl ether at various temperatures is calculated from the equation[6]:

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

The system forms an azeotrope at 28.4 mole per cent of di(iso)propyl ether.

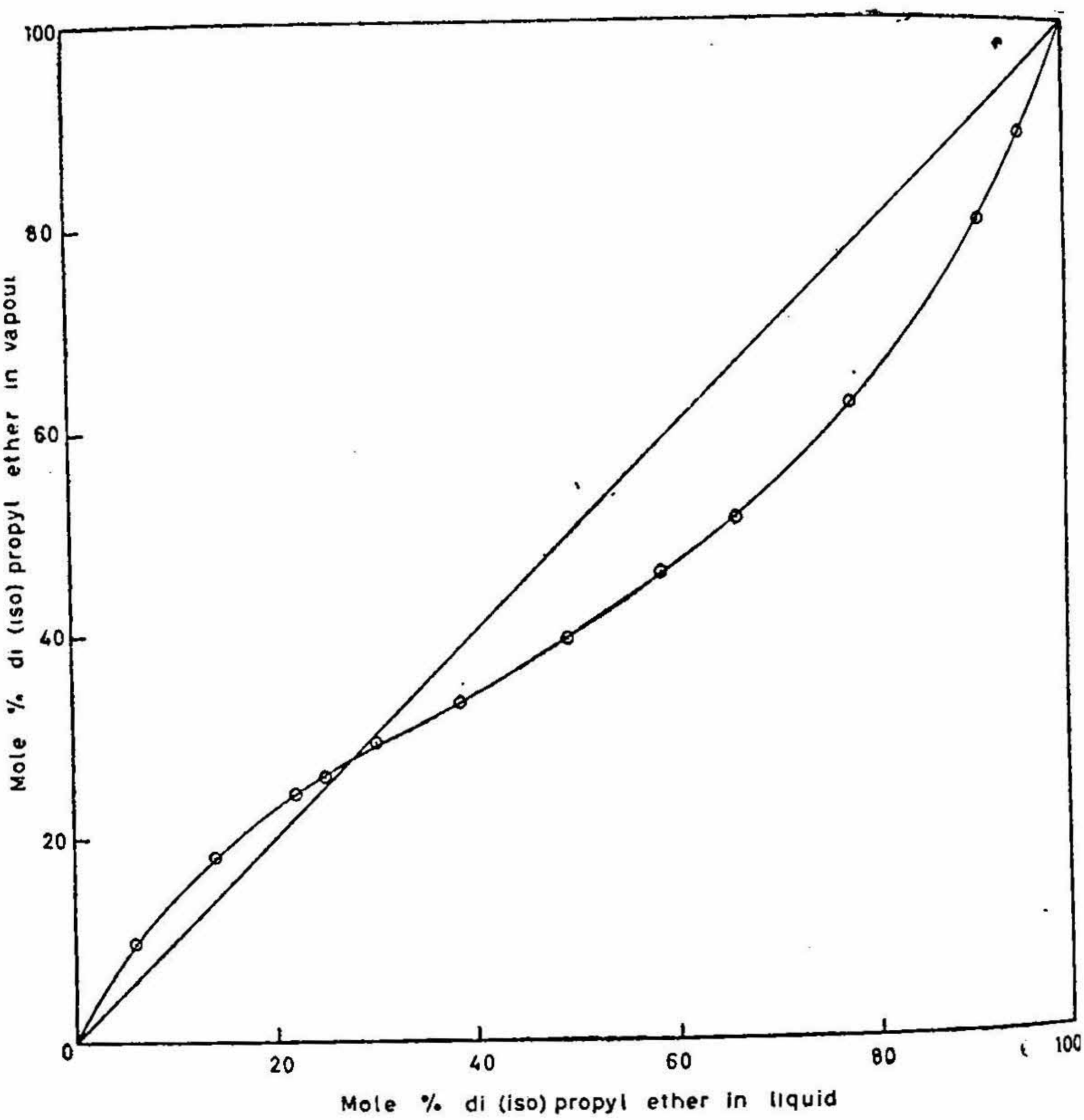

FIG. I

Di (iso) propyl ether—Acetone
x Vs. y

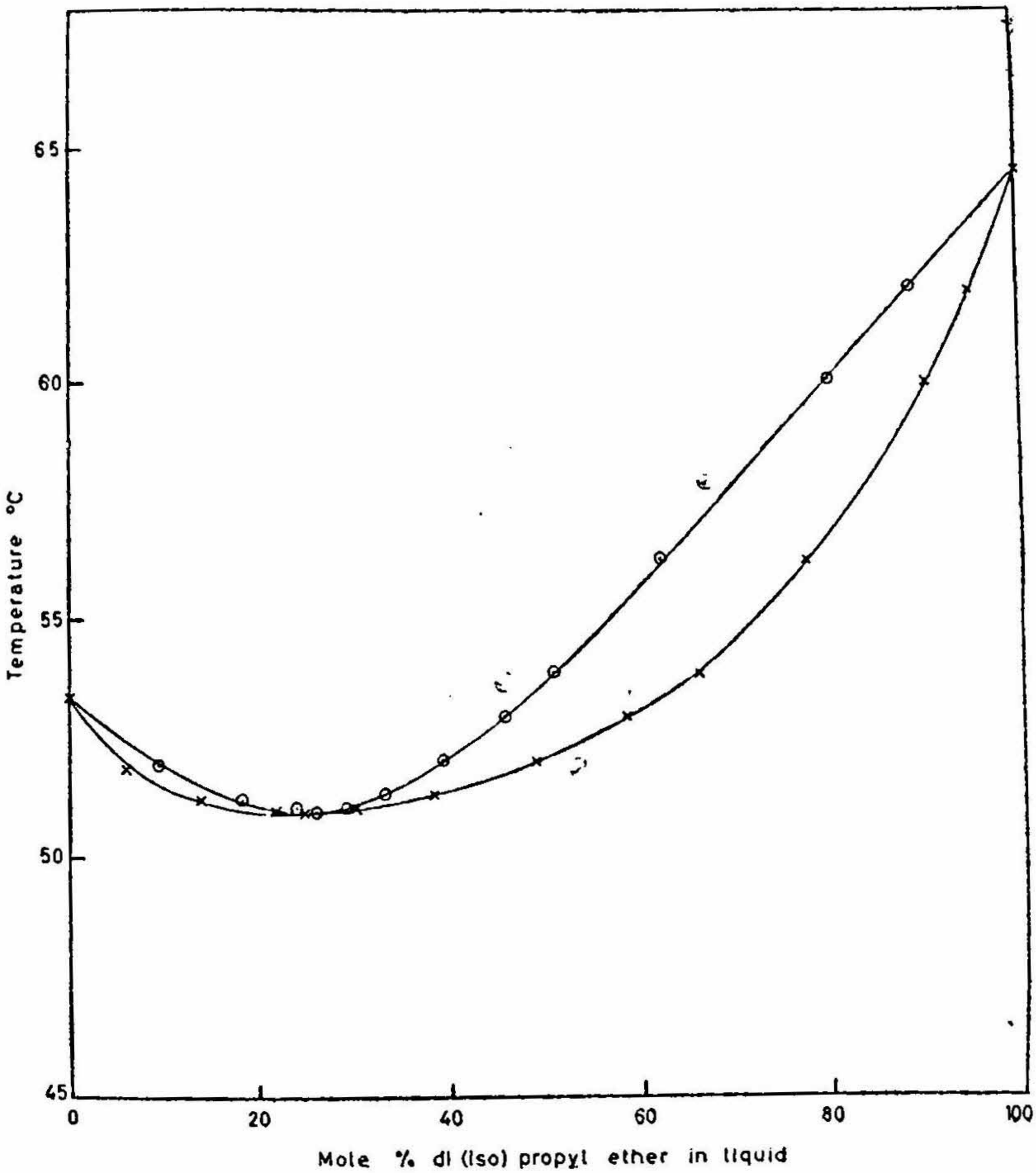

FIG. II

Di (iso) propyl ether—Acetone

t—x—y

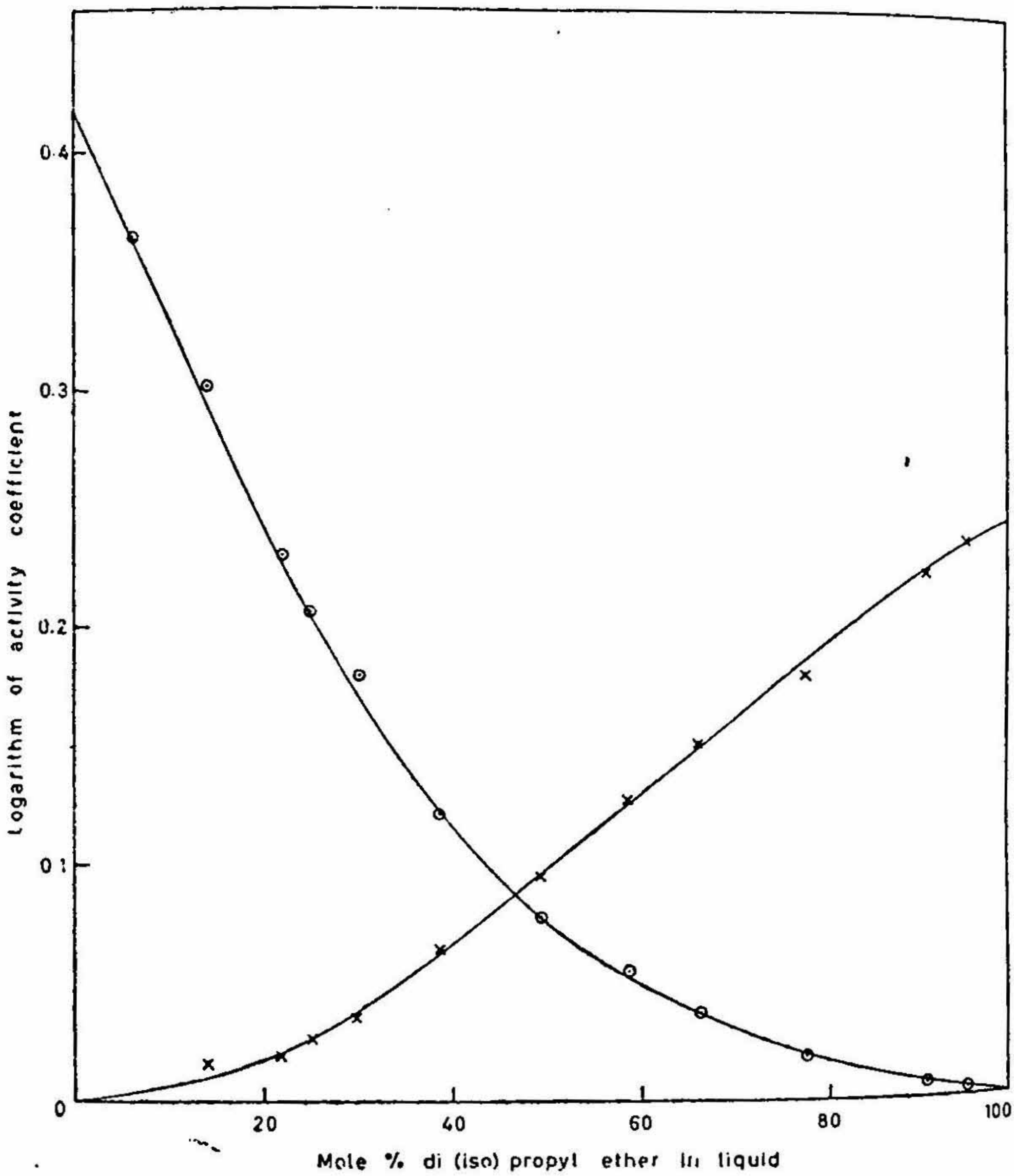

FIG. III

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

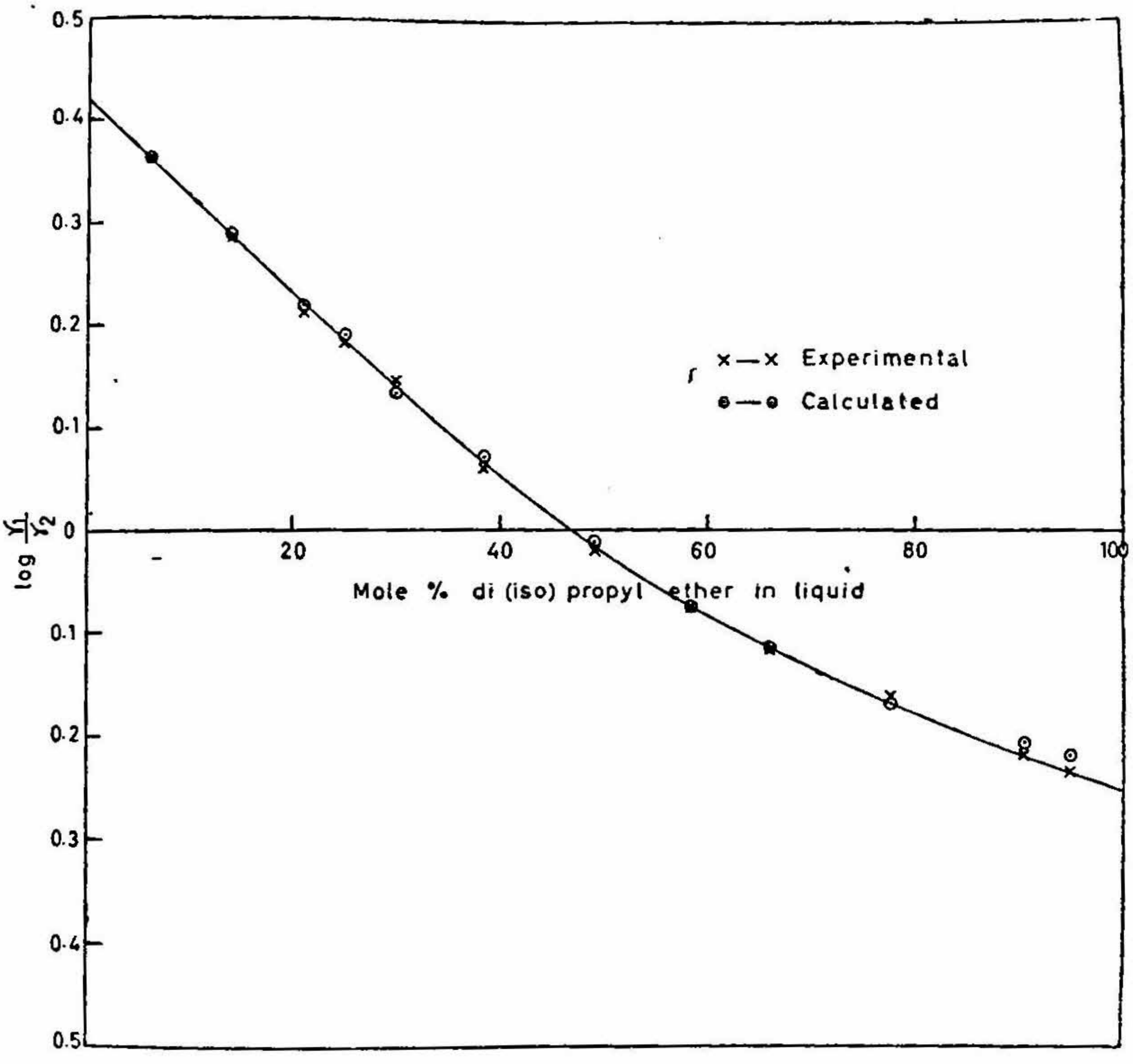

FIG. IV

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

The thermodynamic consistency of the system is tested using Chao's modified Redlich-Kister equation. The $\log(\gamma_1/\gamma_2)$ values-calculated and experimental—are plotted in Fig. IV which shows a very good agreement between the two. The values of constants in the Chao's equation,

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

are as follows :

$$a = 0.025\ ;\ b = 0.3359\ ;\ c = -0.080\ ;\ d = -0.020$$

The average value of $(y_{1\ \text{experimental}} - y_{1\ \text{calculated}})/(y_{1\ \text{experimental}})$ is 1.19%.

The data satisfy Herington's test for the consistency, since the experimental $D - J = 7.70 < 10$.

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, $^{\circ}C$.

SUBSCRIPTS

1 = Di(iso)propyl ether.

2 = Acetone.

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