

## STUDIES IN BINARY SYSTEMS

### PART VII—SYSTEM *Iso*AMYL ALCOHOL-CARBON TETRACHLORIDE

*By (Miss) Nagamani Shama Rao and S. K. K. Jathkar*

It was shown in Part VI that the anomalous nature of the selective adsorption of *iso*amyl alcohol from benzene by norit and silica gel could be explained on the basis of the formation of complexes. In the present paper the authors have carried out a similar investigation on the system *iso*amyl alcohol and carbon tetrachloride.

#### EXPERIMENTAL

The dielectric constant measurements were carried out in the same manner as described in Part VI.

The following table gives the results of measurements of density, refractive index, dielectric constant and dielectric polarisation of the mixtures of *iso*amyl alcohol and carbon tetrachloride. The results are also shown graphically in fig. I.

TABLE I

$f_1^{AmOH}$	Density	Dielectric constant	$P_{12}$	$P_2$	Refractive Index	
					$n_{546}$	$n_{436}$
1.00	0.807	16.73	91.9	...	1.40166	1.41457
0.98	0.841	24.3	93.4	94.9	1.41466	1.43114
0.88	0.889	21.89	94.4	103.3	1.41834	1.42978
0.78	0.958	15.62	88.8	105.6	1.42181	1.42521
0.76	0.959	15.59	89.9	109	1.42321	1.42233
0.61	1.093	7.93	72.6	100.4	1.42900	1.43709
0.57	...	6.84	66.2	94.1	1.43321	1.44170
0.46	1.233	4.95	57.0	89.6	1.43814	1.44672
0.36	1.257	4.29	54.3	118.1	1.43712	1.44563
0.20	...	3.32	45.3	108.5	1.44574	1.45461
0.08	...	2.28	31.7	61.6	1.45675	1.44662
0.00	1.577	2.28	28.8	...	1.45984	1.47541

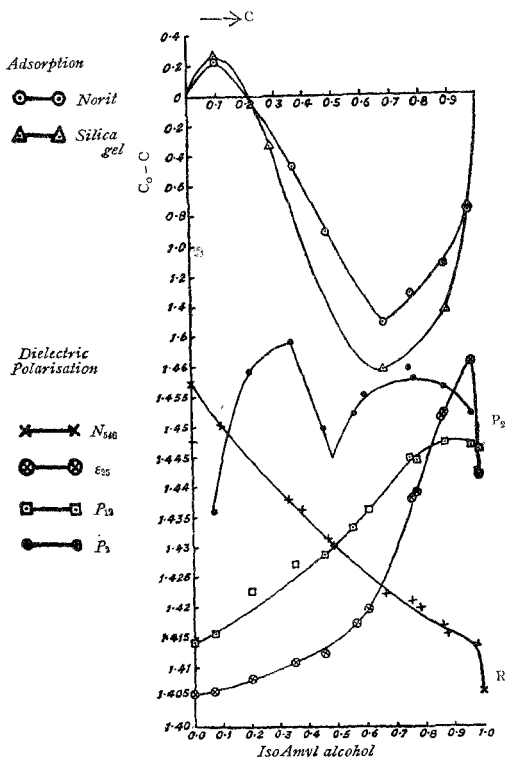


FIG. 1

## DISCUSSION

The densities and the refractive indices of this system are in agreement with the results obtained by Williams and Krchma (*Jour. Amer. Chem. Soc.*, 1927, **49**, 2408) who have, it is significant to point out, not recorded the measurement in the region where the relationship of the physical properties with composition has been found to be abnormal. The refractive index-composition curve shows an abrupt fall at 0.97 mole fraction of isoamyl alcohol. This was

confirmed by two sets of refractive index measurements one at 30°C and the other at 25°C, the latter of which are given in table I.

The dielectric constant goes to a maximum at about 0.97 mole fraction *isoamyl* alcohol and the polarization-concentration curve  $P_{12}$  is flat in the region 1 to 0.8 mole fraction *isoamyl* alcohol. The  $P_2$  curve shows a sharp minima at 0.5 mole fraction *isoamyl* alcohol.

*Adsorption*.—Silica gel and Norit were used from the same stock as was used in the previous part.

The final results are given in the following table II and plotted graphically in Fig. I.

TABLE II

Norit		Silica gel	
$C_{\text{benzene}}$	mean $C_o - C$	$C_{\text{benzene}}$	mean $C_o - C$
0.1	+0.26	0.1	+0.26
0.37	-0.48	0.34	-0.33
0.47	-0.92	0.67	-1.83
0.67	-1.52	0.89	-1.43
0.76	-1.13	0.96	-0.78
0.89	-1.13		

The adsorption curve is of 'S' type in the case of both *silica gel* and *norit* and the curves show an abrupt fall at 0.5 moles fraction *isoamyl* alcohol, corresponding to  $\text{AmOH} \cdot \text{CCl}_4$  and pass through zero selectivity at about 0.25 moles fraction *isoamyl* alcohol in agreement with the result obtained by Heymann and Boye (*Kolloid Z.*, 1933, **63**, 154) for *silica gel*. These authors have not recorded any points between 0.35 to 0.7 moles alcohol in which region the authors have found marked discontinuity in the curve.

The abrupt fall in the nature of the adsorption curve at 0.5 moles carbon tetrachloride is in agreement with the finding of the polarization ( $P_2$ ) curves for this system. In fact in the case of silica gel, the adsorption is in the positive region indicating that the complex is adsorbed preferentially to either of the components.

In dilute solutions of carbon tetrachloride *iso*amyl alcohol is exponentially adsorbed by both silica gel and norit owing to the polar nature of the alcohol molecule. In highly concentrated solutions of carbon tetrachloride the latter is adsorbed by both silica gel and norit. This apparent adsorption is again due to the existence of the 1:1 complex on one side of the composition diagram due to the law of mass action. Thus between the composition 0.8 and 1.0 moles carbon tetrachloride the system behaves as consisting of the complex  $\text{CCl}_4 \cdot \text{AmOH}$  and *iso*amyl alcohol.

Some of the infrared adsorption results seem to indicate the formation of addition compounds between alcohols and carbon tetrachloride

#### SUMMARY

The dielectric constant determinations of the system *iso*amyl alcohol-carbon tetrachloride showed a maximum at about 0.97 mole fraction *iso*amyl alcohol, the molar polarization  $P_{12}$  being flat in the same region. The polarization  $P_2$  curve shows a sharp minima at 0.5 moles fraction *iso*amyl alcohol corresponding to the formation of 1:1 complex.

The selective adsorption curves of this system on both silica gel and norit are of 'S' type passing through a minima in both cases at 0.5 moles fraction of *iso*amyl alcohol which indicates that the one to one complex is selectively adsorbed.

*Department of Pure and Applied Chemistry,  
General Chemistry Section,  
Indian Institute of Science,  
Bangalore, India.*