

Letters to the Editor

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Dielectric relaxation of 1-and 2-naphthaldehydes from microwave absorption measurements

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ϵ' and ϵ'' were measured in benzene solutions at wavelengths 0.22, 3.24, 10 and 25 cm to an accuracy of 2% using apparatus described by Garg *et al* (1965), Laquer & Smyth (1948) and Pitt & Smyth (1959). The static dielectric constant ϵ_0 was measured at 10 KHz using a Schering bridge. The measurements were carried out at 20°, 40° and 60°C. ϵ_∞ is obtained from a Cole-Cole plot and the reduced absorption $\eta'' = \epsilon''/\epsilon_0 - \epsilon_\infty$ is calculated and plotted against $\log \lambda$. The absorption curves obtained were analysed into two Debye terms using a computer IBM 1620. The analysis gives two relaxation times τ_1 and τ_2 where τ_1 belongs to the rotation of the molecule and τ_2 belongs to that of the group.

Table 1 shows the results obtained which are much higher than the comparative values given. So, the substances were repurified and the measurements repeated using solutions of same concentrations; same results were obtained assuring the given values.

So, the larger values of τ_1 and τ_2 in this case may be due to the formation of associates through hydrogen bonding. As the hydrogen bonds in 1-substituted naphthalenes are weaker than the 2-substituted ones, this may be the cause of higher values of τ_1 and τ_2 in the 2-naphthaldehyde than those of 1-naphthaldehyde. Also τ_1 and τ_2 are very temperature dependent especially in the 2-naphthaldehyde which may be due to the same cause as before. The dipole moment of both molecules were calculated and found to be higher in the case of 2-naphthaldehyde than 1-naphthaldehyde as expected.

It is to be noted that the behaviour of the —CHO group in 1-naphthaldehyde is different from the —OH group in 1-naphthol. It is stated by Knobloch (1965) that in the case of 1-naphthol, c''/X is not concentration dependent due to the formation of intramolecular hydrogen bridge with the hydrogen atom in the 8th position. While in the case studied here of 1-naphthaldehyde it is clear from the large values of τ_1 that intermolecular hydrogen bonds are present.

TABLE 1. Relaxation times, dipole moments, activation energy and activation entropy in benzene solutions

Substance	$t^{\circ}\text{C}$	τ_1 P sec	τ_2 P sec	Comparative values at 20°C		$-\frac{\Delta H}{K}$ cal/mole	$\frac{\Delta S}{\text{deg}}$ Cal/mole	
				P sec	P sec			
1-Naphthal-								
dehydro	20	40.2	4 80	0.40	2.52	-OH 26 0	2.1 ^(a)	1 25
$x = 0.0096$	40	33.5	3 93	0.45		-OCH ₃ 24 3	1.7 ^(b)	
mole fraction	60	27.8	2 90	0.50				
2-Naphthal-								
dehydro	20	45.2	8.80	0.30	3.26	-OH 20 6	1.7 ^(a)	
$x = 0.0092$	40	33.4	6.60	0.35		-OCH ₃ 19.7	1.1 ^(b)	
mole fraction	60	24.8	4 50	0.35				-3.1

(a) Knoblock (1965), (b) Klages & Knobloch (1960)

The activation energy (ΔH) and activation entropy (ΔS) are calculated (Glastone *et al* 1941) and given in table 1.

REFERENCES

- Garg S. K., Klip H. & Smyth C. P. 1965 *J. Chem. Phys.* **43**, 2341.
 Glastone S., Laidler K. & Eyring H. 1941 *The Theory of Rate Processes*, New York
 Klages G. & Knobloch P. 1960 *Z. Naturf.* **209**, 580.
 Knobloch P. 1965 *Ber. Bunsenges. Physik. Chem.* **69**, 296.
 Laquer H. L. & Smyth C. P. 1948 *J. Am. Chem. Soc.* **70**, 4097.
 Pitt D. A. & Smyth, C. P. 1959 *J. Phys. Chem.* **63**, 582.