PERMITTIVITY OF LIQUIDS MEASURED BY THE NODE DISPLACEMENT METHOD

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Vol. 32, No. 4, pp. 118-119, 1977

UDC 541.135.6

Various methods for measuring the complex permittivity of liquids have been described in the literature [1-3], and we take particular note of methods applicable in the low-loss case [2,3].

This note describes a method for measuring the permittivity of liquids such that $\varepsilon' \leqslant 40$ and $0{,}08 \leqslant \operatorname{tg}\delta \leqslant 0{,}8$. In this study, the dependence of the displacement l of the node of a standing wave on the liquid layer thickness d was taken for liquid contained in a waveguide cell separated off from the slotted line by means of a thin teflon film.

The dependence of the node displacement on the thickness of the layer of liquid measured displays the form

$$l = \frac{1}{2\beta_0} \operatorname{arctg} \frac{2\beta_0 (\alpha_1 \operatorname{sh} 2\alpha_1 d + \beta_1 \sin 2\beta_1 d)}{(\beta_1^2 + \alpha_1^2 - \beta_0^2) \operatorname{ch} 2\alpha_1 d + (\beta_1^2 + \alpha_1^2 + \beta_0^2) \cos 2\beta_1 d},$$

where α_1 and β_1, β_0 are the damping ratio and the respective wave numbers in the loaded waveguide and empty waveguide.

In order to obtain the ε' and ε'' values for the test liquid, the function $l = l(d, \alpha, \beta)$ is plotted on a graph to find values for α_1 and β_1, and then for ε' and ε''.

Results of measurements taken of several liquids using the method described are tabulated; the data are referable to wavelength 3.2 cm, and comparative data reported by other authors [4-6] are tabulated.

Liquid	Reported by present authors		Literature data		
	ε'	ε''	ε'	ε''	
Metaxylene	2,34±0,6%	—	2,34	0,036	[4]
Paraxylene	2,26±0,6%	—	2,25	0,002	[4]
Methylethylketone	17,11±2%	4,39±3%	17,20	4,40	[5]
Nitromethane	35,36±3%	8,77±3%	35,15	8,41	[6]
Cyclohexanone	11,62±3%	5,82±3%	11,67	5,72	[4]

REFERENCES

1. A. A. Brandt, Investigation of Dielectrics at Microwave Frequencies [in Russian], Moscow, 1963.
2. E. Fatuzzo and P. R. Mason, J. Appl. Phys., vol. 36, no. 2, 427, 1965.
3. E. Fatuzzo and P. R. Mason, J. Sci. Inst., vol. 42, no. 1, 37, 1965.
4. Ya. Yu. Akhadov, Dielectric Properties of Pure Liquids [in Russian], Moscow, 1972.
5. V. V. Savchenko, V. V. Levin, and M. I. Shakhparonov, Zh. Strukturnoi Khimii, vol. 12, no. 6, 1086, 1971.
6. V. V. Levin, B. A. Ovsoyan, and V. I. Ovchinnikov, Zh. Fiz. Khimii, vol. 45, no. 9, 2355, 1971.

3 March 1977

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