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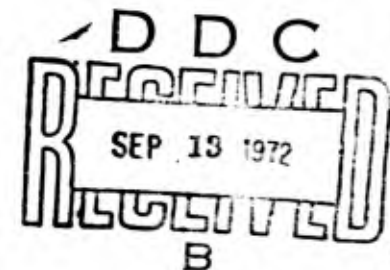
FOREIGN TECHNOLOGY DIVISION



A STUDY OF VISCOSITY AND ELECTRIC CONDUCTIVITY OF ALCOHOLIC  
LITHIUM CHLORIDE SOLUTIONS

by

A. Z. Golik, G. Alianazarov, and P. F. Cholpai



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13. ABSTRACT The viscosity $\eta$ , elec. cond. $k$ , and the $d$ , of LiCl in MeOH, EtOH, PrOH, and BuOH were detd. up to 180°. The $d$ . increased linearly with the concn. and decreased as the temp. increased and $\eta = A \exp(E/RT)$ . The polytherms of $k$ and of the equiv. elec. cond. $\lambda$ increased in all alcs. The max. shifted to higher temps. as the temp. increased. In MeOH and EtOH solns., $\lambda$ decreased as the concn. increased. In solns. of PrOH and BrOH, the isotherms at 120 and 65°, resp., exhibited max. At infinite diln. the polytherms in PrOH and BuOH exhibited max. at 75 and 45°, resp. The degree of dissocn. decreases as the no. of C in the alc. increased.			

14. KEY WORDS	LINK A		LINK B		LINK C	
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1B

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## A STUDY OF VISCOSITY AND ELECTRIC CONDUCTIVITY OF ALCOHOLIC LITHIUM CHLORIDE SOLUTIONS

A. Z. Golik, G. Allanazarov, and P. F. Cholpai

Recently, the interest towards solutions of strong electrolytes [1, 2] has increased considerably. A study of the dissipated X-rays in concentrated solutions revealed a formation of new molecular structures, caused by interaction of ions with molecules of the solvent and with one another [3]. The formation of these structures should have a strong effect on the physical properties of solutions, primarily on the transfer factor. In view of this, we have undertaken a systematic study of the viscosity and electric conductivity of strong electrolytes over a wide range of temperatures and concentrations. Normal monoatomic alcohols whose structure was determined beforehand, using the diffraction of X-rays [4], were used as the solvent.

This report gives a brief summary of the studied results of viscosity and electric conductivity of lithium chloride solutions in methanol, ethanol, n-propanol, and n-butanol. The indicated properties of 28 solutions of various concentrations in the temperature range from room to 180°C have been studied. The density was measured by the pycnometric method with an accuracy of  $\pm 0.01\%$ , viscosity - by the capillary viscosimeter with an accuracy of  $\pm 0.5\%$ , and the electric conductivity was studied by means of a bridge circuit fed by a high frequency generator of 3 Hz and accuracy

of  $\pm 1\%$ . The measurement technique of these properties and the cleaning of the objects was described earlier (Scientific Notes TGPI im. V. I. Lenin, a series of natural sciences, published XXXII, 1968).

The experiment indicates that the density of solutions decreases linearly with an increase in temperature and increases with an increase of salt concentration in the solution. The change in the viscosity of solutions with temperature is described by Ya. I. Frenkel formula

$$\eta = A \exp \frac{B}{RT} \quad (1)$$

The activation energy of viscosity  $B$  and preexponential factor  $A$  as functions of concentration are given in Fig. 1. A maximum which shifts towards higher temperatures with an increase in salt concentration has been detected in alcohols on the polytherms of specific and equivalent electric conductivity.

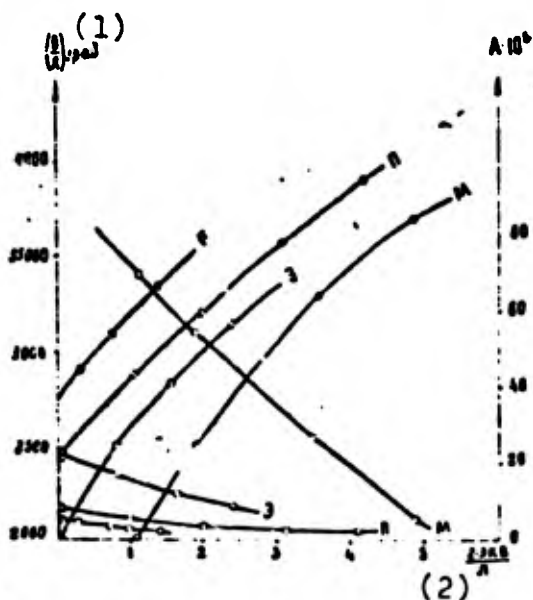


Fig. 1.  $B$  ( $\Delta$ ) and preexponential factor  $A$  ( $\square$ ) as functions of concentration [in g·equiv./l] for solutions in alcohols.

KEY: (1) degree; (2) g·equiv./l.

Figure 2 shows the polytherms of specific electric conductivity of  $ZiCl$  solutions in n-propanol.

A maximum which shifts toward higher concentrations with an increase in temperature has been observed on the isotherms of specific electric conductivity of solutions in all alcohols.

The equivalent electric conductivity of  $ZnCl_2$  solutions in methanol and ethanol decreases with concentration. Starting at  $120^\circ C$ , a maximum is observed on the isotherms for solutions in n-propanol, while for the solutions in n-butanol - it starts at  $65^\circ C$ .

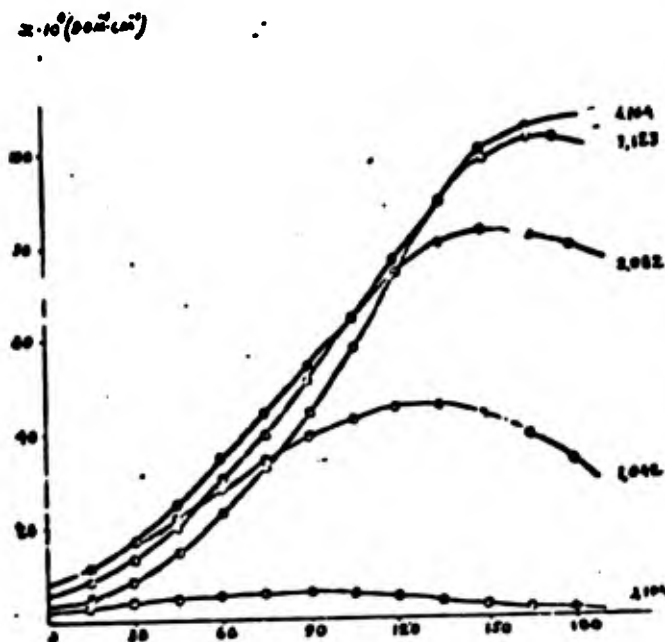


Fig. 2. Polytherms of specific electric conductivity for  $LiCl$  solutions in n-propanol. The numbers designate the salt concentration in solution [in g.equiv./l].

Figure 3 shows the isotherms of equivalent electric conductivity of  $ZnCl_2$  solutions in n-propanol.

According to the Debye theory [5], the ions create a considerable additional electrostriction pressure which depends on the dielectric constant of a medium. For the diluted solutions, the dielectric constant decreases linearly with concentration. The study of the relationship of the dielectric constant of concentrated solutions is interesting in itself. The value of the electrostriction pressure caused by the monovalent ion in various solutions is given in Table 1.

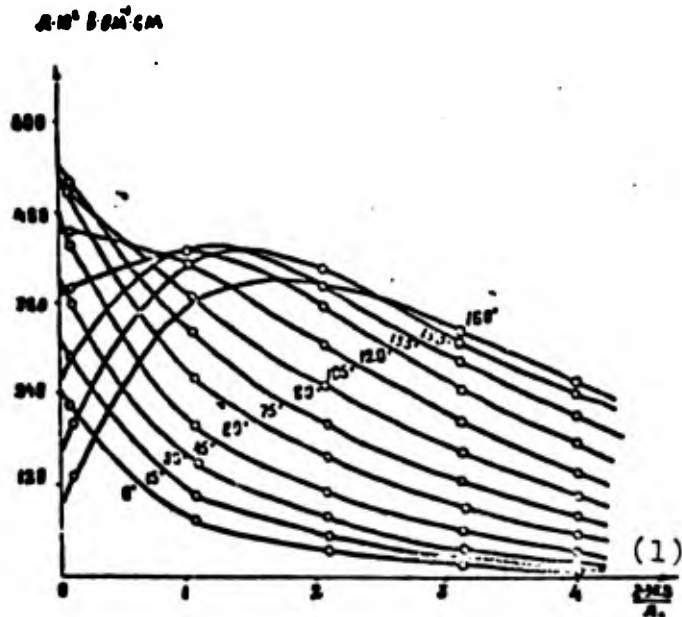


Fig. 3. The dependence of equivalent electric conductivity on concentration  $|\text{in g}\cdot\text{equiv./l}|$  for LiCl solutions in n-propanol.

KEY: (1)  $|\text{in g}\cdot\text{equiv./l}|$ .

Table 1. Dielectric penetration  $[\epsilon]$ , electrostatic field tension of ion  $[E]$ , and electrostriction pressure  $[PE]$  around the ion in various solvents at  $20^\circ\text{C}$ .

Solvent	$\epsilon$	$E$ (kV/cm)	$PE$ ( $10^3$ atm)
$\text{H}_2\text{O}$	80	180	213.8
$\text{CH}_3\text{OH}$	34	414	471.4
$\text{H}_2\text{H}_5\text{OH}$	25	576	663.5
$n\text{-C}_3\text{H}_7\text{OH}$	21	684	795.4
$n\text{-C}_4\text{H}_9\text{OH}$	18	792	890.7

### Conclusions

The equivalent electric conductivity at indefinite dilution ( $\lambda_0$ ) has been determined for the LiCl solutions in n-propanol and

n-butanol. Maximum has been detected on the  $\lambda_0$  polytherms at 75°C for solutions in n-propanol and at 45°C for solutions in n-butanol. The degree of dissociation which increases with an increase in alcohol's number has been estimated at various temperatures.

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