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ELECTRODELESS STUDY OF AQUEOUS KCl SOLUTIONS FOR DIFFERENT CONCENTRATIONS

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Abstract. *Electrodeless studies of aqueous KCl solutions, depending on their concentration, have significant advantages over similar electrode studies, because there is no contact of the liquid with the surface of the electrodes. In this work, we investigate fluids placed in a cylinder made of a transparent dielectric material located in a uniform magnetic field of a solenoid tuned to the resonance of voltages with a frequency of f = 4.8 MHz. The quality factor of the formed oscillatory circuit was measured for different concentrations and volumes of liquid.*

Key words: *electrodeless measurements, aqueous KCl solutions, concentration, cylinder, eddy currents, quality factor, inductance, frequency dependences*

Introduction.

Electrodeless studies of aqueous solutions of electrolytes, depending on their concentration, have significant advantages over similar electrode studies, because there is no contact of the liquid with the surface of the electrodes [1-3].

Main text

In this work, the object of study is a liquid in the form of a cylinder made of a transparent dielectric material, which is located in a uniform magnetic field of the solenoid, tuned to the resonance of voltages with a frequency of 4.8 MHz. The quality factor of the formed oscillatory circuit was measured for different concentrations and volumes of liquid. 23 different concentrations obtained by diluting 7% KCl solution with distilled water were considered sequentially. Knowing the frequency, inductance and quality factor of the oscillatory circuit both with and without fluid, the introduced resistance of the fluid $dR = \omega L\ (1\ /Q-1\ /\ Q_0)$ was calculated. The dependences of the introduced resistance dR on the mass concentration of n% KCl for two different volumes of liquid are shown in Fig.1. Dots and circles show the results of the experiment, and solid curves - the theoretically processed results.

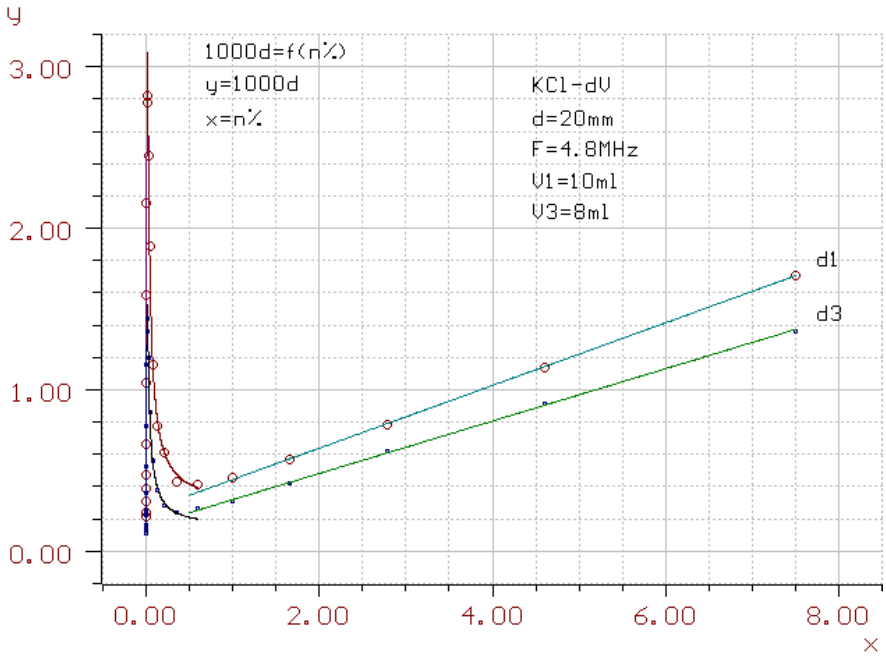

Fig. 1

For more detailed consideration in Fig.2-3 the same dependences in semi-logarithmic and logarithmic scales are given.

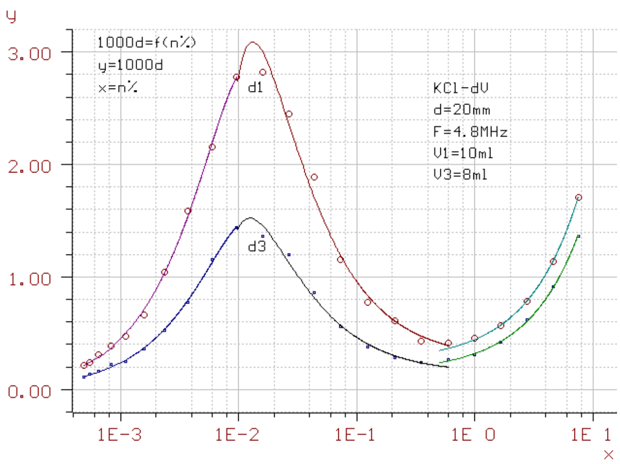

Fig. 2

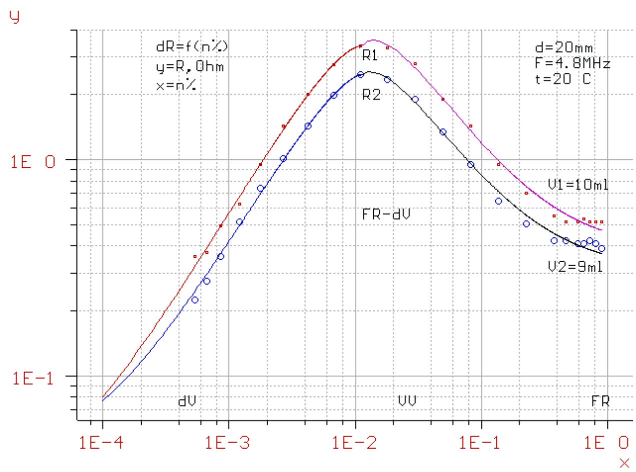

Fig. 3

As can be seen from Figures 1-3, the concentration dependences have a maximum that does not depend on the volume of the liquid. Therefore, the same dependences for the four volumes of liquid as a maximum were considered in more detail (Fig. 4) and after the maximum (Fig. 5) and minimum (Fig. 6).

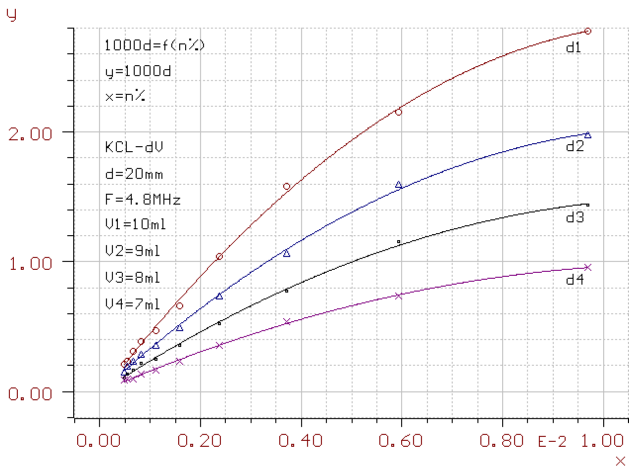

Fig. 4

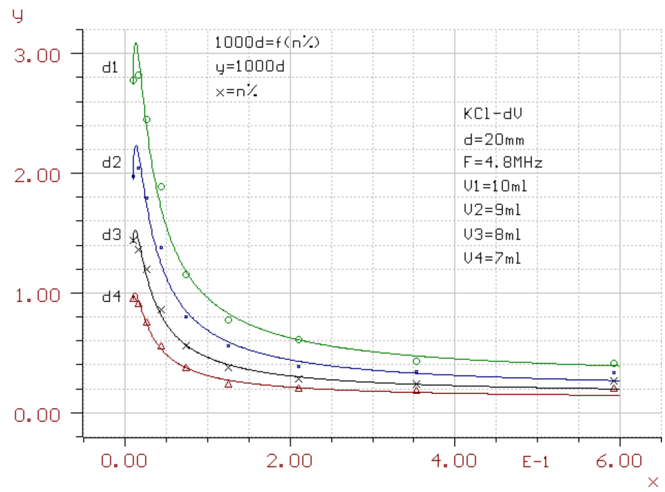

Fig. 5

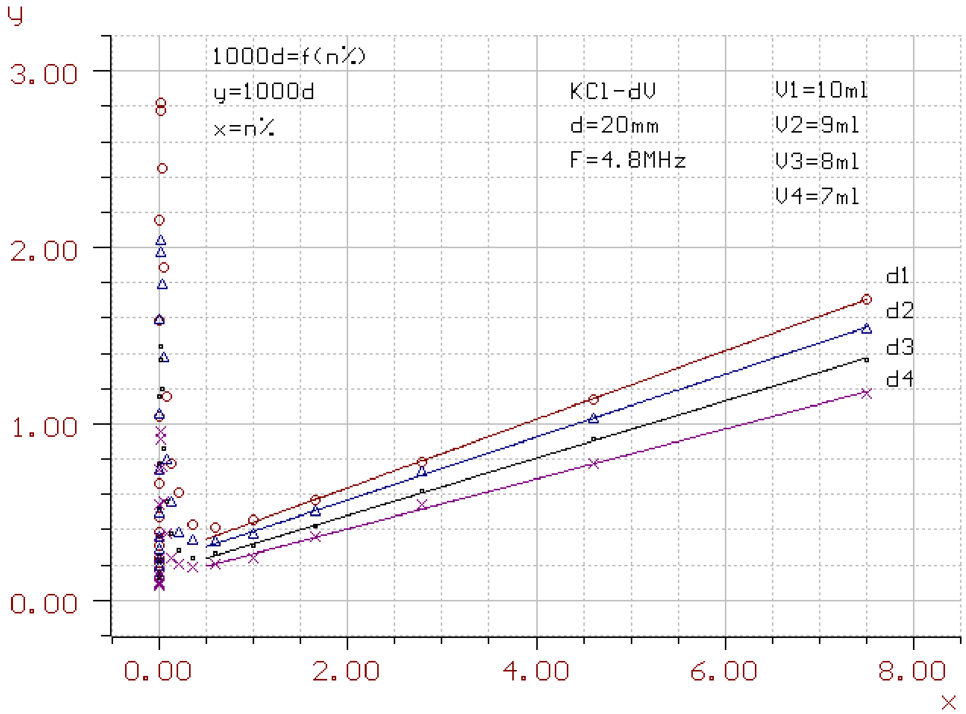

Fig. 6

Figures 4-6 show that due to the maximum and minimum, different concentrations can have the same value of the introduced resistance or Q-factor of the oscillating circuit, but significantly increases the accuracy of electrode-free concentration measurements separately in each of these three ranges. To unambiguously determine the concentration of an unknown liquid with a volume of 7-10 milliliters, it can be quantitatively diluted with a known concentration of distilled water.

The presence of a liquid-independent maximum is explained by an increase in the magnitude of the skin effect with an increase in electrical conductivity, which in our case is proportional to the liquid concentration, and the interaction of end eddy currents in the cylinder with the liquid. The latter is confirmed by the dependences of the introduced resistance dR on the mass or volume of fluid in the cylinder, which are shown in Figures 7-8.

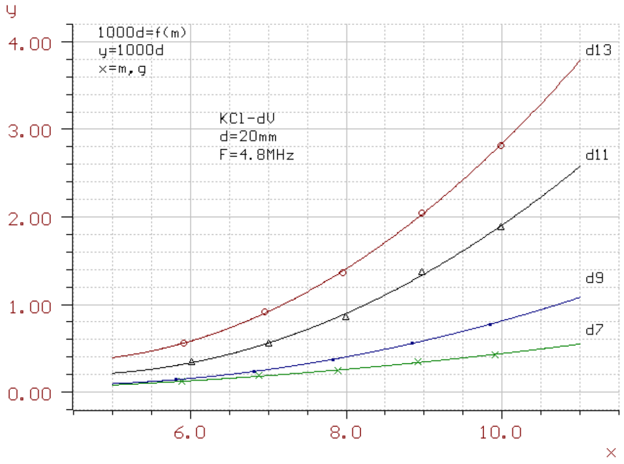

Fig. 7

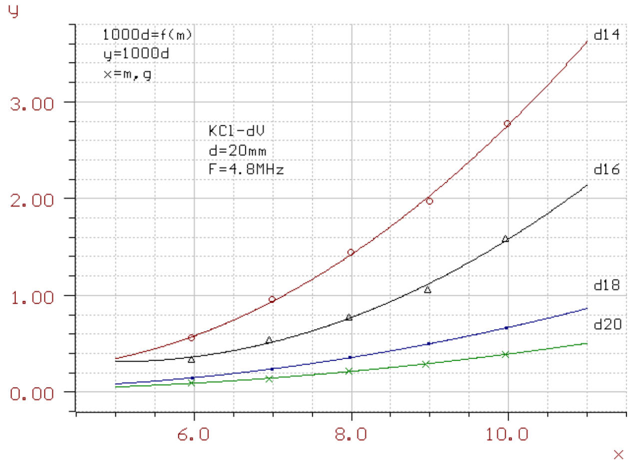

Fig. 8

The interaction of end eddy currents can be neglected (Fig. 9) for concentrations greater than 1%.

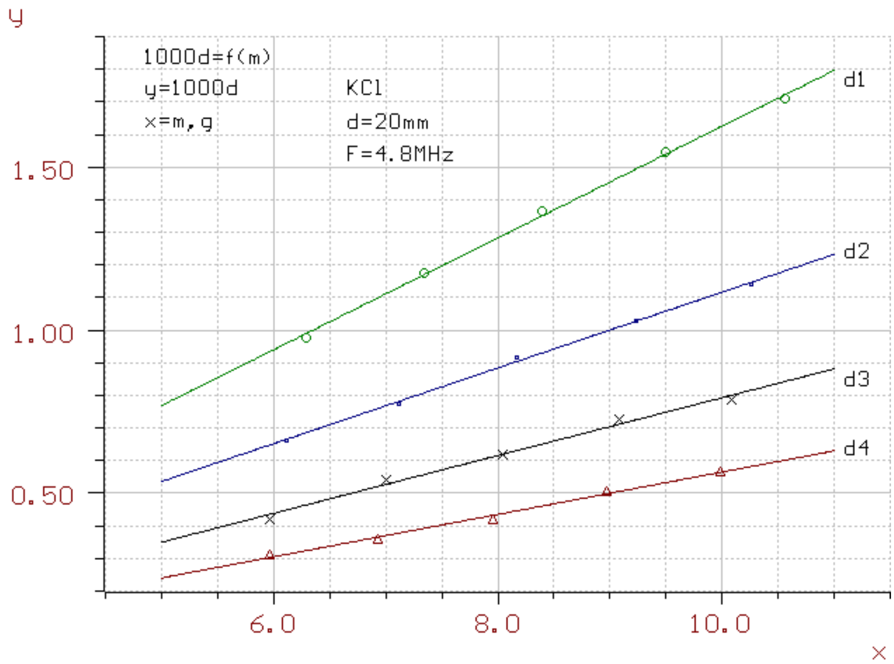

Fig. 9

Summary and conclusions.

Mass measurements of liquid concentrations in the range of 7% by electrodeless method were measured. There is a significant effect of the skin effect and the interaction of eddy currents in the cylinder filled with the studied fluid.

Due to the existence of three monotonic regions of dependence d = f (n%), the sensitivity of determining the concentration of aqueous solutions of electrolytes increases significantly.

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