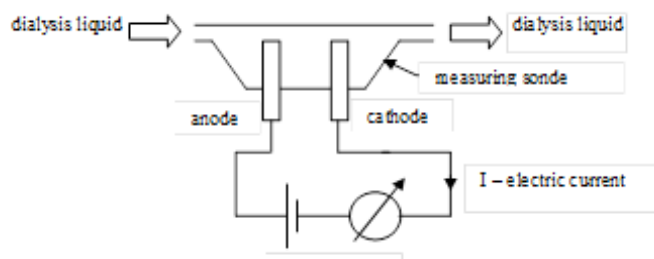


Simplified uncertainty estimation method in the dialysis practice

The necessity and importance of the quality control in the dialysis process [2] impose to verify some specific parameters by measurements and recording the measurement results. In order to give a confidence in the measurement results it is necessary to estimate the uncertainty of the measurements.



Taking into account that the estimation of the composed uncertainty is not very simple in the specific conditions regarding the working practice of the dialysis, a simplified uncertainty estimation for the conductivity measurement will be proposed. The measurement principle of the conductivity consist in an electrical circuit composed from

a power supply (E), an current measuring instrument (ampere meter – A) and a measuring probe with the two measuring electrodes (anode and cathode) which are in contact with the medium for which it will measure the conductivity. In Fig. 1 the principle of the measuring method is presented.

Since all conductivity measurement depends of the temperature of the analyzed medium, the temperature should accompany the results of conductivity measurements. The results obtained by the proposed method will be shown (Tab. 1) for the case of conductivity measurement by the dialysis liquid using a conductivity meter, with measuring domain of 1-20 mS/cm, resolution of 0,01 mS/cm and accuracy of 0,1 mS/cm.

Tab. 1

Medium value of the parameter	Temperature medium value	Experimental standard deviation
14,28 mS/cm	23° C	$S = 9,486 \cdot 10^{-3}$ mS/cm
Uncertainties mS/cm		
$u_s = \pm \frac{0,1}{\sqrt{3}} = \pm 0,057$	$u_t = \pm \frac{S}{\sqrt{n}} = \pm 3 \cdot 10^{-3}$	$u_c = \pm \sqrt{u_s^2 + u_t^2} = \pm 0,057$
The global uncertainty: $U = \pm k \cdot u_c = \pm 0,11$ mS/cm (k = 2)		

The measurement result with the associated uncertainty, estimated by the proposed simplified method, will be:

$$14,28 \pm 0,11 \text{ mS/cm (with } k = 2) \text{ at } t = 23^\circ \text{ C}$$

Conclusions:

The dialysis process is a very complex one, its quality and safety depend of the water treatment, the technical state of the dialysis apparatus and the results of the laboratory analyses. The uncertainty of the measurement is a parameter, associated to the measurement result, which characterize the dispersion of the values that could reasonably be attributed to the measured value.

The proposed simplified method can help in the measurement process of the dialysis liquid conductivity and give confidence to the measurement results in conductivity measurement, underlining the importance of accompanying the conductivity measurement result with the value of the temperature of the measurements.

Selected publications on the topic:

1. John T. Daugirdas, Todd S. Ing: *Handbook of dialysis*, New York, Little, Brown and Co., 1994, ISBN 0-316-17383-5.
2. Endre Ianos: *The quality control importance in the dialysis process* – Proceedings of the 5th International Carpathian Control Conference, Zakopane, Poland, May 25 – 28, 2004, pp.919-925 – volume I, ISBN 83-89772-00-0.
3. Endre Ianos: *Simplified uncertainty estimation method applied to the measurement of the dialysis liquid conductivity* – Proceedings of the 5th International Carpathian Control Conference, Zakopane, Poland, May 25 – 28, 2004, pp.177-182 – volume II, ISBN 83-89772-00-0.