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STUDY OF THE CHANGE IN THE CONCENTRATION OF FLUORIDE IONS IN SOLUTIONS STORED IN GLASS PACKAGING

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Aim of this work:

- determine the value of the fluoride concentration in each of the tested solutions using the standard addition method based on the proposed mathematical model
- draw conclusions about the influence of the glass on the fluoride concentrations in the prepared working solutions

Methods:

By transforming Nerst's expression, a mathematical derivation of the expression for the determination of the unknown analyte concentration in the standard addition method in potentiometry is obtained. The segmental form of the linear equation was used for the determination of fluoride ions in solutions stored in glass bottles.

The expressions c_S and V_S represent the concentration and volume of the sodium fluoride standard solution, V_A is the initial volume of the aliquot to be analyzed, ΔE is the difference between the recorded potentials after each added volume of the standard and the recorded potential in the solution before the addition of the standard. The value of the zero point of the linear equation obtained in this way represents the negative value of the fluoride concentration in each aliquot tested. This mathematical model has already been used to determine the fluoride concentration (in beer and wine).

Results:

Table 1. Fluoride concentrations in working solutions by day

theoretical (expected) fluoride concentration (mol L^{-1})	1.0×10^{-2}	1.0×10^{-3}	1.0×10^{-4}	1.0×10^{-5}	1.0×10^{-6}
time/days	Obtained values of fluoride concentrations in the working solutions stored in glass bottles				
1	1.010×10^{-2}	0.854×10^{-3}	0.918×10^{-4}	1.109×10^{-5}	0.937×10^{-6}
2	0.992×10^{-2}	0.863×10^{-3}	0.950×10^{-4}	1.132×10^{-5}	0.908×10^{-6}
3	0.992×10^{-2}	0.876×10^{-3}	0.931×10^{-4}	1.184×10^{-5}	0.901×10^{-6}
6	0.993×10^{-2}	0.809×10^{-3}	0.965×10^{-4}	1.048×10^{-5}	0.925×10^{-6}
9	1.028×10^{-2}	0.853×10^{-3}	0.905×10^{-4}	1.048×10^{-5}	0.916×10^{-6}
15	0.997×10^{-2}	0.831×10^{-3}	0.946×10^{-4}	1.203×10^{-5}	0.901×10^{-6}
21	1.001×10^{-2}	0.860×10^{-3}	0.948×10^{-4}	1.189×10^{-5}	1.033×10^{-6}
29	1.051×10^{-2}	0.897×10^{-3}	0.902×10^{-4}	1.210×10^{-5}	0.952×10^{-6}
43	1.008×10^{-2}	0.843×10^{-3}	0.914×10^{-4}	1.203×10^{-5}	0.935×10^{-6}
56	1.037×10^{-2}	0.836×10^{-3}	0.933×10^{-4}	1.194×10^{-5}	0.952×10^{-6}
76	1.041×10^{-2}	0.860×10^{-3}	0.938×10^{-4}	1.181×10^{-5}	0.980×10^{-6}
Mean concentration ± standard deviation (mol L^{-1})	**$(1.014\pm0.021)\times10^{-2}$**	**$(0.853\pm0.023)\times10^{-3}$**	**$(0.932\pm0.020)\times10^{-4}$**	**$(1.155\pm0.061)\times10^{-5}$**	**$(0.941\pm0.039)\times10^{-6}$**

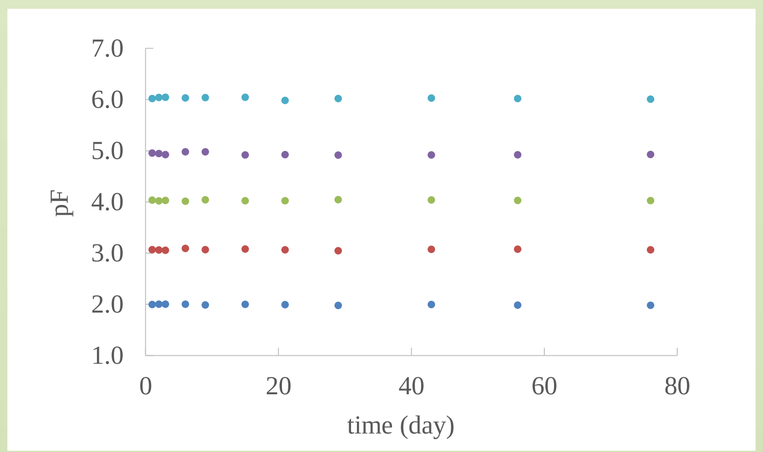

Figure 1. Change in the pF value

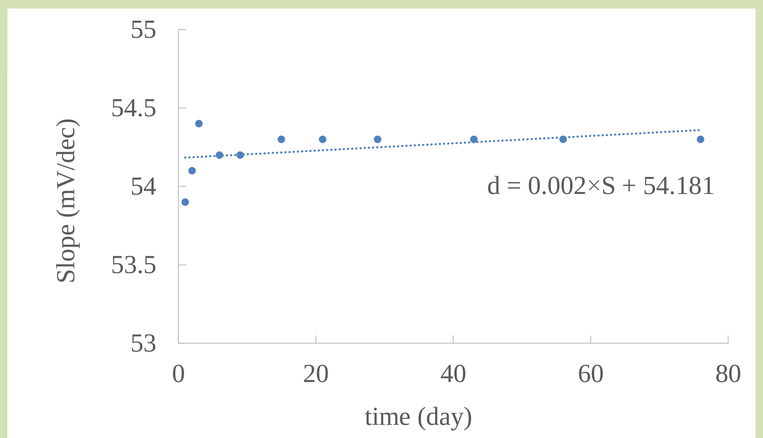

Figure 2. Change in the slope of the calibration curve

Conclusions:

It was found that the originally prepared concentrations of the fluoride standard solutions stored in glass containers do not change significantly, i.e. they fluctuate slightly over time around the originally prepared concentrations. Since no significant changes in the concentration values were observed for any of the solutions tested during the entire measurement period, it can be concluded that the storage of solutions with a pH value of 5.3 in glass containers has no influence on the fluoride concentration.

References:

- J. Radić, Doctoral thesis, University of Split, Faculty of Chemistry and Technology (2022) p72-75
- M. Buljac, M. Bralić, N. Vladislavić, J. Dugeč, J. Radić, *Chemistry* 5 (2023.), 2588-2597