Ion-selective electrodes in real-life applications: Can we reduce or even eliminate the need for calibration?

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The recent success in lowering of the low detection limit of ion-selective electrodes (ISEs) has opened up new application areas (most notably environmental analysis). The new possibilities have intensified issues that weren't critical in other application fields. In particular, the potential of ISEs to be integrated as detector systems in autonomous, deployable devices for environmental analysis have opened the question of the measure of uncertainty in prediction of unknown concentration based on calibration as well as the necessity of reduction or even elimination of calibration itself.

Here we point out the need for the maximal efficiency of using obtained results based on utilization of solid-contact ISEs for heavy metal analysis in soil. We advocate altering the current definition of detection limit and using signal-to-noise ratio as suggested earlier by Bakker and Pretsch.[1]

We also suggest new method for jointly estimating the calibration curve and the unknown concentrations using all the data. This method is in statistical analysis called Bayesian analysis. It allows more accurate prediction of unknown concentration, especially near and even below the detection limit. Furthermore, it allows using of multiple sensors (without disregarding poor performing sensors) which will allow further tightening of the prediction intervals.

Finally, we will present initial work on developing "calibrationless" chemical sensors where we use ISEs as model system. We are developing tests that will enable us to understand whether the surface or the bulk of the membrane has been altered (i.e. due to biofouling or poisoning of the electrode surface) thus avoiding the need to re-calibrate the sensors.

[1] Bakker E. Pretsch E; *Trends Anal. Chem.;* **2005**, 24, (3), 199