TASK SPECIFIC IONIC LIQUIDS MIXED PALM SHELL ACTIVATED CARBON AS ION SELECTIVE ELECTRODES FOR Cd (II) AND Hg (II) DETECTION

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ABSTRACT

Ion selective electrodes (ISEs) are potentiometric sensors used to measure some of the most critical analytes in environmental laboratory. Despite their easy fabrication, simple usage, and low cost, ISEs suffer from long response times, low response sensitivity, interference by a number of metal ions, long equilibration times and short lifetimes. Therefore, the development of new ISE materials that can address some of these limitations is a worthwhile and challenging topic of research. In this study, the combination of activated carbon with task specific ionic liquids has resulted in a unique new generation paste in which the traditional components have been replaced with alternate materials. The proposed electrodes exhibited improved performance compared to those of conventional type. This improvement is presumably due to the electrode composition. The manipulation of the electrode composition can improve the sensitivity and selectivity in the detection of some heavy metals in aqueous solutions.

The objective of this work is to prepare modified ion selective electrodes and then to use them for determining the heavy metal concentrations in drinking water samples and study of adsorption kinetic of cadmium and mercury ions onto modified palm shell activated carbon.

In this study, palm shell activated carbon modified with trioctylmethylammonium salicylate (TOMAS) was used as a novel electrode component for the potentiometric determination of cadmium ions in water samples. The proposed potentiometric sensor has good operating characteristics when used to determine Cd(II), including a relatively high selectivity; a Nernstian response in a working concentration range of 1.0×10^{-9} to 1.0×10^{-2} M, with a detection limit of 1×10^{-10} M and a slope of 30.90 ± 1.0 mV/decade; and a fast response time (~ 10 s). The proposed sensor can also be used for at least two months without considerable changes in its response characteristics. No significant

changes in the electrode potential were observed when the pH was varied over the range of 4-9. Another potentiometric sensor composed of palm shell activated carbon modified with trioctylmethylammonium thiosalicylate (TOMATS) was used for the potentiometric determination of mercury ions in water samples. The proposed potentiometric sensor has good operating characteristics towards Hg(II), including a relatively high selectivity; a Nernstian response to Hg(II) ions in a concentration range of 1.0×10^{-9} to 1.0×10^{-2} M, with a detection limit of 1×10^{-10} M and a slope of 44.08±1.0 mV/decade; and a fast response time (~ 5 s). No significant changes in electrode potential were observed when the pH was varied over the range of 3-9. A potentiometric method was developed for the in situ adsorption kinetic study of cadmium and mercury ions onto modified palm shell activated carbon based on the continuous direct monitoring of cadmium and mercury concentrations by the developed ion selective electrodes. The apparent adsorption rate constant was estimated assuming pseudo-second-order kinetics. Additionally, the proposed electrodes have been successfully used for the determination of the cadmium and mercury contents of real samples without a significant interaction from other cationic or anionic species.

List of publications

1- Chemical Engineering Journal 225 (2013) 306-314 "Palm shell activated carbon impregnated with task-specific ionic liquids as a novel adsorbent for the removal of mercury from contaminated water".

2- International Journal of Environmental Science and Technology (in press) "Cadmium (II) selective electrode based on palm shell activated carbon modified with task specific ionic liquid: kinetics and analytical applications".

3- The World Congress on Engineering and Technology (CET), International Conference on Chemical Engineering – China indexed by Ei Compendex and ISTP. "Potentiometric determination of trace amounts of mercury (II) in water sample using a new modified palm shell activated carbon paste electrode based on Kryptofix 5".

4- Sensors & Actuators, B: Chemical (Review article submitted) “Uses of Ion selective electrodes in determination of heavy metals in water and other environmental samples”.