

Optimized Parameters for Simultaneous Detection of Cd²⁺, Pb²⁺ and Co²⁺ Ions in Water Using Square Wave Voltammetry on the Unmodified Glassy Carbon Electrode

Authors : K. Sruthi, Sai Sneetha Yadavalli, Swathi Gosh Acharyya

Abstract : Water is the most crucial element for sustaining life on earth. Increasing water pollution directly or indirectly leads to harmful effects on human life. Most of the heavy metal ions are harmful in their cationic form. These heavy metal ions are released by various activities like disposing of batteries, industrial wastes, automobile emissions, and soil contamination. Ions like (Pb, Co, Cd) are carcinogenic and show many harmful effects when consumed more than certain limits proposed by WHO. The simultaneous detection of the heavy metal ions (Pb, Co, Cd), which are highly toxic, is reported in this study. There are many analytical methods for quantifying, but electrochemical techniques are given high priority because of their sensitivity and ability to detect and recognize lower concentrations. Square wave voltammetry was preferred in electrochemical methods due to the absence of background currents which is interference. Square wave voltammetry was performed on GCE for the quantitative detection of ions. Three electrode system consisting of a glassy carbon electrode as the working electrode (3 mm diameter), Ag/AgCl electrode as the reference electrode, and a platinum wire as the counter electrode was chosen for experimentation. The mechanism of detection was done by optimizing the experimental parameters, namely pH, scan rate, and temperature. Under the optimized conditions, square wave voltammetry was performed for simultaneous detection. Scan rates were varied from 5 mV/s to 100 mV/s and found that at 25 mV/s all the three ions were detected simultaneously with proper peaks at particular stripping potential. The variation of pH from 3 to 8 was done where the optimized pH was taken as pH 5 which holds good for three ions. There was a decreasing trend at starting because of hydrogen gas evolution, and after pH 5 again there was a decreasing trend that is because of hydroxide formation on the surface of the working electrode (GCE). The temperature variation from 25°C to 45°C was done where the optimum temperature concerning three ions was taken as 35°C. Deposition and stripping potentials were given as +1.5 V and -1.5 V, and the resting time of 150 seconds was given. Three ions were detected at stripping potentials of Cd²⁺ at -0.84 V, Pb²⁺ at -0.54 V, and Co²⁺ at -0.44 V. The parameters of detection were optimized on a glassy carbon electrode for simultaneous detection of the ions at lower concentrations by square wave voltammetry.

Keywords : cadmium, cobalt, lead, glassy carbon electrode, square wave anodic stripping voltammetry

Conference Title : ICEACACP 2022 : International Conference on Environmental Analytical Chemistry and Analytical Chemistry of Pollutants

Conference Location : London, United Kingdom

Conference Dates : August 16-17, 2022