CAPSULES
preliminary notes and applications from Bioanalytical Systems, Inc.

Determination of Trace Levels of Paraquat by Indirect Adsorptive Stripping Voltammetry

Purpose

Paraquat I (F1) is a broad-range herbicide which is also toxic to mammals. Consequently, a method is required for the determination of trace levels of I in a variety of environmental matrices.

Reference

Determination of Paraquat by Cathodic Stripping Voltammetry after Accumulation Through the Formation of an Ion Pair on a Hanging Mercury Electrode, J.M.P. Macias, L.H. Hernandez, J.M.M. Sobrino and M.T.S. Escribano, Electroanalysis 5 (1993) 79-83.

Method

The basis of electrochemical trace analysis is the accumulation of the analyte at the working electrode before the potential scan. In Adsorptive Stripping Voltammetry (AdSV, which has been used for a range of organic molecules), this accumulation occurs via direct non-electrolytic adsorption of the analyte on the surface of the working electrode (the mercury drop electrode is most commonly used). In this study, a slightly different approach was used; an anion (tetraphenylborate (TPB)) was directly adsorbed to the surface of a mercury drop electrode, and the cationic analyte of interest (I) was indirectly adsorbed via the formation of an ion pair with the adsorbed anion. This method allows AdSV to be used for analytes that do not adsorb directly on the surface of the working electrode.

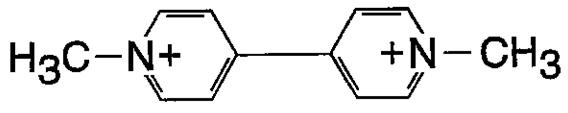

Figure 1. Molecular structure of paraquat (I).

Results

The indirect adsorption of paraquat on the surface of a mercury drop electrode is shown by the difference in the differential pulse polarograms recorded after a 90 s accumulation time (F2a) and after 0 s accumulation (F2b). It is clear that the peak current in F2a is greater than that in F2b. The optimum experimental conditions were found to be as follows: 0.01 M acetate buffer (pH 4.0), 1×10^{-4} M TPB, accumulation potential = -0.1 V (vs. Ag/AgCl), accumulation time = 90 s.

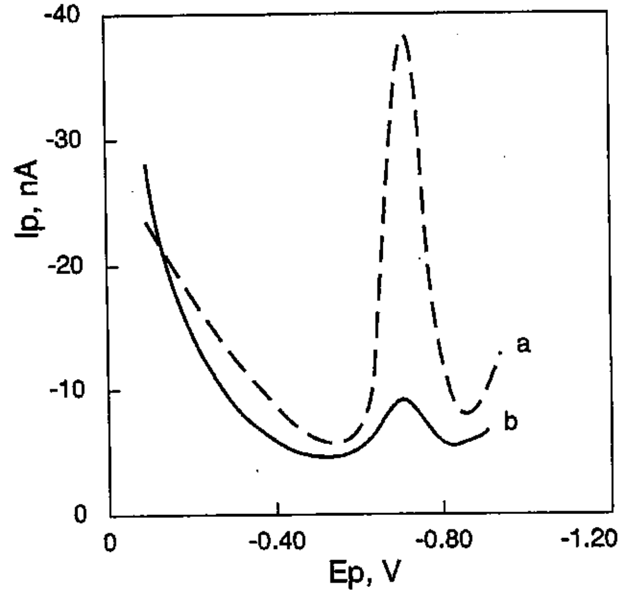

Figure 2. Differential pulse polarograms of paraquat in the presence of TPB (see text for experimental conditions). Accumulation time = 90 s (a), 0 s (b). Figure adapted from Reference.

The current response was found to be linear over two different ranges: one for concentrations below 8.75×10^{-8} M, the other for concentrations over the range 8.75×10^{-8} M to 5.0×10^{-7} M. The detection limit was 9.7×10^{-9} M, and the standard deviation at 4.04×10^{-7} M was 3.5%. It was found that cations and anions interfered with this determination, and the use of the method of standard additions was recommended. This is shown in F3 for a sample of natural water.

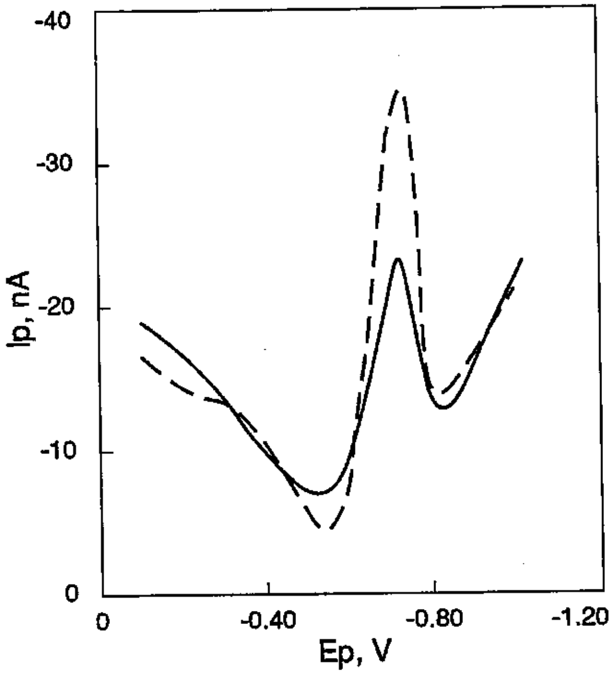

Figure 3. Differential pulse polarograms of paraquat in a natural water sample (solid line) and following standard addition (dashed line). Figure adapted from Reference.