ELECTROCHEMICAL METHODS FOR THE INVESTIGATION OF REACTIVITY OF PROPANIL

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Propanil is a common and a widely applicable herbicide that is extensively used in Sri Lanka on rice and potatoes. Colorimetry and gas chromatography have quantitatively determined its presence at 10^{-5} M concentration levels in soil, plant and water. Residual analysis of Propanil has been successfully conducted using gas chromatography with electron capture detector, as 3,4-dichloroaniline is the principal degraded product.

Electrochemical methods are generally inexpensive and easy to perform although some skills are necessary. Consequently, electroanalytical methods have been attractive for quantitative and qualitative analysis and for mechanistic studies in recent years due to their unique advantages over traditional methods.

The goal of this research is to employ electrochemical methods, which provide reliable detection methodology for electroactive substances, in order to investigate the kinetics of degradation of Propanil, together with adsorption characteristics of it on glassy carbon surfaces, under different experimental conditions.

The stability and hence the reactivity of Propanil is a function of both solution pH and time of solution preparation. Propanil is fairly stable in mixed water/ethanol medium between pH 4 and pH 7 for a period of ten weeks. However, in strong acidic medium (pH =1), it undergoes rapid degradation, while in strong basic medium (pH = 13), its degradation follows first order kinetics with an apparent rate constant of 9.2×10^{-8} s^{-1}. An adsorption characteristics of Propanil is also pH dependent, and it is irreversibly adsorbed onto glassy carbon surfaces in basic medium. A fresh solution of 3,4-dichloroaniline mimics the behavior of Propanil after degradation.

According to cyclic voltammetric experiments, Propanil is found to be electroactive under extreme pH condition such as pH 1 and pH 13, while below pH 4, interference of solvent breakdown masks its activity. The electroactivity of Propanil, however, strongly depends on the solution pH and the time of solution preparation. Comparison of the electrochemical behavior of fresh solutions of 3,4-dichloroaniline and that of Propanil prepared at different time periods, and the variation of the features of voltammetric peaks of these two analytes at different pH's suggest that the principal degradation product of Propanil is 3,4-dichloroaniline. Although this degradation process is very rapid at pH =1, it would probably undergo slow degradation under environmental conditions. Such studies would promote the use of economical and simple electroanalytical methods for investigation of the fate of pesticides in the environment, and to design models for pesticide degradation pathways.