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Development of Highly Sensitive Method for the Determination of Novel Organoborane Antifoulant and Determination of Its Degradation Ratio

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Summary

A commercial organoborane compound, pyridine-triphenylborane (PTPB), is often applied to ship hulls as an anti-fouling agent in order to keep them free from marine organisms, such as barnacles and bivalves. However, the degradation process of PTPB and its degradation products have not been well understood, because of lack of an analytical method for both PTPB and its estimated degradation products. We developed a procedure using capillary zone electrophoresis (CZE) with direct UV detection for the simultaneous determination of PTPB and its estimated degradation products, such as diphenylborinic acid (DPB), phenylboronic acid (MPB), and phenol. The stock solutions (1,000 mg/l) were prepared in acetonitrile and 1% (v/v) pyridine was added to the stock solutions to stabilize PTPB. The following optimum analytical conditions were established: a background electrolyte (BGE), 20 mmol/l sodium tetraborate solution adjusted to pH 10.0 with 1 M sodium hydroxide; detection wavelength, 200 nm; vacuum (5 in. Hg) injection period of sample, 4 s (*ca.* 84 nl); applied voltage, 15 kV with the sample inlet side as the anode. By using the proposed procedure, limits of detection (LODs) for PTPB, DPB, MPB, and phenol were 25, 30, 50, and 29 μg/l, respectively, at a signal-to-noise ratio of three. At concentrations of 0.5 mg/l, values of the relative standard deviation (RSD, n = 6) of peak area: 4.1, 4.1, 4.7, 3.4%, peak height: 3.6, 3.2, 1.7, 1.4%, and migration time: 1.1, 1.1, 1.0, 0.7%, for PTPB, DPB, MPB, and phenol, respectively, were obtained. The analytes were detected within 14 min. Simple degradation experiments were carried out to verify the usefulness of the proposed method for further PTPB degradation investigations. That is to say, PTPB samples dissolved in acetonitrile were put in the open air and a dark place to examine the effects of the light intensity and the temperature on the degradation of PTPB. The sample solutions were analyzed by the CZE method with the elapse of time. As a result, it was suggested that the degradation of PTPB was significantly affected by the light intensity, rather than the temperature. It has consequently been demonstrated that the CZE method is a useful tool to elucidate the degradation process of PTPB and its degradation products.