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Comparison of an Electrochemical and Luminescence-Based Oxygen Measuring System for Use in the Biodegradability Testing According to Closed Bottle Test (OECD 301D)

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Abstract:

The effects of persistent organic pollutants on the aquatic environment still can hardly be assessed. Therefore, ready biodegradability is a desired key characteristic of chemicals. Accordingly, biodegradation testing is of utmost importance and is a vital part within the risk assessment for organic chemicals. In the closed bottle test (CBT:OECD 301D) the degree of biological degradation of a chemical is assessed by monitoring the oxygen consumption so far with a Clark electrode as standard method. However, this method is time-consuming, laborious and led to frequent fluctuations of the test results, which limited their validity. Due to these shortcomings, an optical system that enables contact-free measuring of the oxygen concentration in a closed bottle, based on dynamic luminescence quenching, was examined. The test results were compared to those obtained with the “classical” electrochemical technique (Clark electrode). At first, a basic standard for the handling of the new instrument in the laboratory was developed. Then possible influencing factors, reliability, comparability and reproducibility of the test results were investigated by running the CBTs in parallel with the electrode and optode method. The findings proved the new optode method to be unambiguously superior to the electrode technique. The frequency of fluctuations of the test results and time and effort necessary for the test run could considerably be reduced. The degradation kinetics of the test substances could be followed easily in the CBT by increasing the measuring points without much additional effort.

Keywords: Clark electrode, closed bottle test, luminescence quenching, optode, oxygen measuring