Measurement of Dissolved Oxygen in Biochemical Oxygen Demand Determinations With a Luminescence-based Oxygen Quenching Sensor

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Biographical Sketches of Authors

Dr. Jackson has 28 years experience in the development and validation of analytical methods for water, wastewater, and solid waste. As a principle consultant to EPA Office of Water, he has developed, co-developed, or managed the development of over 20 promulgated methods. His long-term research interests have focused around mass spectrometry, chromatography, and solvent-based partition systems. Currently with the Hach Company, Dr. Jackson directs the regulatory sciences activities for EPA and consensus-based method approvals. He earned his Bachelor of Arts degree in chemistry from University of Northern Colorado and a Doctorate of Philosophy in Soil Chemistry from Colorado State University.

Dr. Craig is a research and development chemist focusing on cutting edge spectroscopy technologies as applied to water and wastewater applications and homeland security. After obtaining his Doctorate of Philosophy in Analytical Chemistry from Ohio State University, he served as a Post-doctoral fellow at the Australian National University and University of California, San Francisco in automated interpretation of nD-Protein NMR spectra. Prior to joining the Hach Company, Dr. Craig taught analytical chemistry and instrumental analysis for Louisiana Tech University and the University of Northern Colorado.

Abstract

Dissolved oxygen (DO) is the second most sought out measurement in the operation of wastewater treatment plants. When used to derive the biochemical oxygen demand (BOD) from a wastewater, it becomes a regulatory compliance and process control tool. Consequently, precision and accuracy of the determinant to measure DO becomes a critical issue of interest in estimating the degree of water quality or purification, and calculating industrial discharge loading costs for public owned treatment work (POTW) facilities.

Attempts to measure DO are hampered by a lack of robust analytical techniques that are accurate, precise, easy to use, and resistant to matrix interferences. The two EPA methods approved to measure DO (Winkler titration and Clark-type electrode) often fail to deliver interference free readings that are accurate and precise across the BOD range of 1.0 to10 mg/L, DO. In an attempt to address these measurement deficiencies, a luminescence-based sensor was evaluated as alternative determinant. An in-house side-by-side comparison study with Winkler, Clark-type electrode and luminescence-based dissolved oxygen (LDO) was conducted with reference water and incubated BOD_5 samples.

Initial results indicate that LDO is a superior alternative to Winkler titrations and Clark-type electrodes for DO measurements with respect to accuracy, precision, detection limit, and response linearity. A further nationwide Tier III validation study will be conducted to develop statistically pooled quality control acceptance criteria for EPA method approval.

This presentation will briefly discuss luminescence-based oxygen sensor technology and the results of the initial in-house side-by-side comparison study.