

Continuous On-Line Monitoring of Dissolved Oxygen in the Activated Sludge of a Sewage Treatment Plant

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An oxygen sensor based on a gold microelectrode array was developed for wastewater applications. Adequate detection limit, linearity range and reproducibility have been achieved. A compact reliable transmitter was developed for field tests in a sewage treatment plant.

Dissolved oxygen is traditionally measured using a Clark cell, which relies upon a gas-permeable membrane for its operation. Such sensors are subject to fouling with subsequent loss of accuracy, making frequent maintenance and calibration necessary.

The objective of this development was to take advantage of specific properties of microelectrode arrays, such as low flow-dependence, insensitivity to media conductivity and fast response time^{[1] [2]} to realize the direct, i.e. membrane-free, electrochemical measurement of dissolved oxygen (DO) in wastewater. The necessity of frequent calibration/cleaning was avoided by the use of a simple disposable membrane-less sensor.

Procedures for the determination of DO in water were initially developed and tested under laboratory conditions. Adequate detection limit (0.2 ppm), linearity range (0 – 10 ppm) and reproducibility (5% at mid range) were achieved with gold microelectrode arrays. A stable sensitivity in difficult media, such as sewage water, has been obtained by applying an "in-situ" electrochemical pre-activation step before each measurement.

A compact robust electronic interface based on the existing CSEM miniaturized potentiostat was developed to allow field-testing of the sensor. Figure 1 shows a view of the interface. The system was easy to operate. A 4 to 20 mA analogue output was available for process control and up to 30'000 stored data-points could be retrieved through a RS 232 interfaces.



Figure 1: View of transmitter with sensor head

Figure 2 shows the sensor after more than three weeks of continuous monitoring a) in the activated sludge of a sewage treatment plant alongside a commercial membrane sensor b). The two results are consistent as shown in Figure 3a). Due to its membrane-less construction, the microelectrode array re-

sponse time was short and tracks sharp changes in dissolved oxygen concentration can be achieved in a much better way than the membrane sensor, as indicated in Figure 3b).

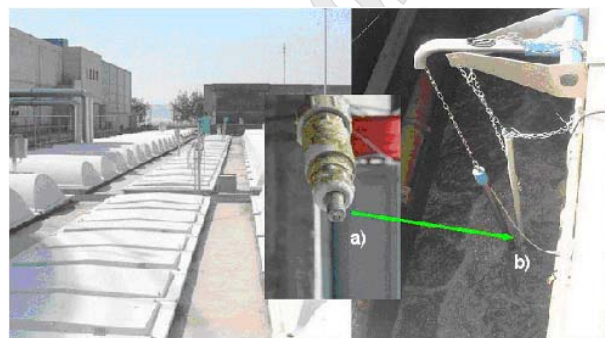


Figure 2: Field test in sewage treatment plant

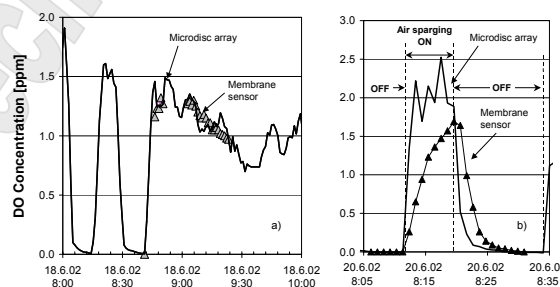


Figure 3: Dissolved oxygen concentration in activated sludge vs. time; comparison of microelectrode array and membrane sensor responses

Future work will address the issue of a sensor construction suitable for easy replacement of the chip. In addition a modification of the array design by including an integrated auxiliary electrode will be evaluated for improvement^[3] of the array lifetime (antifouling effect) as well as for the possibility to provide a self-test/self-calibration function to the sensor.

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- [1] J. Gobet, P. Rychen, C. Madore, N. Skinner, H. van Buel, F. Jaggi, "Development of a On-Line Chlorine Sensor for Water Quality Monitoring in Public Distribution Networks", *Water Science and Technology: Water Supply* 1/2 (2001) 211
- [2] D. Pletcher, S. Sotiropoulos, "Towards a Microelectrode Sensor for the Determination of Oxygen in Waters", *Analytica Chimica Acta*, 322 (1996) 83
- [3] Patent pending