AquaSentinel: A Real-Time Reagentless Biosensor System for Standoff Detection and Classification of Toxins in Source Water

Elias Greenbaum and Miguel Rodriguez, Jr.
Oak Ridge National Laboratory
P.O. Box 2008, MS-6194
Oak Ridge, TN 37831-6194

ABSTRACT

AquaSentinel is an automated and field-deployable real-time technology for detection of source water environmental toxins that is based on the fluorescence induction properties of algae that grow naturally in the water. We report here that the algal biosensors can be used as a sentinel alarm system based on toxin-induced fluorescence readout as the characteristic signature for identification and verification of environmental pollutants in source drinking waters. This reagentless self-contained optoelectronic detection system naturally lends itself to mapping and ranging of the presence of pollutants in source waters. We have developed an original algorithm for performing the analysis of the readings from the biosensors. The approach is based on differential offset between the fluorescence signatures of healthy algae and that of the poisoned algae. The technique yields a set of time-dependent numbers that uniquely maps the transformation of the normal or healthy fluorescence induction curve to that of the poisoned curve. We show that the set of numbers generates a characteristic signature that can be used to group and identify the specific pollutant that caused the alteration of the fluorescence. Data on five well-known toxins will be presented: cyanide, methyl parathion, atrazine, diuron and paraquat. This data was generated from dose-response experiments performed with “as is” water samples collected from the Clinch River. The Clinch is the primary source of drinking water for the City of Oak Ridge, Tennessee.

Keywords

Biosensors, collecting and interpreting data, new technologies