

Navy's Biosensor System Provides for Rapid, Cost Effective Toxicity Screening

QwikLite Demonstrates Versatility & Effectiveness in the Field

THE QWIKLITE BIOSENSOR

System™ is a toxicity testing procedure that was developed at the Space and Naval Warfare Systems Center Pacific (SSC Pacific) in the late 1990s, with support from what is now the Navy Environmental Sustainability Development to Integration (NESDI) program. The QwikLite System is a tool for rapid and cost effective screening of water or sediment samples to help direct environmental decision making at Navy facilities. Since its development, the prototype device has been extensively demonstrated and validated, patented, approved by the American Society for Testing and Materials, and licensed for commercial use. The commercial unit has demonstrated its effectiveness in a variety of applications.

The QwikLite test utilizes the natural phenomenon of light producing, single-celled, photosynthetic algae, known as dinoflagellates, as an indicator of toxicity in a variety of water sample types. This biologically produced light is commonly known as bioluminescence, and can be seen at night along coasts during large algal blooms, or red tides. The dinoflagellate species used in the commercial QwikLite test is known

as *Pyrocystis lunula*. The light emitted by the cells is captured, measured, and recorded by the optics and electronics of the QwikLite instrument, following a controlled exposure to samples (usually 24 hours).

Significantly lower light production in test samples relative to clean “control” seawater is a measure of the potential toxicity of the water sample to marine life. Examples of sample types appro-

priate for the test include stormwater and industrial discharges, ambient marine and estuarine waters receiving those discharges, sediment elutriates (created from mixtures of sediment and water), and sediment porewater (water between sediment grains).

The commercial version of QwikLite is small, simple to use, portable, and rugged enough for use in the field or onboard survey vessels. With NESDI



The QwikLite Biosensor System.
Assure Controls, Inc.

program support and by leveraging other projects, SSC Pacific personnel undertook an effort to expand the technology transfer and integration of the commercial test system. The commercial unit was used to focus remediation efforts funded by the Strategic Environmental Research and Development Program (SERDP) in the Bayou Grande estuary near Naval Air Station (NAS) Pensacola in Pensacola Bay, FL. Personnel were also able to coordinate with an ambient monitoring program for monitoring potential effluent toxicity from industrial discharges from the Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF) and adjacent receiving waters of Sinclair Inlet, WA. In a third effort, QwikLite was employed in assessing the bioavailability and toxicity of oil and dispersants released during the British Petroleum (BP) Deep Water Horizon oil well disaster in the Gulf of Mexico.

Sediment Quality Testing at NAS Pensacola

At NAS Pensacola, the QwikLite system was used to identify possible contaminant sources during a study of the NAS Pensacola Yacht Basin, located at the mouth of Bayou Grande, an estuary that connects with Pensacola Bay on the Florida panhandle. The QwikLite bioassay tests were used to evaluate samples from areas of the estuary where there was concern whether contaminated sediment and/or groundwater could be causing impacts to the estuary. In the study, porewater samples were extracted from 26 different locations within the estuary and adjacent wetlands using another SSC Pacific tool—the Trident Probe. The samples were then tested with



Bioluminescence along shoreline in eastern Australia.
Phil Hart

The NESDI Program

THE NESDI PROGRAM is the Navy's environmental shoreside 6.4 Research, Development, Test and Evaluation (RDT&E) program. The program provides solutions by demonstrating, validating and integrating innovative technologies, processes, materials and filling knowledge gaps to minimize operational environmental risks, constraints and costs while supporting Fleet readiness. For more information, visit the program's web site at www.nesdi.navy.mil.



Bioluminescent dinoflagellate, *Pyrocystis lunula* (actual size approximately 0.1 mm).
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SSC Pacific sampling team at NAS Pensacola Yacht Basin.
Gunther Rosen

the QwikLite system to determine whether toxic levels of contaminants were present in the porewater. The results helped identify which areas of the estuary should be the focus of further investigation using additional chemical and biological measurements. The data assisted in delineating wetland areas where no further action was recommended.

Discharge & Ambient Water Quality Monitoring at PSNS

For the past two years, the QwikLite Biosensor System has also been routinely employed by SSC Pacific in a comprehensive study for the PSNS & IMF, located in Bremerton, WA on Sinclair Inlet within the Puget Sound. The study is being conducted to characterize environmental conditions,

assess potential impacts, and establish environmental quality trends within the Inlet. Water, sediment, and biota monitoring locations were selected that were co-located near suspected sources (industrial, waste water, and stormwater outfalls; marinas, stream mouths, and others) and locations that were representative of ambient marine and nearshore conditions for seasonal sampling. The study is being conducted to inform the National Pollutant Discharge Elimination System (NPDES) permit process for the shipyard. A battery of toxicity tests and chemical analyses are being used in this program to characterize environmental quality of the samples. In addition to QwikLite 24 hour bioluminescent response, effluent and water column toxicity tests include mysid shrimp (*Americamysis bahia*) 96 hour survival, purple sea urchin (*Strongylocentrotus purpuratus*) 96 hour embryo development, mussel (*Mytilus sp.*) 48 hour larvae survival and development, and kelp (*Macrocystis pyrifera*) 48 hour growth and germination. The QwikLite test has provided an important line of evidence for assessing the potential



Porewater samples awaiting testing at NAS Pensacola.
Gunther Rosen



University of South Florida researcher Jenny Delaney assessing QwikLite data on the research vessel Weatherbird II in the Gulf of Mexico.

Bryan Bjorndahl

effects of discharges and receiving water conditions in concert with the other tests, which are more laborious and costly. Overall the toxicity tests results show minimal or no toxicity in the discharge samples. However, the tests have identified the presence of toxicity in ambient samples with high concentrations of toxic algae from episodic blooms (red tides) that commonly occur within the Puget Sound.

In addition to the seasonal monitoring at PSNS & IMF, a pilot study was conducted during August and September 2010 that involved weekly QwikLite toxicity testing and chemical analyses of samples from industrial processes and effluents in the shipyard. For this work, SSC Pacific personnel trained shipyard staff to conduct the testing using portable incubators and testing equipment set up in temporary laboratory space on site at the shipyard. The ability for personnel unfamiliar with the equipment to set up quickly in temporary laboratory space and to easily learn how to conduct the tests and meet the various quality assurance and quality control requirements was a testament to the portability, simplicity, and user-friendliness of the QwikLite system. The pilot study showed that the QwikLite system was versatile, reproducible, sensitive, and capable of providing rapid (within 24 hours) information on the potential presence or absence of toxicity in the samples tested.

Gulf Oil Spill Studies with QwikLite

Assure Controls, Inc., exclusively licensed to commercialize the QwikLite system, has also been busy promoting the technology in a number of different applications. Their team provided technical assistance for toxicity testing that

was conducted onboard the research vessel Weatherbird II during the BP Deepwater Horizon oil well disaster in the Gulf of Mexico last year. Led by researchers at the University of South Florida, several toxicity endpoints, including QwikLite, were used to help understand the potential bioavailability and toxicity of both crude oil and dispersants at varying distances from the well head, and near delicate habitats along the Gulf Coast. These QwikLite studies have received television coverage on the National Geographic Channel and Public Broadcast Service programs. The field portability, simplicity, and ecological relevance of the test (i.e. bioluminescent dinoflagellate species are an important component of the Gulf of Mexico food web) also led the

U.S. Environmental Protection Agency (EPA) Region 6 Houston, Texas laboratory to experiment with the QwikLite test as a screening tool for anticipated long term monitoring studies along the Gulf Coast.

Since the Gulf Oil Spill, Assure Controls has continued to identify a variety of unique applications for the QwikLite technology. In addition to traditional applications for sediment quality assessment and NPDES monitoring of industrial discharges, the company has identified promising applications for shipboard monitoring of ballast water discharges, water quality assessments of freshwater wells potentially impacted by natural gas drilling, and monitoring of private drinking water wells near Superfund sites. By keeping costs and labor well below that of traditional bioassays and providing rapid turnaround of time critical samples while maintaining contaminant sensitivity and reproducibility, the commercial QwikLite Biosensor System has proven itself well suited for determining whether water and sediment samples are toxic. [↓](#)

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