Rapid Detection of Explosives and Other Pollutants

Cleanup
CU-28

RESEARCH CATEGORY: 6.3 Advanced Development

LEAD AGENCY: U.S. Navy

LAB: Naval Research Laboratory - Washington, D.C.

PRINCIPAL INVESTIGATOR: Ms. Anne Kusterbeck, (202) 404-6042

FY 1997 COMPLETED PROJECT

OBJECTIVE: The Department of Defense (DoD) has more than 1,200 sites contaminated with explosives and 87 percent of these exhibit contamination in the groundwater. Remediation of munitions sites contaminated with explosives, and monitoring of the surrounding area, require accurate analyses of field samples. Tests should be conducted rapidly and on site for the most effective remediation to proceed. Recent advances in antibody technology have allowed the introduction of immunoassay techniques to environmental monitoring. Immunoassays now being marketed for environmental analysis, such as products from Ensys and Editek, while extremely selective, have several disadvantages for field use. The Naval Research Laboratory (NRL) has developed a biosensor which can be configured to measure either discrete samples containing explosives, in under one minute, or to monitor process streams at timed intervals. Using a displacement immunoassay, multiple samples can be injected into a micro-column containing a fluorescent signal molecule bound to immobilized antibody. If explosives are present in a sample, the fluorescent molecule is displaced and detected. If the sample contains no explosive molecules, reagents are not expended.

The objective of the present work was to use the existing biosensor for explosives to test soil and water samples from known sites of contamination. Operating parameters for selected molecules, including detection limits, possible interferents in samples, and useful system lifetime are being investigated. Following successful laboratory studies in the initial years of the project, on-site analyses of environmental samples, including soil and groundwater, are currently being performed to detect and quantify the explosives TNT and RDX. A portable device to improve on-site testing is also being developed.

BENEFIT: The primary goal has been to develop a commercial version of the Flow Immunosensor. The Environmental Protection Agency (EPA) has initiated a purchase request for an instrument and will work with NRL to begin the formal methods-validation process, a two-year effort. Their plan is to use the instrument at selected Superfund sites to monitor remediation progress in parallel with the EPA-approved method.

ACCOMPLISHMENTS: During FY97, a portable device to improve on-site testing was developed and work was performed on pre-field trial activities, that included participation of an NRL scientist in a field trial run by the group from U.S. Army Waterways Experiment Station (CU-1043). The field trial was held at the Louisiana Army Ammunition Depot, and researchers were able to observe their logistical set-up and quality control measures. Work also included the writing of an EPA-format demonstration test plan, with documentation of all standard operating procedures (SOPs) and FAST 2000 instrument protocols. The low-end detection research was also successful, with demonstrated detection limits for TNT and RDX in the low parts per trillion. This level of sensitivity is well below current field methods.

TRANSITION: In coordination with EPA region 10 and the EPA chemists at the Environmental Lab in Manchester, WA, the FAST 2000 portable biosensor was successfully used in a field test. The technology will be transitioned to the industrial contractor, Research International, who collaborated with NRL on this project. It is expected that this work will be continued following transition to the Environmental Security Technology Certification Program (ESTCP).