Sandia National Laboratories

Environmental Program

Barrier Verification and Monitoring System

Technology Need

New designs and materials for covers and subsurface barriers are being developed for landfills, underground storage tanks and pipelines, and uncontrolled hazardous and mixed waste sites. These barriers are intended to prevent the unchecked release of contaminants into the environment. Development of new techniques to verify the emplacement and monitor the performance of these barriers is of critical importance to gain acceptance of the containment technologies and to provide early detection of flaws or leaks. Traditional techniques such as construction quality assurance and control, surface and borehole geophysics, and ground water detection systems do not provide sufficient resolution or timely detection of flaws or leaks potentially resulting in contaminants escaping and further impact to the environment.

Figure 1. Field Portable Autonomous SEAtrace™ System.

Objective

The objective is to develop a low-cost, real-time technology to quantifiably assess and verify the emplacement of a barrier after construction and to monitor the integrity and performance of the barrier over time.

Project Description

The SEAtrace™ system (Figure 1) is an integrated solution for barrier verification and monitoring in the unsaturated zone. It can determine the location and size of a breach after construction and continue to monitor performance over time. The SEAtrace™ system was developed and tested in joint collaboration by Sandia National Laboratories and Science and Engineering Associates, Inc. to produce a post-construction, non-destructive, autonomous, real-time barrier verification and monitoring technology.

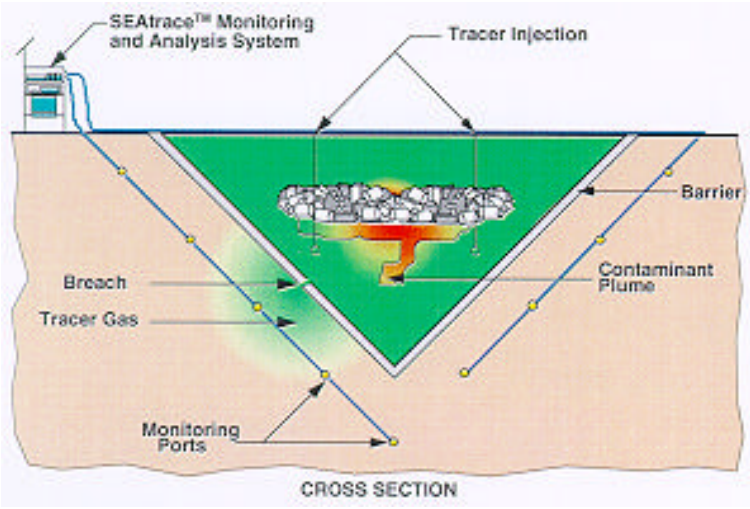

Figure 2. Barrier Verification and Monitoring System schematic.

The SEAtrace™ system uses gaseous tracer injection, and in-field, real-time gas analysis and data interpretation to evaluate barrier integrity. Figure 2 shows a schematic of the system installed at a subsurface barrier. Multiple sample ports (up to 64) are installed inside and outside of the barrier. These ports are connected to a stand-alone sample

collection, analysis, and evaluation system. An inert, non-toxic tracer gas is injected inside the barrier and allowed to diffuse into the surrounding media. Samples collected over time provide tracer concentration histories that are input to a global optimization code to quickly determine the location and size of the leak(s).

Recent field tests at subsurface barriers installed at Dover Air Force Base and Brookhaven National Laboratory demonstrated that the SEAtrace™ system is able to simultaneously identify multiple leaks, locate leaks to within 0.5 m, and to size leaks to within 0.15 m. This is quickly accomplished within 30 minutes. These results were independently corroborated with construction QA / QC, hydraulic, geophysical, and excavation techniques (Figure 3). However, the SEAtrace™ system, obtained the results significantly faster and pinpointed the leaks more accurately than the other verification and monitoring techniques.

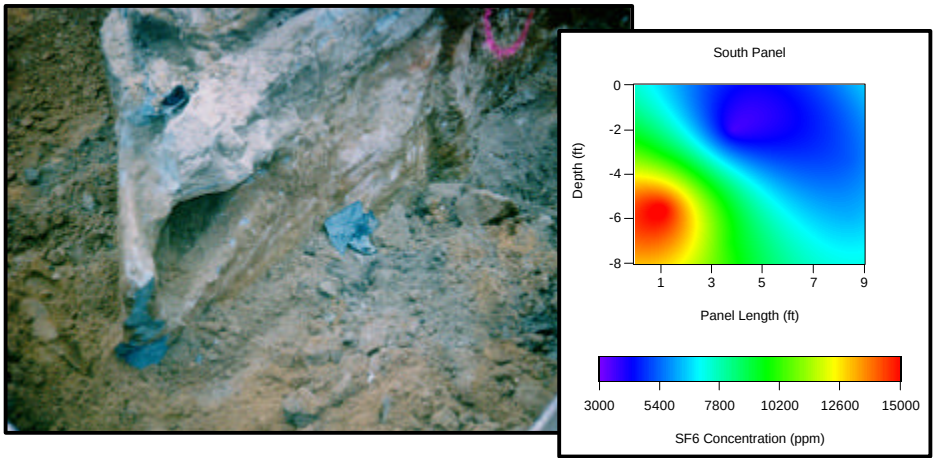

Figure 3. Excavation and confirmation of barrier construction flaw detected by SEAtrace™ System.

Advantages

The SEAtrace™ system has been thoroughly tested and demonstrated in the field, and its results have been independently corroborated. The system is fully capable and ready for full-scale field applications. The SEAtrace™ system is completely autonomous and automated, uses solar power, has a self-starting back-up generator, is trailer mounted, and provides remote communications via cellular modem. It is non-destructive and minimally intrusive. Within 30 minutes, the system can automatically sample up to 64 ports, analyze the tracer gas concentration, evaluate the resulting data, and then locate leaks to within 0.5 m, and size leaks to within 0.15 m. It can be controlled and report results anywhere accessible by telephone. The system is very robust and can monitor a site unattended for months. The sample ports can be installed by various, drilling and minimally intrusive means, such as direct-push techniques. The SEAtrace™ system provides verification and monitoring capabilities in the unsaturated zone that are complementary to construction QA / QC, geophysics, and hydraulic methods; however SEAtrace™ results are repeatable, and faster and more accurate than these methods. Costs are approximately $7-8 per square foot of barrier wall.

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