

Environmental Site Characterization and Remediation at Former Grain Storage Sites

In support of the Commodity Credit Corporation of the U.S. Department of Agriculture, Argonne developed and implemented improved, more efficient methods for environmental site characterization and remediation, which expedite the return of contaminated resources to beneficial use.

PROBLEM/OPPORTUNITY

In the early 1990s, the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA) was faced with the need for environmental characterization at many former grain storage facilities that had been contaminated with carbon tetrachloride. The shortcomings of conventional characterization techniques led the CCC/USDA to collaborate with Argonne National Laboratory to develop an expedited method.

APPROACH

The CCC/USDA sought an environmental site characterization process that is technically effective, economical, and relatively quick to implement.

Argonne responded by developing a flexible, focused characterization methodology based on

- Integration of multiple technical disciplines;
- Adaptation of cone penetrometer technology to environmental characterization;
- Development of new sampling and drilling tools for use with the cone penetrometer;
- Improvement of drilling and well installation procedures;
- Implementation of minimally intrusive sampling techniques;
- Development of innovative analytical approaches with faster turnaround and lower detection limits; and
- Creation of faster, more encompassing data management and visualization systems for investigation data.

For remediation of sites (as needed), Argonne was asked to seek, develop, and implement the innovative, emerging types of options that the CCC/USDA and regulators both prefer, where those options are applicable.

Early in the program, the CCC/USDA implemented a conventional pump-and-treat system that had already been designed when Argonne became involved. More recently, Argonne has explored more innovative remediation technologies by employing engineering cost analyses and a dynamic risk assessment program that produces realistic, defensible projections of remediation benefits.



Cone penetrometer rigs at work in Kansas.

RESULTS

The site characterization method that Argonne developed for the CCC/USDA is the basis for the American Society for Testing and Materials standard ASTM D-6235-04. Argonne has implemented this process and other innovations at dozens of former CCC/USDA facilities in Nebraska and Kansas. More than 20 sites have ongoing activities.

In addition to the CCC/USDA, Argonne has conducted environmental characterizations for the U.S. Department of Energy, the U.S. Department of Defense (Navy and Air Force), and the Bureau of Land Management.

Two Nebraska CCC/USDA sites are in active remediation, and remedy selection is in progress for two sites in Kansas. One remediated Superfund site in Nebraska is being monitored, pending delisting in 2009.

For the Nebraska sites now in remediation, Argonne designed and implemented innovative systems.

The remediation system at Utica, Nebraska, employs spray irrigation treatment of contaminated groundwater, with beneficial reuse of the treated water to restore an existing deteriorated wetland in a critical flyway for migratory waterfowl.

At Murdock, Nebraska, a modified spray irrigation system is treating deeper groundwater near the contaminant source. The local school uses the treated water to irrigate its athletic fields. Farther from the source, where the contaminated groundwater emerges at an existing creek tributary, Argonne installed a phytoremediation plantation involving some 2,000 trees of six species, plus an engineered wetland. In its first seasons of operation, this system has consistently demonstrated reductions in carbon tetrachloride concentrations from > 3,000 ppb in groundwater entering the phytoremediation area to trace levels in water leaving the wetland.

Both of the Nebraska remediation systems have been received enthusiastically by the local communities and regulators.



Specially designed spray irrigation equipment treating contaminated groundwater in Nebraska.

Remediation plans for two Kansas sites involve (1) large-diameter borehole technology with soil vapor extraction and (2) pilot testing of an injected zero-valent iron product. Both sites are characterized by great subsurface heterogeneity and limited permeability, which reduce the effectiveness of conventional remediation methods.

The research component of our remediation work is evident in our (1) selection of innovative technologies suited for specific sites, (2) design of tailored systems, and (3) development of monitoring programs to evaluate the effectiveness of the remediation systems and improve understanding of the way they work.

FUTURE

At the request of the CCC/USDA, Argonne is expanding its characterization work into Missouri. As site characterizations are completed, the program's focus is shifting to remediation. This is particularly true in Kansas, where the regulatory agency is active and involved.

COMMUNICATION OF RESULTS

Argonne's work for the CCC/USDA has resulted in the following recent publications:

- Standard on expedited site characterization (ASTM D-6235-04).
- Cooperative Conservation America case studies on the Nebraska remediation projects (cooperativeconservationamerica.org; search for case study for Utica or Murdock).
- Three U.S. patents for tools that improve the performance of cone penetrometer technology in environmental applications.
- Conference papers and posters on the projects at Utica and Murdock, Nebraska.
- A journal article describing our analytical method for low levels of carbon tetrachloride in soil and vegetation samples (Alvarado and Rose, 2004, *Talanta* 62:17-23).
- Numerous technical reports.

Further information is available at our Web site (<http://www.EVS.anl.gov>).