



Sandia
National
Laboratories

Environmental Program



Advanced In Situ Moisture Logging



Technology Need

Monitoring the vadose zone beneath hazardous and mixed waste landfills is necessary to provide an early warning system for contaminant migration from waste sites. Such information is critical to the characterization of waste sites, monitoring of waste remediation activities, and evaluation of post-closure performance of remediated sites.

Objective

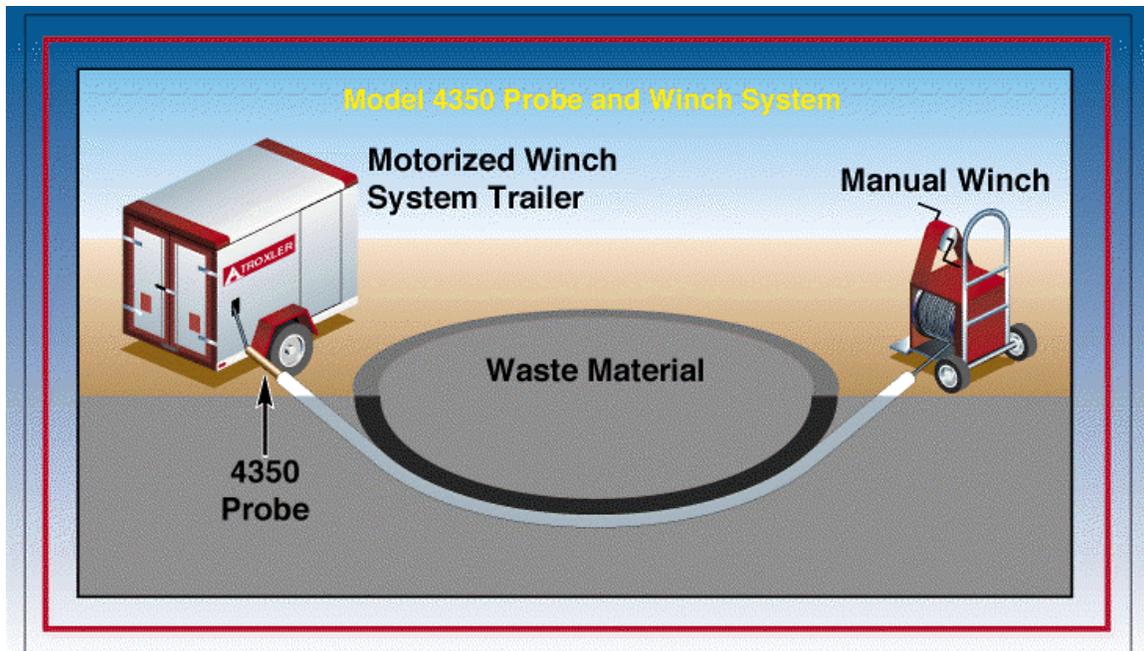
This project was designed to develop a system capable of measuring moisture content and soil density around access tubing within the soil/rock medium. These measurements are necessary to determine the changes in fluid potential that are indicative of leakage/contaminant movement from a waste site. The device developed through this project provides an alternative to costly monitor well networks for vadose zone monitoring.

Project Description

The neutron source/detector used in the Advanced In Situ Moisture Logging System consists of an americium/beryllium combination (10 mCi). The source and detector are used in close proximity to each other, and the probe counts the thermalized "slow" neutrons that have contacted hydrogen atoms. This technique is significantly different from those used in the mineral and oil industries, where the source and detector are widely spaced and the probe counts "fast" neutrons. This device's count ratio is generally linear with respect to percent moisture. Its configuration allows for quantification of the moisture content to within +/-2% volumetric water content when calibrated to a given soil and has approximate radius of influence of about 30 cm. The mineral and oil industries' probes integrate soil moisture over much larger volumes with less accuracy and precision. The gamma source for measuring soil density is an 8-mCi Cs- 137 configuration. The neutron source/detector can be used in vertical as well as horizontal access tubes.

The probe used in the system is a Model 4350 manufactured by Troxler Electronics Laboratory, Inc. It monitors soil moisture/density at any depth. The probe is self-contained; the electronics required to take a reading and program subsequent readings of moisture content and soil density are contained within the housing of the device. The probe is drawn through an access tube by a support cable and requires no electronic communications to the top of the casing. Therefore, length of access tubing is not prohibitive, and long horizontal tubes may be used.

Troxler offers a sophisticated, transportable constant velocity winch with a continually monitored take-up rate. Using the winch system, the probe can be pulled through the access tubing while taking data at pre-programmed intervals. Using the moisture and density data from the 4350 and the footage measurements from the winch system, the physical location of a leak can be determined. All distance and rate data is transmitted to an on-board computer capable of storing 3000 different moisture and density readings in non-volatile memory. The data downloads to a personal computer.



Model 4350 Probe and Winch System.

Advantages

The advantage of a downhole logging device is its continuous data collection along the length of the access tubing allowing for greater spatial coverage. This technology is also self-contained and programmable, making the application faster and easier. The length of the access tubing is not prohibitive because the support cable doesn't require electronic communication from the probe to the surface.

With the advent of the horizontal/directional drilling technologies, the applications of downhole, self-contained monitoring devices are significantly enhanced. One could envision a network of horizontally drilled access tubes beneath a facility that, coupled with the right monitoring technology, could provide an early warning system for leak detection.

Costs

Start-up costs are approximately \$30,000 for the probe and \$50,000 for the Troxler winch system. Leasing options are available from Troxler.

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