



Vadose Zone Monitoring System

Technology Need

Post-closure monitoring is required of virtually all remediated sites. Standard practice is to monitor ground water wells for contaminants. This approach may be problematic at a site with a relatively great depth to groundwater. By the time contaminants are detected in the groundwater, significant vadose zone (unsaturated zone between surface and water table) contamination will have occurred. Monitoring the vadose zone beneath the remediated site instead of the groundwater permits earlier detection of a contaminant release with a smaller volume and results in less costly additional remediation.

Objective

The Vadose Zone Monitoring System is designed to provide unattended, automated monitoring of multiple vapor sampling locations in single or multiple boreholes for unsaturated zone measurements. Measurements determine the predominant mechanism of vapor or volatile contaminant movement which allows more accurate prediction of the rate of movement to the water table.

Project Description

The Vadose Zone Monitoring System integrated pressure sensors and gas sampling is a stand alone field system that performs real-time measurement at up to 64 sampling ports in either single or multiple wells. The wells used can range from test holes of one to two inches in diameter to boreholes eight inches in diameter. The sampling system utilizes a Bruel and Kjaer gas analyzer, a barometric pressure sensor, a differential pressure sensor (to determine the pressure difference between the surface and the sampling point), and a solenoid valve system to sequentially connect each sampling port to a sensor. Also, temperature sensors and thermocouple psychrometers (TCPs) which measure soil water potential are located in selected wells. The Bruel and Kjaer gas analyzer identifies, measures, and stores the concentration of up to five target gases.

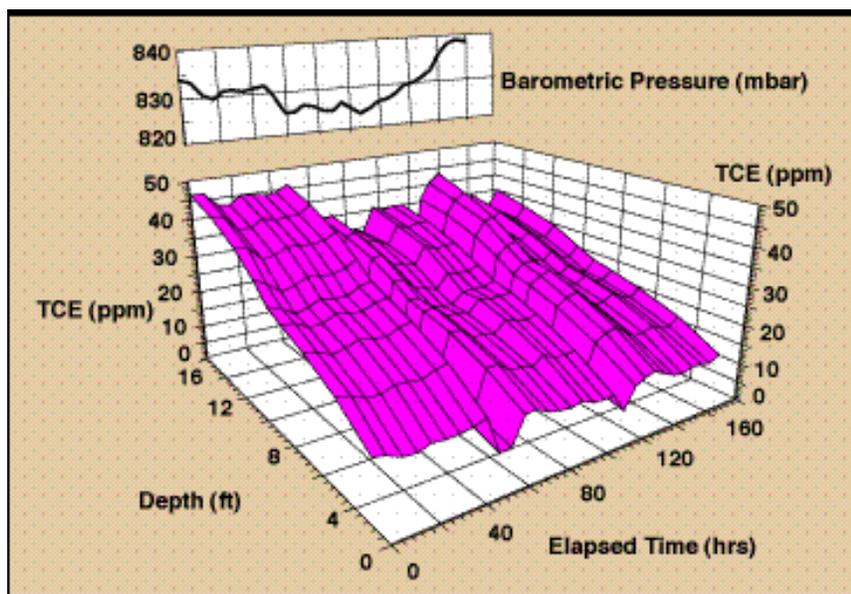


Figure 1. Sample measurement results (correlation between trichloroethylene concentration and barometric pressure)

It is based on photoacoustic principles where an intense infrared light is shined on the gas sample in the chamber, and very sensitive detectors monitor the response of gas to the light, producing a very accurate measurement of the gases contained in the sample and the concentrations of these gases in the sample. A Campbell Scientific CR-7 datalogger is used to monitor the pressure sensors, store pressure and temperature data, and control the solenoid valves and the gas analyzer.

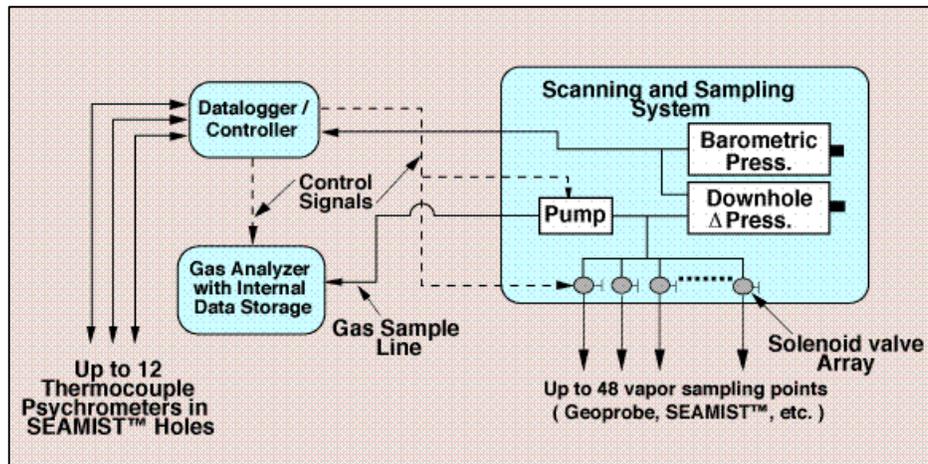


Figure 2. Vadose Zone Monitoring Zone Schematic

The system runs automatically without supervision. Data are periodically downloaded using a portable personal computer and analyzed using spreadsheet programs. The pressure data are correlated to gas analysis data from each well to determine the effects of changes in barometric pressure on the movement of the vapor through the soil. The vapor movement is analogous to contaminant movement.

Advantages

The system can perform vapor sampling and analysis and gather data in real time from numerous sampling ports. It is also low maintenance and tolerant of a range of environmental conditions. It is expected that this technology will reduce characterization and monitoring costs while increasing the quality of these efforts. This technology will achieve better data on contaminant distribution and the effectiveness of remediation efforts which should reduce remediation costs.

Costs

Specific costs of the system comprise purchasing components, operation, and maintenance. Start-up costs include purchasing a Bruel and Kjaer gas analyzer, Campbell Scientific CR-7 datalogger, pressure and temperature measurement devices, and a pressure scanning package. The system cost totals approximately \$40,000. The main operations cost is

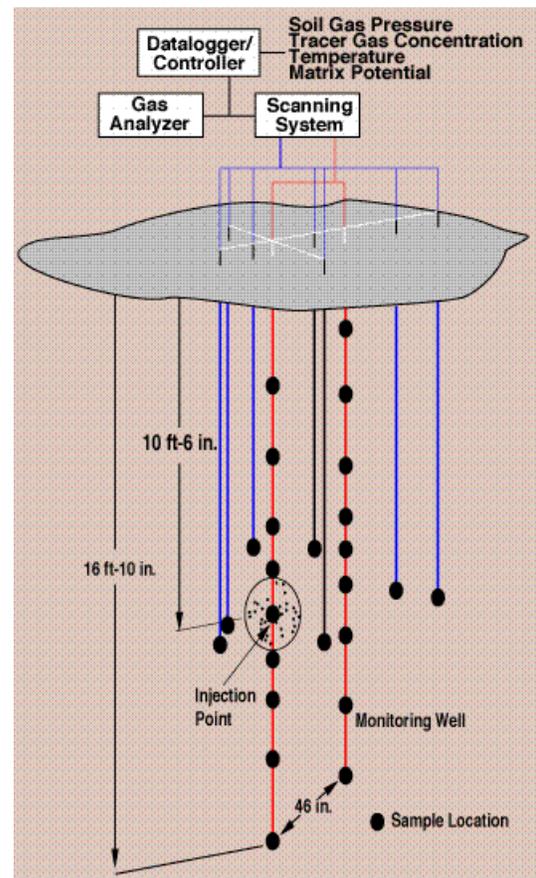


Figure 3. Vadose Zone Monitoring System used in tracer gas migration study

weekly downloading of data from the system which takes approximately two hours. The main maintenance cost is checking the calibration on the Bruel and Kjaer gas analyzer which takes approximately 15 minutes.

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