Remote Monitoring of Soil Moisture

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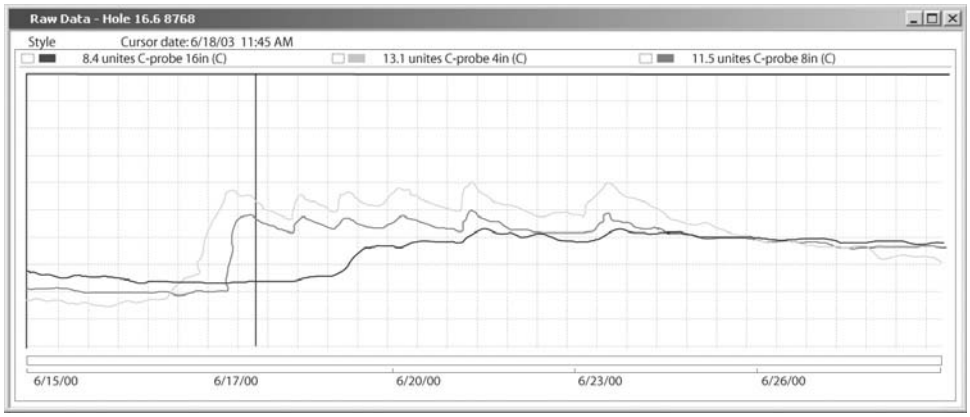
Soil moisture monitoring systems that have the capability to automatically collect and transmit data are being used in settings as diverse as golf courses, copper mines, and nuclear waste repositories. The ability to receive real-time data from remote locations greatly enhances the utility of the systems for both the operators and the clients.

In the first example, an irrigation monitoring system was installed at a southern Arizona golf course using capacitance-type soil moisture sensors and a full weather station. The sensors, installed at several fairway locations, monitor soil moisture by measuring the dielectric strength of the soil at depths of 4, 8, and 16 inches. The data are transmitted directly to a base receiver and computer in the greenskeeper's office four times per hour via FM transceivers at each monitoring station. The chart above illustrates the wetting front from a heavy irrigation cycle during a 14-day period. The effects of overwatering are apparent, as moisture at the 16-inch sensor exceeds surface moisture. This monitoring system allows the golf course operator to optimize irrigation practices using real-time soil moisture data, thus avoiding both overwatering and underwatering.

A fairway transceiver receives sampling commands from, and transmits sample data back to, the golf course base station.



A 14-day golf course irrigation record, illustrating a period of overwatering. Note that the 16-inch depth moisture exceeds surface moisture after 10 days.

At a large copper mine, stacked heat dissipation sensors (HDS) were installed to monitor moisture flux through experimental tailings cover systems. These laboratory-calibrated sensors measure water energy conditions at depths of 0.5, 1.5, 3, 6, and 10 feet. Stacking the sensors in this fashion allows a hydraulic gradient to be calculated and a one-dimensional flux estimation to be made within the system. The soil pressure potential data are collected by data logger and downloaded on demand by cellular phone, both powered by a solar panel.

HDS and water content reflectometer arrays were installed in a clay cover system constructed over a low-level nuclear waste repository. The system allows near-real-time monitoring of soil moisture conditions. Data are transmitted hourly by low-frequency radio telemetry, allowing operators to monitor cover performance conditions.

Installation of automated HDS and water content reflectometer arrays in a nuclear repository clay cover.

The data transmitting capabilities of all three systems allow both the data and the system operation to be closely monitored, thus enabling immediate evaluation of site conditions, and saving the operator and client costly site visits and system downtime.

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