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Technology for Tomorrow

Locus TECHNOLOGIES

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AUTOMATIC $AVINGS

The cost to operate and maintain an environmental remediation system over 30 years can be staggering. By automating routine tasks and monitoring, site owners can save a bundle.

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In the last several years, growth in the environmental remediation industry has slowed. One reason is that at many contaminated sites remedial construction activities have been completed and the operation and maintenance (O&M) phase has begun. However, this slow growth, accompanied by increased competition, does not necessarily translate into cost savings for the owners of contaminated sites with long-term O&M requirements.

Long-term O&M costs often dwarf engineering and remedial construction costs, but they don't have to. By negotiating with regulators for adequate cleanup standards, reducing labor through automation and standardizing environmental reporting and record keeping, site owners often can shut down a system early or reduce the long-term operating costs of environmental treatment systems by 30% to 50%.

Construction of a $1 million groundwater treatment plant operated for 30 years or more, for example, typically would be preceded by five years of consulting, regulatory negotiation and engineering costs. These initial costs would total about $300,000. After construction, the O&M phase might continue for 30 years. If the initial O&M cost is $40,000 per year and the inflation rate is 3%, the true future cost of O&M exceeds $2 million, which is substantially higher than consulting, engineering and construction costs combined (see figure, p. 56).

Even a 10% reduction in O&M costs can produce enormous savings in the long run. The following four strategies can help to lower overall O&M costs:

- Negotiate with regulators to reduce O&M requirements.
- Design a system that will require less servicing.
- Automate the system so that human factors play a minimal role in routine tasks.
- Computerize environmental data management and reporting.

The ability to influence overall project costs is greater at the early stages of development. The engineers and scientists involved in the project need to establish a scientific approach to determining when to shut down in situ remediation systems, such as groundwater treatment or soil vapor extraction processes. These processes typically provide an initial rapid decline in contaminant concentrations, followed by a gradual flattening of removal efficiency over time.

THE CONTROL PANEL OF AN AUTOMATED ENVIRONMENTAL TREATMENT SYSTEM CAN BE ACCESSED FROM REMOTE LOCATIONS USING WIDE AREA NETWORKS OR THE INTERNET

Contaminant levels eventually get so low that the system can no longer reduce them. In many cases, the contaminant concentration may be higher than the cleanup standard, but continued operation of a treatment process in this situation is unwarranted, wasteful and ineffective. No discernable benefit can be obtained.

A policy for shutting down a treatment process that is based on the rate of change of the concentration versus time could save millions of dollars in cleanup costs. This would be consistent with California's Containment Zone Policy. The policy, adopted in October 1996, recognizes the futility of trying to remediate groundwater to drinking water standards without considering technological and economic limitations.

In addition, a shut-down standard based on science could justify an impracticability waiver from the U.S. Environmental Protection Agency, based on the inability of the system to achieve required cleanup levels using available remedial technology. This approach offers the owner an opportunity to shut down a system early and renegotiate sampling and reporting frequency. When a system can no longer significantly reduce the concentration of contaminants, groundwater concentrations change slowly. Frequent well sampling and monitoring are unjustified and wasteful.

SYSTEM DESIGN

Like the automobile, environmental treatment systems have changed dramatically in the past decade. In the past, automobiles required frequent maintenance, but this maintenance could be performed by mechanics with ordinary training. Now, because automobiles include computer technology, tune-ups can be performed only by highly trained electronics technicians.

Similarly, environmental treatment systems once required significant labor that was not highly specialized. Modern computerized control systems allow unmanned treatment processes to operate for longer periods without attention, except for routine maintenance analogous to changing the oil filter in a car. When more sophisticated, less frequent corrective maintenance is required, highly trained technicians equipped with modem diagnostic tools are needed.

Newly developed procedures and technology can continue to save money for site owners well into the O&M phase of long-term environmental projects. Owners can take advantage of highly automated treatment systems that combine environmental engineering expertise with the latest computer science technology.

The latest generation of digital field devices can gather, transmit and display information beyond simple process variable measurement. For example, they can monitor operational status and the readiness of the operating equipment. With this information, maintenance staff can perform preventive and corrective repairs in far less time and at far less cost than required by traditional, predigital control systems.

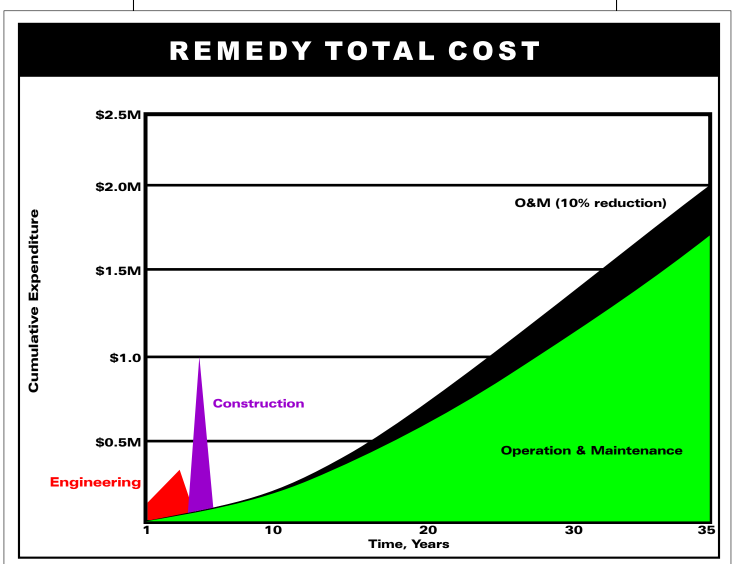
The most flexible control systems are industrial computer based and run Microsoft Windows software on an Intel Pentium personal computer. Standard control components, such as General Electric Fanuc programmable logic controllers (PLCS) and the InTouch Man-Machine Interface software from Wonderware Corp., Irvine, Calif., make these systems relatively inexpensive to install and maintain. An automated control system for a typical $1 million groundwater treatment plant costs about $20,000.

Digital field devices typically communicate with the PLC through a single communication cable. Gone is the need for an electrical engineer to prepare complicated drawings and wiring diagrams for installation and maintenance. Capital costs associated with plant engineering and construction drop dramatically.

A supervisory control and data acquisition (SCADA) system combines telemetry and computer technology to provide centralized monitoring and control of facilities over a large geographic area. By integrating a wide area network (WAN) and the Internet with the SCADA system, technicians can monitor and adjust a system anywhere in the world, from any location.

Once SCADA systems are installed, plants and systems can be remotely monitored and controlled-allowing troubleshooting, system resets and diagnostic work without a site visit. The customer's local area network (LAN) can be integrated into a SCADA system to allow remote control from any workstation in the company. System security is designed to allow only the level of access that certain persons need.

Although construction cost savings generally pay for a distributed control system in a new treatment plant, O&M savings also make retrofit of existing systems an attractive option. Many site owners have discovered that reduced maintenance labor, downtime, repair costs and monitoring, as well as compliance improvements, result in a payback period of a few months.



Cost reduction is not the only reason to automate monitoring systems. Improved regulatory compliance may be reason enough. It is now possible to place environmental monitoring and control at the engineer's desktop computer instead of in the plant's control room. In fact, many systems are located at remote, unmanned sites and are designed using only a standard electrical cabinet to house the field components, such as a PLC. In these cases, complete operational control and monitoring of sites can be accomplished anywhere in the world from any location.

The most compelling benefit of automated control systems is that they provide an opportunity to shut down the treatment system early. All groundwater and soil vapor extraction systems approach the cleanup goal asymptotically, or with a greater reduction in contaminant levels early in the process. The high efficiency and reliability of automated systems mean that they achieve cleanup more rapidly than other systems, thus providing an opportunity to shut them down early.

LESS COSTLY BENEFITS

The costs and benefits of automating environmental remediation systems can be generalized as follows:

New construction. If integrated into a new design, an automated system can be installed at near the cost of a traditional control system, and in some cases at a significantly lower cost. Although automated control system components cost more than their analog counterparts, installation is easier, which can offset material costs.

Existing system retrofit. If an existing monitoring or treatment system is retrofitted, costs are incurred in several areas, including engineering, construction and operator training. But once a system is automated, many benefits can be realized immediately.

Treatment precision. Unlike a human operator, the PLC monitors and adjusts system parameters several times every second rather than hourly, daily or weekly. This precision means that the treatment technologies are always running at peak efficiency, and the system is vigilantly monitored for alarm conditions, which is critical for regulatory compliance.

Consumables expenditure. A system that adds a chemical anti-scalant for an air stripper, for example, can use a PLC to continually monitor the chemical residual in the effluent water of the air stripper and automatically increase or decrease the amount of the chemical injected upstream to attain the desired level. The system automatically and immediately compensates for changes in flow rates and injection pump variations so that no wasteful overdosing occurs.

Waste removal expenditure. Traditionally, technicians change water filters on a set schedule. An automated system would alert an operator to change the filters only when the differential pressure across them reached a predetermined set point, usually the point at which the degradation in filter performance begins to adversely affect system operation. When used in conjunction with a voice-call alarm system, the PLC can notify an off-site maintenance technician that it's time to change the filter.

System downtime. The PLC can be programmed to respond to alarm conditions in a way that keeps the system running. In addition, when an alarm condition occurs, the PLC can immediately notify an off-site operator of the condition. The operator can either make an informed trip to the site or remotely access the system from a personal computer, make an adjustment and restart the system without a site visit.

Data collection. The system software can be programmed to collect and store process data as often as once per second.

Water levels can be recorded hourly, rather than during monthly site visits, providing more useful information. Daily summary reports can be generated in a word processing or spreadsheet format. The automatic data collection, when combined with preformatted documents that make real-time inquiries to the database, can dramatically reduce the time needed to generate routine monthly, quarterly and annual reports and can increase the quality and accuracy of the information contained in the reports.

Because the systems can be monitored and adjusted at any time or at any desired interval from a desktop computer with virtually no increase in cost, system reliability and environmental compliance improve dramatically. If stringent regulations and stiff penalties for permit violations are part of the picture, improved compliance can be benefit enough to justify the cost of a retrofit. The high efficiency and reliability of automated systems mean that cleanup occurs more rapidly and O&M expenses may be lower.

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CASE STUDY:

GROUNDWATER TREATMENT SYSTEM AUTOMATION

The owner of a 200-acre site in Mountain View, Calif., that was formerly operated as an electronics manufacturing facility faced cleanup of soil and groundwater contaminated with volatile organic compounds. The owner hired Locus Technologies to design, construct and operate multiple groundwater extraction and treatment systems and a soil vapor extraction system to treat contaminated soil.

Because the manufacturing facility had been demolished and the site was being redeveloped as a business park, the project owner requested a remediation system with minimal O&M costs and intrusiveness. The solution was a fully automated system manageable from a remote station located at Locus Technologies offices, in Mountain View, Calif.

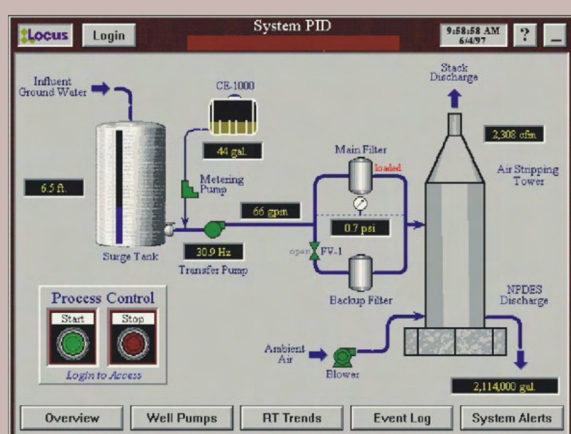
The treatment system contains a collection of 13 groundwater extraction wells that pump into a common pipeline leading to a treatment plant. The plant uses a 5,000 gal. surge tank and pumps collected water through a 20 ft-high packed air stripping tower. The influent stream is filtered and a chemical antiscalant is injected prior to air stripping. Treated effluent is either discharged to surface water or reused for on-site irrigation.

Controls at the treatment plant are organized into two panels. The main control panel houses the programmable logic controller (PLC) and low-voltage electronics. A separate pump control panel houses the high-voltage electrical equipment used to control the extraction well pumps and treatment plant equipment.

An industrial personal computer with a flat-panel, touch-screen display mounted directly to the main control panel allows an operator to start and stop pumps, vary flow rates and monitor levels and system pressure. The on-site operator interface is directly connected to Locus Technologies' corporate wide area network (WAN). This connection allows any workstation on the WAN to act as the operator interface. The Locus WAN is connected to the Internet, making it possible for anyone on the Internet with authorization to access the plant controls.

The operator interface computer runs a graphically based software package that allows the operator to view real-time operating conditions of a particular subsystem or component and monitor its performance or make operational changes.

The process and instrumentation diagram screen displays detailed real-time data, such as flow rates, total flow, filter differential pressure, filter status, surge tank levels, valve and equipment status, and antiscalant levels. A complete history *and events log, far more detailed than can be kept manually, is automatically prepared and can be easily accessed at any time.*



THE PROCESS AND INSTRUMENTATION DIAGRAM SCREEN DISPLAYS REAL-TIME DATA, SUCH AS FLOW RATES, TOTAL FLOW, FILTER PRESSURES, AND VALVE AND EQUIPMENT STATUS.

The system alert screen shows the warnings, alerts, problems and security status of the treatment system. The PLC is connected to a programmable voice-call dialer, which allows the system to call a series of telephone numbers and leave voice or pager messages if trouble occurs.

By default, an operator wishing to access the system is allowed monitoring-only access. If an operator wants to make changes to the system parameters, log-on is required. The log-on process allows customized user-access levels. For example, a standard operator may be granted permission only to start and stop the pumps and the plant. An administrative-level operator would be granted the level of access needed to change critical system set points.

The ability to observe status, perform routine maintenance as needed and troubleshoot the system from remote locations has reduced the cost of preventive and corrective maintenance for the automated system to about half that of more traditional systems.