Non-Traditional Indicators of System Performance

The use of real-time sensors and supervisory control and data acquisition (SCADA) systems has become commonplace in large centralized wastewater treatment systems, however, this WERF research project indicates the number of decentralized wastewater treatment facilities currently using on-line sensors for real-time remote monitoring is relatively small. This could be due to perceptions of high cost for installation and maintenance, and perceptions of poor reliability. However, the cost effectiveness and reliability of the technology has been demonstrated in larger systems, which should be transportable to smaller clustered, decentralized systems.

This project focused on assessing on-line sensing and data acquisition technologies applicable for use in decentralized wastewater treatment systems to provide real-time information on the performance and operational status of the facility. A life-cycle cost analysis tool is provided that can be used by the decentralized wastewater system professional to provide defensible budgetary estimates of instrumentation procurement and installation costs and ongoing labor expenses to support maintenance requirements over the life-time of on-line sensing equipment.

The results of this study will help wastewater facility managers, operators, and designers select real-time sensors and SCADA systems for decentralized wastewater treatment facilities. Improved remote monitoring of these facilities should provide facilities with a cost-effective means to manage and improve the performance of decentralized wastewater treatment plants.

The research project involved five main areas of investigation related to the use of on-line sensing and data acquisition technologies in decentralized wastewater treatment systems, including a literature and technical review, development of monitoring needs, identification of sensor capabilities, identification of SCADA capability, and additional research needs.

The results of the literature and technical review were used to help identify the monitoring needs for decentralized wastewater treatment facilities. The review identified traditional and non-traditional parameters that could be monitored in decentralized wastewater treatment systems to allow operations or management staff at a remote location to assess the operating or performance status of a facility and to respond to upsets, process or mechanical failures, or other non-routine situations. This study determined that operating conditions, process control parameters, and effluent quality parameters could be monitored on-line at decentralized facilities, and a list of parameters requiring further investigation in the third area of the study ("identification of sensor capabilities") was identified.

Table 1. Summary of Research Needs.

PRIORITY	RESEARCH NEED
1	Field Testing
2	Develop Sensor Standard Testing Protocols
3	Cost-Benefit Analysis
4	Education and Training
5	Improve Cleaning and Calibration Frequency of Sensors
6	Develop Best Practices for SCADA Standards
7	Review SCADA Security Issues

BENEFITS

- Identifies decentralized facilities that are successfully using real-time, on-line monitoring as a management tool.
- Demonstrates that a range of parameters can be used to monitor plant performance and prioritizes the types of parameters that should be monitored.
- Provides a life-cycle cost analysis tool that can be used by decentralized wastewater system professionals.
- Identifies sensors currently available to remotely monitor plant performance and provides information to select sensors.
- Demonstrates a range of options for communication and storage of data.

RELATED PRODUCTS

Sensor Technology for Water Quality Monitoring: Bioluminescent Microorganisms (01WSM2a)

Sensor Technology for Water Quality Monitoring: Fiber-Optic Biosensor (01WSM2b)

Sensor Technology for Water Quality Monitoring: XRF Spectroscopy (01WSM2c)

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The study also determined the status and characteristics of real-time sensing equipment for on-line monitoring of the parameters in decentralized wastewater treatment systems. Selection matrices were developed that display traditional and non-traditional instrument technologies, listing specific attributes of individual manufactured instruments categorized by cost of ownership and on-line monitoring capabilities to assist the end-user in making direct comparisons of the differences in manufactured instruments. The data provides decentralized wastewater treatment system professionals with general principle of operation descriptions to assist in determining which technology would best fit the application.

Additionally, individual instrumentation specification matrices are also provided which report supplementary instrument parameters for further consideration in the decentralized wastewater treatment system instrumentation selection process. Included is a review of the capability of SCADA systems to collect and analyze the information generated by real-time sensors to provide relevant operational and performance information to remote operational staff. Wireless and wired communication systems can relay information from a decentralized site to an operator or central monitoring location. A review and discussion of the advantages and disadvantages and relative costs for the options available for data transfer from remote facilities to a centralized operations center is also provided.

Following up on information obtained from previous stages of the study, research needs that could lead to broader acceptance and use of real-time sensors and SCADA in decentralized wastewater systems were identified. This included gaps in knowledge or technology for real-time remote monitoring of decentralized wastewater treatment systems. The study identified three main areas requiring further study:

- Technology and technology transfer
- Verification of cost-effectiveness
- Education and training

Specific recommendations for research are provided and presented in order of priority in Table 1. Detailed descriptions of the research recommendations are available in the full report.

A proposed priority list of parameters for field testing of sensors was identified for field testing, which is presented in Table 2. Detailed rationales of the proposed priority list of parameters for field testing are available in the full report.

Table 2. Proposed Priority List of Parameters for Field Testing.

PRIORITY	MEASUREMENT	
1	Ammonia-nitrogen DO	Nitrate-nitrogen Turbidity
2	Alkalinity BOD_5 Chlorine Residual COD Conductivity	ORP pH Phosphate Respirometry
3	Flow Level Power	Pressure Pump Run Status UV Light Intensity

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