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PROCESS ANALYZERS

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ChemScan® Application Summary #171 Water Security Monitoring

Statement of the Problem

Consumers are understandably concerned about the possibility of water contamination through accidental or intentional introduction of a contaminant into a water supply. Water suppliers have responded to this threat by increasing the security at water treatment facilities and at source water entry points, water reservoirs, storage locations and at strategic locations within the distribution system.

Most water systems contain large volumes of water and would require substantial volumes of a contaminant to impact the entire system. Nevertheless, selective introduction of contaminants could affect many consumers at a downstream point of use. The potential for dilution offered by the volume of the entire water system is no defense, given the much smaller amount of dilution between some convenient point of contaminant introduction and the nearest points of use on the system.

Indicator Parameters

It would be impossible for water systems to test for every contaminant imaginable. Most contaminants, especially those that are commonly available for legitimate commercial uses or could be manufactured from commercially available materials, would generate a response to at least one but, more likely several of the following **indicator parameters**:

- * pH - an indicator for acidic or caustic sample conditions
- * ORP - the redox potential difference between an indicator electrode and a reference electrode
- * Conductivity – a measure of the ability of an aqueous solution to carry an electrical current. Solutions of most inorganic compounds will dissociate in water, contributing ions that result in an increase in conductivity.
- * Disinfectant residual or demand. Loss of disinfectant residual is an indication of possible microbial contamination. In natural waters that have not been disinfected, a change in disinfection demand can signal a change in the microbial content.

- * Ultraviolet-visible absorbance signature. A variety of organic compounds, nutrients, halogens and heavy metals have strong UV and visible absorbance signatures in water. Organics include unsaturated hydrocarbons and compounds with high molecular weight and high conjugation, aromatic structures and/or substituent groups containing nitrogen, sulphur, halogens and metals. (Organics can also be detected using a TOC analyzer, but uv-vis absorbance provides the capability for detection of organics plus detection of many other substances.)

Indicator parameters are not specific to a particular contaminant but are responsive to many different kinds of contamination including organic, organic-metallic, corrosive, caustic, microbiological, petrochemical and pharmacological. In addition, distribution system pressure should be monitored as a further precaution against tampering.

Multiparameter Baseline Analysis

For any water source or water system, changes in indicator measurements can and will occur as a result of natural processes including:

- * Seasonal changes in source water chemistry
- * Predictable changes in water chemistry due to weather, source water mix, and/or treatment practices
- * Periodic changes in water chemistry due to turnover or demand
- * Normal changes in water chemistry due to the age or location of the water in the distribution or storage system

Indicators cannot identify unusual conditions without a baseline record of the indicator responses to seasonal, environmental and operational conditions.

A baseline record needs to be established at strategically selected locations throughout the distribution system. These may be the same locations chosen for general water quality monitoring purposes, such as at reservoirs, blend connections, disinfection boost points, etc. (See ChemScan Application Summary #169, Distribution System Monitoring and # 170, Reservoir System Monitoring.) Some indicator parameters such as disinfectant residual are identical to those recommended for water quality management purposes.

Two types of baseline comparisons are needed. The **historical baseline** compares current indicator data at a specific location to a base of data for the same or similar set of seasonal, environmental and operational conditions. A **sequential baseline** comparison focuses on the differences in indicator data between two consecutive points in the distribution system. Deviations from the historical or sequential baseline may be cause for investigation. Substantial deviations from the historical and sequential baseline may be cause for alarm.

Water security monitoring systems must include provision for large volume data collection, data communication and data analysis.

ChemScan Analyzer Systems

In order for a security monitoring system to be feasible for widespread use throughout the water system, the monitoring equipment must be sensitive, reliable, automatic, self correcting and capable of long term operation at remote locations with little or no maintenance.

ChemScan has analyzers capable of monitoring the full UV spectrum plus turbidity, color, and disinfectant residual or disinfectant demand. Additional sensors for pH, ORP, and conductivity can be provided in the same sample loop. MODBUS or other digital data communication modules are available for the system. The system includes auto zero and auto clean functions plus maintenance alarms and power outage alarms. Data recorders, auto samplers, auto dialers and other peripheral items can be used in conjunction with a ChemScan system.