Contamination Monitoring

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Small drinking water plant operators seeking to guard against a terrorist attack might want to consider some of the equipment and techniques that they already have on hand. Monitoring systems should be considered potential tools that can be effective in reducing the impact of criminal chemical or biological contamination. Monitoring of water quality can provide early and accurate detection of a breach in any treatment process, and is essential to engaging any countermeasures to the contamination. Let's look at some ways of monitoring for contamination with the knowledge and equipment you may already have.

Chlorine Residual

Chlorine has been used to disinfect drinking water for more than 100 years.
It is currently used to disinfect over 95% of the drinking water in the United States.
You should continuously monitor residuals at the water plant, in the distribution system, and at reservoirs. Maintain the proper residuals throughout the entire system (0.2 ppm free chlorine <u>minimum</u>). An increase in chlorine demand could result from the introduction of significant amounts of contaminants into the water supply. Have a back-up and/or booster chlorine feed system in case of equipment failure or a "demand" emergency.

Oxidation Reduction Potential (ORP)

ORP measures the potential of transfer of electrons in water (in millivolts or mV).
Since most chemical reactions in the aqueous phase can be explained by a transfer of electrons from one substance to another. Changes in chemical constituents in the water will result in a sudden change in ORP as millivolt readings. ORP can detect a very small amount of chemicals because ORP responses are logarithmic making them more sensitive at low levels of oxidant and reductant. (An ORP of 650-700 mV potential will kill E. coli in seconds).

pH / Conductivity

Both pH and conductivity can be used to detect changes in the water due to dissolved substances. Conductivity is the measurement of the dissolved ions in water. A sudden change in pH or conductivity may indicate the presence of a hazardous chemical contaminant. Both are simple to measure and can serve as early indicators of changes from normal baseline operations.

Turbidity

Although turbidity does not have a direct relationship to contamination, it may be used as an indicator of water quality. High turbidities can "shield" some microorganisms from chlorine disinfection and UV, allowing them to survive on in the distribution system. Turbidity monitoring can also serve as an early warning of filter breakthrough due to large amounts of contaminant loading.

Dissolved Oxygen

Dissolved Oxygen (DO) is a major parameter for the survival of aquatic organisms. Contamination of a water supply by organic compounds usually results in a decrease in DO levels. A DO level of l8-15 mg/L is needed for healthy game fish in lakes and reservoirs, while a DO of 4-5 mg/L is borderline for their survival.

Ammonia

An increase in ammonia levels may be the result of the introduction of agricultural wastes or sewage into the water supply or system. Ammonia also has an effect on the reaction of chlorine in water. An increase in ammonia concentration can trigger an increase in chlorine demand. Various ion-selective electrodes are available that can monitor for ammonia, cyanide, nitrate, nitrite, chloride, copper, and lead in water.

Total Organic Carbon (TOC)

A measure of Total Organic Carbon (TOC) gives an indication of the total organic load of the water. TOC can be measured continuously with online instrumentation or by lab analysis. Once a reference baseline has been established, a change in TOC can also be an indication of contamination from organic compounds.

Biological Monitors

This "canary in a coal mine" approach uses aquatic organisms as monitoring devices.
Fish, clams, mussels, daphnia, algae and bacteria can all be used as indicators of water quality. A fish tank supplied with a constant flow of raw water can be used as a biological monitor. The Mohawk Valley Water Authority uses a series of tanks connected together, supplied by raw water, in what they call a "fish avoidance system". If a contaminant is introduced into the influent of the tanks, the fish will congregate near the discharge end of the tanks in an attempt to avoid the contaminant. When putting together a biological monitoring system, always try to use native species if possible.

Increased Monitoring

Increase the frequency at which you monitor and increase the number of sites that you monitor. Continuous on-line monitoring combined with chart recorders and/or alarms are best whenever possible. Watch for any sudden changes or trends in your water quality that could mean possible contamination of your supply or system. The EPA recommends that you sample and monitor all…
Raw water intakes, lakes and ponds
Finished water reservoirs and water towers
Distribution system entry points
Key monitoring locations within the distribution system such as near hospitals, nursing homes, schools or problematic areas of your system

The future of contamination monitoring lies in better monitoring and testing equipment, increased sampling and analysis, and the rapid communication of data. By combining continuous online monitoring with Wireless communication, radio telemetry, SCADA, and the Internet, it is now possible to provide your customers with a rapid and effective contamination early warning system.

Early detection and rapid response to contamination is one of the most important responsibilities of a small system operator. That's why we shouldn't forget that many of the simple tests and duties that we perform everyday can be critical to protecting our water supplies, systems, and customers from chemical or biological attack.
Remain vigilant and keep on monitoring!