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Disinfection

Part 2: Is Chlorine Still the Answer?

As everyone knows, the practice of using chlorine in drinking water treatment has been acclaimed as one of the most significant public health advances of the 20th century, if not the entire millennium. More than 98 percent of water treatment plants use some form of chlorine to treat their water because of several benefits: germicidal potency, sustained residual disinfection properties, taste and odor control, as well as cost-efficiency. Chlorine-based disinfecting agents also are recognized as an effective defense against many biological warfare agents. In the past few years and, more recently, with the signing of the Bioterrorism Act by President Bush, the federal government has increased the effort to keep this nation's water supply safe. Disinfection of the public water supply should not be compromised. Title IV of the Bioterrorism Act indicates that over the next two years, water utilities will be required to perform vulnerability assessments of their water systems in regard to such issues as water collection and treatment; the use, storage or handling of various chemicals; and the operation and maintenance of their water treatment systems.

Water suppliers continually are being challenged to prevent the presence of disease-causing microorganisms in their water systems, and methods of treatment vary depending on site-specific factors as well as the quality of the raw water supply. The importance of water disinfection is evidenced by the fact that most past cases of outbreaks of waterborne diseases were due to inadequate disinfection or no disinfection at all. Alternatives to the use of chlorine have received increased interest since concerns over the formation of disinfection byproducts (DBPs) have emerged. However, most of these alternatives (i.e., chloramine, chlorine dioxide and ozone) also produce DBPs. Less information is known about the DBPs formed by some of the alternatives, and the risks using these technologies may be equivalent or higher. Chlorine still is the most common drinking water disinfectant used today and the one we have the most information about. On balance, the health risks of not chlorinating water appear to be greater than risks associated with DBPs.

Example of a Tablet Chlorination System

The PowerPro chlorination unit incorporates the patented Accu-Tab chlorinator (model shown with automated controller and weigh scale options). The Accu-Tab System from PPG Industries consists of 3-inch calcium hypochlorite tablets with 65 percent available chlorine and patented erosion chlorinators. Long-term reliability makes it a competitive alternative to chlorine gas cylinders and sodium hypochlorite (liquid bleach) for sanitizing water systems.

Emerging national security issues along with complying with other federal regulations such as EPA's Risk Management Plan and OSHA's Process Safety Management have pushed the water and wastewater treatment industry into looking for alternatives. Alternatives for water treatment such as ozone, UV irradiation and chlorine dioxide have been used. Although these other processes do provide efficient disinfection capabilities, each alternative has associated disadvantages. Ozone and UV irradiation do not provide a persistent residual disinfection capability, require high capital investments and have relatively high operating and maintenance costs associated with them. Chlorine dioxide forms organic byproducts and requires on-site generation equipment and the handling of several chemicals.

As mentioned before, chlorine has many benefits. First, the use of chlorine has been demonstrated to reduce the level of microorganisms that cause waterborne diseases. It is easy to apply, and small amounts stay in the water from the treatment plant through the distribution system to the consumer's tap. Chlorine also controls biological growth by eliminating bacteria and algae as well as other organisms. Since chlorine oxidizes natural substances such as decaying vegetation, reduction in odors and tastes occurs. For these reasons, chlorine still is a good choice of drinking water experts. However, in looking for alternatives, one need not go far from the traditional forms of chlorine to find one. Water treatment facilities have been turning to another form of chlorine—calcium hypochlorite—as their system for water chlorination.

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Typically two well-recognized forms of chlorine have been used in water treatment: the use of chlorine gas in cylinders or sodium hypochlorite (bleach) solutions. Due to the physical nature of these chemicals, both of these technologies present specific safety concerns about potential releases and spills and both typically require special buildings and spill containment designs. These chemicals also present handling issues. For example, chlorine gas requires personnel training and use of personal protective equipment when changing cylinders. Similarly, handling drums of bleach is difficult and presents safety issues. Maintenance costs are another factor. Keeping chlorine gas eductors and bleach addition pumps operating efficiently is a chore because the equipment's small orifices are prone to clogging. Bleach loses strength and efficacy over time that can result in increased material costs to keep residual disinfection capability in the system.

Calcium hypochlorite is an alternative to chlorine gas or sodium hypochlorite (bleach) solutions because it is a dry form of chlorine that offers several handling advantages Calcium hypochlorite contains approximately 65 percent available chlorine as compared to the 12 percent in bleach and does not require operator certification or containment areas. Many facilities have opted for a technology using calcium hypochlorite tablet systems as the preferred method of introducing chlorine disinfectant. This technology is selected because of its lower capital costs, accuracy, reliability, safety and maintenance benefits. It has opened new horizons in water chlorination for applications of many types and sizes. Calcium hypochlorite systems have been used for years and currently are being used for drinking water applications in more than 40 states as the primary disinfection treatment or as remote booster chlorination stations. They also have been successful and proven in food processing including fresh vegetables and poultry, pool and spa applications, cooling towers, grain milling and wastewater treatment.

Technology combining calcium hypochlorite in a three-inch tablet form along with a specifically designed patented erosion feeder is becoming a standard in the industry. Tablets are eroded by incoming water from a side stream contacting only those tablets at the bottom of the feeder. The erosion rate is a predictable rate because it is dependent upon water flow to the unit; therefore, chlorine dosage can be achieved by controlling the water flow rate. The chlorinator effluent then is returned to the unchlorinated main system flow, providing the desired level of available chlorine to meet operational requirements. Water plants as large as 14 million gallons/day with chlorine demands exceeding 400 lbs./day have been chlorinated by these systems for years. Smaller units have turndown ability to supply the 35 gpm well water user without overchlorination.

As regulatory requirements and safety issues provide increasing incentive for water treatment plants to reconsider their water treatment systems, it is important to recognize that calcium hypochlorite—the solid form of chlorine—offers safety and low maintenance benefits together with small capital investments. It is becoming the preferred alternative. **WQP**

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