A Tale of Two Cities:

SAFE, EFFICIENT WATER CHLORINATION IN THE 1990S

By Larry Grubb

Summary: A tablet chlorinating system presents a number of pulses in relation to chlorine gas and liquid chlorine for safe, effective disinfect ion of drinking water. Although more expensive on a per unit cost, it offers cost, it offers cost-saving advantages in terms of less maintenance, less staff time required, literally no system down-time, fewer hazardous materials handling requirements such as storage, training and paperwork, and automated operation. Such technology is ideal for wells and small systems. Here is a case study looking at two cities where such a system was installed

You could say it was a potential problem situation for the nearly 5,500 men, women and children served by the Stratmore Hills Water and Sanitation District. One year ago, the Colorado Springs-area water district used chlorine gas to chlorinate and sanitize 300,000 gallons of well water a day. And their system did an excellent job of providing area residents with safe drinking water.

According to District Superintendent Ralph Ravenscroft, however, a review of the system resulted in concern because one of the gas chlorinators was located within 10 feet of a resident's bedroom window, and another was located a quarter mile from a school.

Safety is chief issue

"Safety was our No. 1 concern," says Ravenscroft, as he discussed his search for an alternative water chlorination system.

Fortunately, the Strathmore Hills Water and Sanitation District never had a serious incident at any of their

three wells. However, there were numerous times, says Ravens croft, when he or his employees would walk into a well house and know there was a leak because of the smell. Depending on the concentration, that also can be a serious health hazard.

"There were times when minor leaks resulted in personnel being treated at the hospital," says Ravens croft.

Aside from the safety issue, however, Strathmore Hills was also looking for a system that could reduce their chlorination costs. According to Ravens croft, the time and cost involved in maintaining their gas chlorine system was extensive. If not properly maintained, chlorine gas can corrode metal fittings, copper pipes and electrical connections, making it necessary to replace and repair parts frequently.

It was much the same scenario for the Parma Valley Water Company in San Diego County, Calif. On average, it chlorinates a million gallons of water per day to serve 200 people and feed area orchards. But concern over potential for releases led Parma Valley to begin looking for an alternative to its chlorine gas water chlorination system as well.

"We actually had to wear NASA backpacks when entering areas where the chlorine gas was being stored or used," says Bill Hutchings, a member of the Parma Valley Board of Directors.

The options

Options for chlorine disinfection include chlorine gas, liquid chlorine or a system using a solid, dry chlorine dispenser. In any chlorine system, the efficacy and reactivity is the same because the active ingredient is the same, so there may be some concern about production of trihalomethanes (THMs). As such, these systems should include steps to remove organics, or THM precursors, in the water prior to treatment.

Chlorine gas has been used safely for many years to chlorinate water. It should also be said that this form of chlorine is relatively

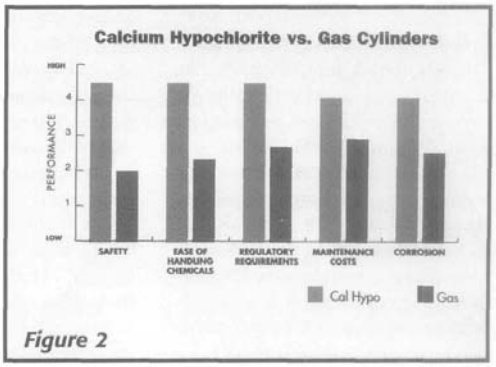

Figure 2

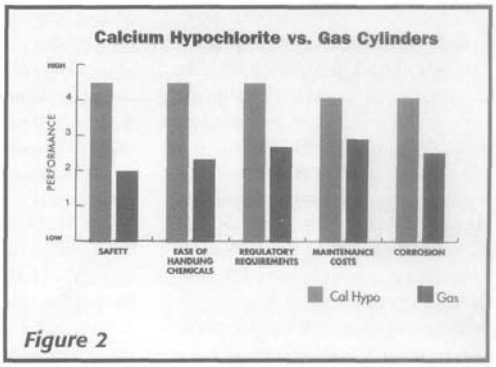

Figure 2

inexpensive on a dollar-per-pound basis, doesn't produce by-products such as chlorite or chlorate ions in storage and is the most common chemical used in water treatment. Chlorine gas cylinders must be kept in separate, vented rooms. Likewise, personnel must be specially trained before servicing the cylinders. The special procedures for shipping, storing and handling chlorine cylinders increase operating costs. Leaking chlorine gas in the presence of moisture also may corrode supply line fit tings, which can create larger leaks

Special equipment is needed to ensure the safety and accuracy of adding chlorine gas to water. The equipment also requires a great deal of maintenance, making the process even more costly. Adding to the problem is the fact that the Occupational, Safety and Health Administration (OSH A) has imposed regulations on record keeping and reporting for chlorine cylinders weighing more than 1,500 pounds.

Certainly, another alternative is sodium hypo chlorite (liquid chlorine). On one hand, liquid sodium hypochlorite is less dangerous than gaseous chlorine and can be easily monitored and administered into product water chlorination systems. However, liquid sodium hypochlorite also has several disadvantages. In storage, the product breaks down over time, losing efficacy and forming by-products chlorates and oxygen. The breakdown of sodium hypochlorite, while insignificant, depends on storage temperature and the presence of impurities in the concentrated product. Product suppliers can inform users of procedures to minimize the presence of contaminants. An important by-product of sodium hypo chlorite is sodium chlorate, which is a by-product of decomposition reacting according to a given ratio. For every one-percent hypo chlorite loss, 0.8 percent sodium chlorate is formed. Thus, if an 8 percent active hypo chlorite product is used to provide 6 parts per million (ppm) of available chlorine in water, it also will deliver 1.5 ppm sodium chlorate. If not properly maintained, sodium hypochlorite can corrode metering pumps and feed-lines. Personnel should wear proper protective clothing when handling concentrated sodium hypochlorite, and the product should not be stored near acid products, since the reaction between acid and sodium hypochlorite will produce chlorine gas.

Faced with increased concerns about safety, Stratmore Hills and Pauma Valley investigated other methods of water chlorination. And when they selected a water chlorination system utilizing calcium hypochlorite, a solid form of chlorine, they were pleasantly surprised.

Advantages of solid chlorine

Calcium hypochlorite, now available in tablet form, is an effective alternative for water chlorination.

It contains about 70 percent hypo chlorite, is safer to handle and can be easily loaded into an accompanying chlorinattor unit. The solid product is significantly more stable than liquid sodium hypochlorite, so the formation of sodium chlorate is essentially eliminated.

Additionally, water chlorination systems using calcium hypo chlorite appear to fare better through the use of this form of chlorine. With no moving parts, such systems are simple to clean, are virtually maintenance-free and have long-term reliability. There are no small orifices to clog and no buildup or residue to remove. The product also significantly reduces corrosion, and eliminates the need for metering pumps and gas regulators. Use of calciumhypochloritc reduces the levels of both sodium and chlorate ions. For example, the addition of 2 ppm chlorine from calcium hypo chlorite will add less than 0.2 ppm sodium ions and 0.04 ppm chlorate ions.

Solid chlorination delivery systems provide consistent, automatic dosing of hypo chlorite. The chlorinators are controlled by water flow, so they deliver a predetermined amount of active chlorine based on water de mand or requirements. Unlike in typical chlorine pellet feeders, there are no moving parts. An inline flow meter is used to accurately dose the required amount of water.

Standard storage procedures should be followed when using solid calcium hypochlorite. Product containers should be tightly closed and stored in a cool, dry place. Solid calcium hypochlorite shouldn't be dis posed of in the trash, since it could react with organic materials, such as oils or greases. As per federally required Material Safety

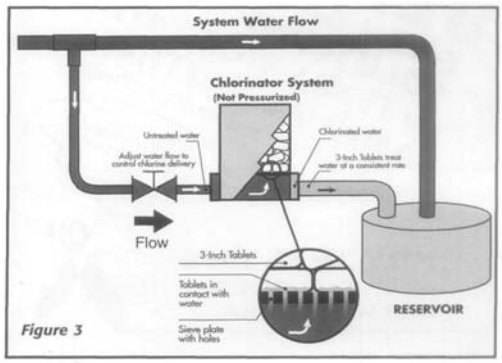

Figure 3

Data Sheets (MSDS), the product should be swept up and dissolved in water, which should be disposed of per local regulations. Additionally, it may be neutralized with hydrogen peroxide.

For residential wells, calcium hypochlorite is just as effective as chlorine gas or liquid bleach. Feeding calcium hypochlorite directly into the intake line of the well pump is the best use of the compound. Even if it's not possible to locate a feed at the intake line, well owners can feed calcium hypochlorite anywhere in the pump discharge line.

Preferred method for some

For Stratmore Hills and Pauma Valley, the decision to switch to a calcium hypochlorite water chlorination system proved to be a good one. Ac cording to Ravenscroft, their new sys tem has not only provided his employ ees and community with safer conditions, it provided ease of use and low maintenance. In fact, Ravenscroft says they refer to it as the "idiot-proof" system. It may notbe idiot-proof, but it is a simple system to operate. Additionally, the system provided the water district with a $3,000 per well cost savings and overall operating costs. Stratmore Hills is the first Colorado municipality to use a calcium hypochlorite water chlorination system such as this for drinking water. And now, says Ravens croft, other municipalities in the state are calling him to learn more about the system.

As for Pauma Valley, they too have realized tremendous benefits since making the switch to calcium hypochlorite, including a one-third cost reduction in overall operating costs. "The calcium hypochlorite system is very simple and easy to maintain— and that's what I wanted," says Hutchings. "We've not had one bit of trouble."

Conclusion

Today, 98 percent of drinking water in the United States is treated with chlorine as the preferred method of sanitizing and disinfecting. In fact, more than 200 million Americans rely on chlorine every day to give them safe water for everything from brushing their teeth and making their morning orange juice and coffee to cooking, washing, cleaning, swimming and, of course, drinking. The water industry may still debate the best method of water chlorination, but Strathmore Hills and Pauma Valley are already convinced of the best method for their water districts. Both have taken a step toward maintaining the quality that comes from water chlorination but have managed to do it safely and efficiently with the help of calcium hypochlorite. □

About the author

♦ *kharry Grubb is account manager for PPG Industries' Calcium Hypochlorite Chemical Group in Pittsburgh, Pa. Last fall, PPG re leased a new product, Cal-Hypo, for the residential well and small system water treatment markets. Grubb has been with PPG for 18 years. He can be reached at (800) 245-2974 or (412) 434-3695 (fax).*