

# Question of the Month

ADVICE FOR SMALL SYSTEMS

## How Should We Respond to Unusual Chlorine Demand?

BY SCOTTY BOGGS

**Unusual chlorine demand can trigger further testing and investigation before complaint calls come in. Operators can monitor pH and breakpoint chlorination and take steps like flushing to regain optimum chlorine residual levels. They also need to account for seasonal fluctuations, unusual events, distribution system configuration, and other local factors.**

**U**nusual chlorine demand isn't something to be brushed off or taken lightly. It's an important indicator with deep-running influence. How do you notice it? Experience and two sources recently brought my attention to the issue, but you might notice it after receiving a customer complaint of taste or odor issues. Responding to unusual chlorine demand requires investigation.

### BREAKPOINT CHLORINATION

To practice breakpoint chlorination with free chlorine where you maintain 85–90 percent of total residual as free available chlorine, you must first accomplish the oxidation of elements that might otherwise create odors. If this is done properly, with 85–90 percent of free chlorine existing in your total residual, no taste or odors should be detected.

If free chlorine is taken too far past 90 percent of the total residual, you'll likely get a call or two. If free chlorine is less than 85 percent of the total residual, all of the elements that may be in the process of breaking down can cause some funky tastes and odors, which potentially could lead to more calls.

### BACTERIOLOGICAL MONITORING PROGRAMS

Unusually low chlorine residuals noted during monthly bacteriological monitoring programs can indicate a demand change. Such samplings record chlorine residuals monthly. Residuals falling below a certain acceptable level should trigger more intensive and specific residual testing to see if a problem exists that may otherwise go unnoticed. The numbers are

there; make them useful. If a total chlorine residual test proves that free available chlorine has fallen below the breakpoint, you can—and should—investigate why.

Bacteriological monitoring programs help operators detect distribution contamination. No matter the source, a sudden uncharacteristic drop in chlorine residuals can be a good indicator of contamination—most likely from backsiphonage resulting from improper plumbing or a temporary cross-connection.

Think about it: Some contaminants could be harmful without influencing the presence or absence of total coliforms. But chances are that the pH or some element might influence the chlorine residual and be detected. We normally don't monitor pH in the distribution system when we collect bacteriological samples. But a drastic change in chlorine demand should trigger more intensive investigation, including breakpoint chlorination and pH. If localized, a condition might indicate a problem that flushing could help considerably.

Dead-end lines and blowoffs in the distribution system need to be on a regular flushing schedule to freshen water that may have become stale. I have personally seen evidence of biogrowth in a distribution line. The area had low residuals, but they increased significantly after a good flushing. Something was using up that chlorine.

### FIELD EXPERIENCE

Summers are hot in central Arkansas. Sometimes we maintain adequate raw supplies but have a difficult time meeting production demand. Last summer, I noticed that water was leaving our surface water plant at about 80°F—

atypically high, as it normally averages in the 50s. The higher temperature required a higher chlorine dose, which also dissipated faster. Some customers complained their tap water was unusually warm. All I could offer was ice! Later that fall, we began to notice lower than normal chlorine residuals. Unfortunately, we even had a total coliform positive sample. That got our attention quick.

Investigating the distribution tanks, we found low residuals leaving some key tanks and other tanks receiving low residuals. Normal residence time was consuming the tanks' remaining residuals. A plan was developed to perform more aggressive drawdowns in the distribution tanks by altering pump station on-off levels.

Our goal was to freshen old water stuck at the top of these single inlet-outlet tanks. We noticed some residual increase but not as much as we had hoped for from our limited efforts. A lot of companies sell mixing systems to help utilities with old or stale water levels layered in storage tanks. A tank warms during the day and heats the water inside, and the warm water rises to the tank's top. Higher-density cool water that remains at the bottom flows in and out of the tank, depending on pumping and demand. An older and possibly stale layer can become trapped in the top portion of a tank.


According to our state regulatory agency, some rural systems occasionally "overflow" their tanks intentionally. I used to think this practice folly, but it might be a good idea in certain situations. Tank thermoclines can negatively affect residuals and contribute to disinfection by-product formation. We have one modern standpipe designed to help inhibit thermoclines by having an inlet at the top of the tank and an outlet at the bottom. In this case, the tank is oversized to meet future growth. Freshwater with good residual

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enters the top of the tank, passes through the thermocline, and sinks to assimilate with stored water. This process seems effectively to remove the residual, as there isn't enough flow to keep the tank fresh. Treated water with a residual of 1.5 mg/L free chlorine goes into the tank, but the first house downstream barely has a measurable residual. We may have to install a booster chlorine feed system.

In another event, an odd set of circumstances created by heavy winds and snow resulted in power outages and conditions in which we almost emptied a couple of the tanks we'd been struggling with. Evidence was mounting that we indeed had some stale water from the previous unusually hot summer weather. Seemingly this water, treated two months before, remained an influence in the tanks. When we nearly ran the tanks out and refilled them almost completely with fresh treated water, the chlorine residuals immediately jumped up. The evidence was clear.

#### LESSONS LEARNED

In reviewing these conditions, the importance of noting an unusual chlorine demand is obvious. Something caused it, and something is using up the residual disinfectant. It could go away and sometimes does. But for the sake of public health, peace of mind, and liability concerns, don't ignore it. It's far better to investigate the situation more in-depth. At the least, you have a paper trail proving the incident was noted and professionally addressed. At best, you may have done your community a service that will make you and your utility proud. 

#### RESOURCES

- AWWA Manual of Water Supply Practices M20: *Water Chlorination and Chloramination Practices and Principles*, 2006 (catalog No. 30020).
- Lauer, W.C., 2013. *Water Distribution Operator Training Handbook*. AWWA (catalog No. 20428-4E).

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