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## Investigating Chlorine Monitoring Options for Water Conservation and Safety

A California city solved its water waste and infrastructure challenges with a new in-pipe chlorine sensor.

BY MICHAEL SANTILLAN, DERWIN DY, DEREK NGUYEN, AND MICHAEL SILVERI

**T**HE WATER SUPPLY for the City of Lakewood (Calif.) is 100% groundwater. The city draws all of its water from the Central Basin aquifers and pumps approximately 6,500 acre-feet of groundwater per year, operating 11 deep wells with approximately 180 miles of water mains that range from 4–27 inches in diameter. The city also has three water storage facilities, which hold approximately 13 million gallons, and two treatment facilities.

In 2018, the city started looking for a chlorine sensor that wouldn't require a waste stream, as some of its wells don't have the infrastructure to effectively drain the waste stream generated from its existing chlorine analyzer. The city verified chlorine residuals by collecting daily grab samples at several well locations. However, this process wouldn't notify operators if, for whatever reason, chlorine wasn't injected into the distribution system. This issue could result from air-locking, chlorine feed pump failure, or a break or leak from the chlorine feed line.

In addition, water consumption was a factor for the city. The city's amperometric sensors and *N,N*-diethyl-*p*-phenylenediamine (DPD) instruments required a waste stream of up to 69,000 gallons of water. This amounts to 0.2 acre-feet of water per year. At the city's billable

rates, this is \$690 per year in nonrevenue water. A primary concern in California is water consumption. After almost a decade of drought, California water agencies are looking for ways to conserve water.

### THE SEARCH BEGINS

The city started searching for a wet tap chlorine analyzer that was approved by the National Science Foundation (NSF)

and American National Standards Institute (ANSI) and didn't generate a waste side stream. After several months, the city found a company, Halogen Systems, which advertised a chlorine analyzer for seawater use. Although the analyzer wasn't NSF/ANSI 61-approved, the city worked with the company on trial projects to determine whether the analyzer would meet its needs.



Photo 1. Results from the initial flow-cell installation were accurate within 0.04 mg/L of the city's existing analyzer.

The City of Lakewood, Calif., uses a wet-tap chlorine analyzer to continuously monitor chlorine residuals throughout its distribution system.



**First Trial: Flow-Cell Version.** In April 2021, Halogen Systems developed its first prototype, and the city tried the flow-cell version of the company's MP5 sensor at one of its booster stations. The best way to test the new analyzer was to compare with the existing analyzer at the booster station, so the flow-cell version was installed to track chlorine residuals from the same sample tube (Photo 1). Data were collected for several months.

The new sensor was installed without any flow regulator, start-up configuration was simple, and results were accurate within 0.04 mg/L of the existing analyzer. During the next six months of

operation, the new sensor didn't require any calibration and needed only minor maintenance to clean the cells from manganese buildup. After six months of operating with both sensors, the city decided to take the existing sensor offline. The city was confident that monitoring results from the Halogen Systems' flow-cell analyzer were accurate and reliable. The city continued to check accuracy by collecting grab samples after the old sensor was removed.

The city's experience with other membrane-style amperometric sensors is that they require regular calibration in addition to other periodic maintenance. The Halogen MP5 was different,

with features such as being flow-independent and self-cleaning. It has been operating since April 2021 and started up with no calibration or flow adjustment. There was a 0.05 mg/L difference in DPD, with no drift.

**Second Trial: Wet-Tap, In-Pipe Version.** The flow-cell version worked well, but the city was particularly interested in the company's wet-tap, in-pipe version of the sensor. Once Halogen Systems had received NSF/ANSI 61 and NSF/ANSI 372 certification, the city tested the wet-tap version. Because it was the first wet-tap installation, there were a few setup issues. However, once the bugs were worked out, the sensor was installed at a well location where there was no ongoing monitoring. The wet-tap sensor's results were compared with grab samples, and its performance was similar to the flow-cell sensor. Shortly after installing the wet-tap sensor, a notification was sent to plant operators that the chlorine residual had dropped. An operator was able to quickly resolve the issue. However, without the wet-tap sensor, the well may have continued to deliver water to the distribution with little chlorine residual. The city realized the importance of continuous monitoring at each well location.

#### TWOFOLD SUCCESS

During two years of operation, the wet-tap sensor hasn't required calibration or service, and the city intends to deploy the sensor at other well locations as needed to help continuously monitor chlorine residuals delivered throughout the distribution system. The sensor also helps the city detect water age problems as well as measure monochloramine and free chlorine. Having served as a test case for Halogen Systems' new product, the city successfully concluded its search and provided the company with valuable feedback to consider for future upgrades. 