# DO odor control

By Inken Mello

## California water district limits $H_2S$ odor using a DO system

*The Moulton Niguel Water District (MNWD) serves 167,000 residents in southern Orange County, Calif. The Wastewater Department maintains 537 miles of sewer pipelines and 17 lift stations. A stringent preventative maintenance program helps keep wastewater pipes free of blockages and identify structural deficiencies early. For the last several years, MNWD has had fewer wastewater incidents than any other district in Orange County.*

Figure 1. $H_2S$ in Interceptor Manhole Before $ECO_2$ Startup

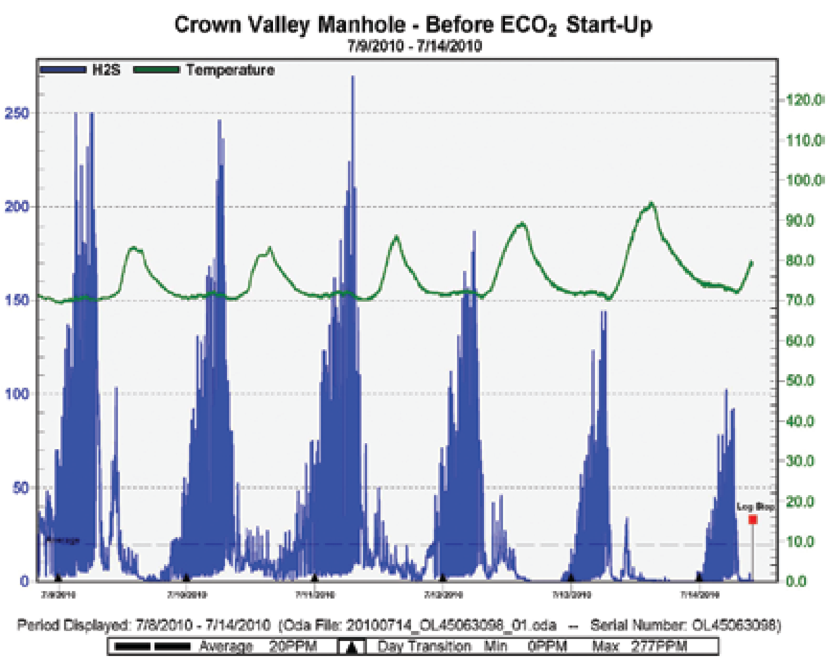
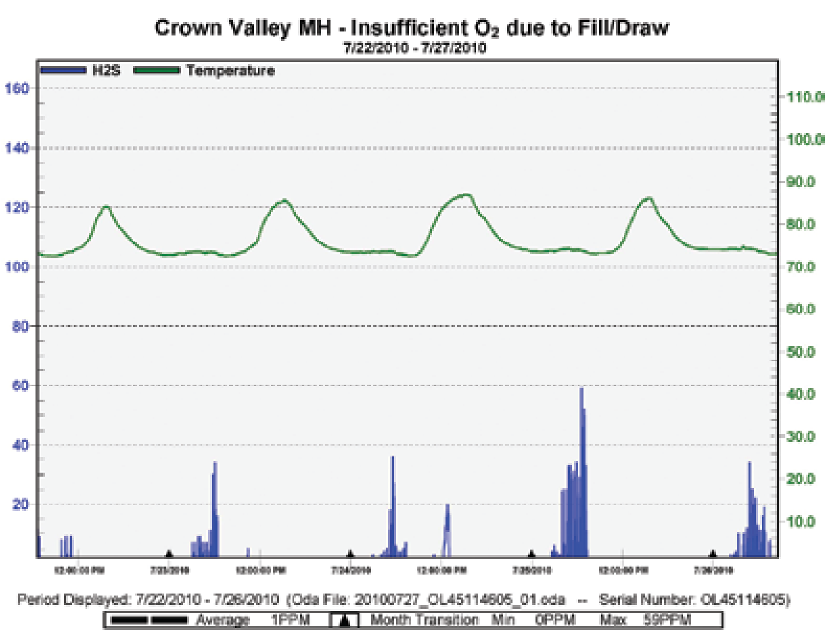



Figure 2. Insufficient $O_2$ Due to Fill/Draw




Besides ensuring reliable wastewater service, the MNWD Wastewater Department prides itself on being a good neighbor. Part of that means providing an odor-free environment, which is not easy when dealing with wastewater.

Hydrogen sulfide ($H_2S$) is the rotten-egg odor that is typically associated with wastewater systems. Long force mains are often a significant source of $H_2S$ due to the septicity of the wastewater. Bacteria in the slime layer of the pipe wall require an oxygen source to consume the biochemical oxygen demand in the wastewater. The preferred source of oxygen is, naturally, dissolved oxygen (DO). Once the dissolved oxygen is consumed, bacteria will use nitrates and then sulfates as an alternative oxygen source. Sulfur-reducing bacteria (SRB) will convert sulfates to sulfides under anaerobic conditions and produce $H_2S$.

Oxygen is consumed rapidly in force mains, resulting in anaerobic conditions and sulfide production. At the point of discharge, these sulfides will come out of solution as $H_2S$. This foul-smelling $H_2S$ accumulates in the headspace of gravity lines, causing corrosion and odor complaints as it escapes through manholes and vent shafts.

MNWD has two force mains that discharge into the same gravity line. Odor problems have been persistent at the converging manhole. The district previously used an air-scrubbing device to pull odorous air from the manhole that was then treated in an ultraviolet system followed by a carbon scrubber. Though the unit appeared to remove most of the $H_2S$ from the air, neighbors reported a bitter smell from the exhaust. In addition to not entirely eliminating the odor complaints, the unit also required a significant amount of maintenance due to the replacement and disposal of carbon and fluorescent lights. These issues led the district to explore other options for odor control.

Because extracting the right amount of air from a sewer system and installing an appropriately sized air scrubber nearby can pose a challenge, MNWD decided to look into liquid phase treatment options. Ferris chloride was tested for a year. The district's maintenance personnel were dissatisfied with the discoloration of the wet well and force main pumps. Damage also was reported on facility surfaces that came in contact with the ferris chloride. MNWD continued its search for alternative options.

MNWD is a member of South Orange County Wastewater Authority (SOCWA). Through this association, the district was familiar with the successful installation of a SuperOxygenation System providing odor control in neighboring Laguna Beach, Calif. MNWD decided to persue this technology.

### The Solution

The Upper Salada Pump Station pumps an average of 820 gal per minute (gpm) through 12-ft-8-in. dual force mains over a distance of 6,700 ft. It discharges at the top of a hill and flows by gravity into the receiving interceptor. The hydraulic retention time (HRT) in the force main is up to four hours.

An $ECO_2$ SuperOxygenation System was installed in the summer of 2008. It dissolves enough oxygen to prevent the formation of $H_2S$. The system operates by oxygenating a sidestream to extremely high levels—in this case, about 60 mg/L DO, which is then blended back into the force main to provide sufficient DO to maintain aerobic conditions throughout the length of the force main. The oxygen uptake rate by the bacteria in the slime layer of this pipeline is approximately 10 mg/L per hour. For four hours of hydraulic retention time, therefore, 40 mg/L of DO is required to satisfy the oxygen demand. Additional oxygen is added to oxidize any existing sulfides that are formed upstream or in the wet well. A positive DO carries through the force main discharge, which has a carryover effect into the gravity interceptor.

The 4-ft-diameter $ECO_2$ Cone dissolves 400 lb of oxygen per day at an efficiency of 95%. Sulfide production was prevented successfully in the Upper Salada Force Main, and $H_2S$ levels in the gravity line dropped to near nondetect.

Due to the success of this first installation, MNWD decided to install a second system on the converging force main to eradicate $H_2S$ in the downstream interceptor. The Lower Salada Pump Station pumps 550 gpm through a 12-in.-diameter, 9,420-ft-long force main into the same gravity

**Figure 3. $ECO_2$ System Operational**

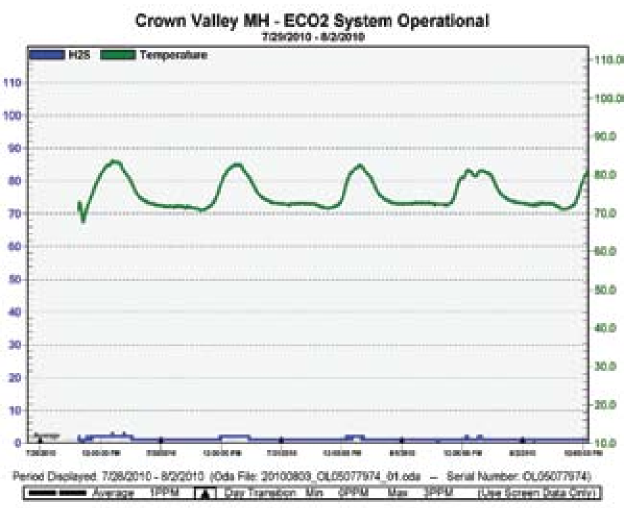
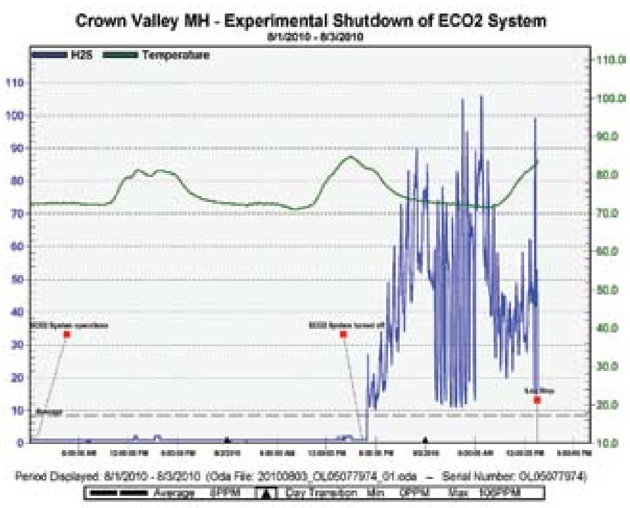



**Figure 4. Experimental System Shutdown**




interceptor. The hydraulic retention time was calculated to be five hours in the force main, and a similar 4-ft-diameter cone was designed for this pump station.

$H_2S$ concentrations were logged in the downstream interceptor prior to system startup. Daily peaks reached $H_2S$ concentrations of 150 to 277 ppm (see Figure 1, page 40).

Upon startup of the $ECO_2$ system, $H_2S$ concentrations were lowered to 0 ppm for most of the day. The $H_2S$ data logger still recorded short daily spikes of 20 to 60 ppm (see Figure 2, page 40). A review of the operating parameters of the pump station revealed that the force main pumps did not operate continuously as anticipated, but in a fill/draw cycle during low-flow periods of the day.

Oxygen can be added to the force main only while the force main pumps are running. The times that the force main pumps are off contribute to an increase in the overall HRT of the wastewater in the pipe, thereby increasing the amount of oxygen needed to sustain aerobic conditions. Additional DO is required to account for these longer hydraulic retention times. Adjustments were made to the oxygen feed rate, and now the $ECO_2$ system is able to even out these spikes and reduce the $H_2S$ levels in the interceptor to 0 to 2 ppm consistently (see Figure 3).

## Follow-Up Test

By adding a sufficient amount of DO to the force main, the oxygen uptake rate of the bacteria can be satisfied, whereby the bacteria uses DO for an oxygen source rather than reducing sulfates to sulfides. Sulfide formation is prevented by adding a sufficient amount of DO.

On Aug. 2, 2010, the MNWD ran a test by turning off the $ECO_2$ SuperOxygenation system for a day to see the effects of DO consumption and $H_2S$ production (see Figure 4). $H_2S$ concentrations started to build up again right after the DO was consumed fully. This demonstrates that once DO is eliminated, SRB start to use sulfates as an oxygen source, reducing them to sulfides and producing odorous $H_2S$. WWD

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