OMCTS – International Odour Conference

The City of Milford, CT combats Odor and Corrosion with SuperOxygenation

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The City of Milford, CT has an extensive sewerage system that has been plagued by odor complaints for many years. High levels of hydrogen sulfide (H2S) have caused severe damage to the sewer system, a key pump station and the wastewater treatment plant itself. The main cause of the problem was isolated to 13,200ft long, dual force mains, carrying an average of 3MGD from the Gulf Pond PS into the East/West Interceptor and ultimately, another mile to the West Ave. PS. Measurements of atmospheric H2S in a manhole downstream of the force main discharge were as high as 900ppm.

All of the manholes on the East West Interceptor were badly deteriorated and the ductile iron sewer had developed perforations along the spring line of the pipe and had to be replaced. Effects of H2S at the WWTP were not as severe as at the West Ave. PS, but still noticeable, including metal corrosion and persistent odors.

AECOM used a two pronged approach to eliminate the generation of hydrogen sulfide. The first part consisted of flow optimization to reduce the hydraulic retention time in the force main.

The second part consisted of introducing a sidestream flow saturated with pure oxygen to satisfy the oxygen demand in the force main. The combination of efforts has been successful in eliminating odors in the

downstream sewer system and has eliminated hydrogen sulfide in the West Avenue Pump Station wet well.

Pump Station Modifications

Flow meters, motorized valves and a PLC were installed to control the usage of the two force mains.

At low flows (0-2 MGD) the valve to the 24'' force main is closed and only the 20'' force main is used, reducing the hydraulic retention time to its minimum. At normal flows (2-5 MGD) the force mains are programmed to alternate every 2 hours to prevent sewage in the inactive force main from becoming septic. During times of high flows (5-7 MGD) the 24'' force main is used and for the occasional rain event and flows over 7 MGD, both force mains will be opened.
By matching force main usage to pump station flow, detention time in the force mains is reduced. While this does not completely eliminate the generation of hydrogen sulfide, it does reduce it and it reduces the amount of oxygen needed.

SuperOxygenation System

The oxygen system selected for the Gulf Pond Pump Station in Milford is simple yet very effective. A sidestream wastewater flow is taken from the discharge header of the sewage pumps and is saturated with pure oxygen before being reintroduced to the force main. Adding dissolved oxygen to the force main helps maintain aerobic conditions, under which sulfide formation is prevented. Using a sidestream system, prevents the entrainment of oxygen bubbles into the force main and the potential of airlocking pipe or pumps. The City of Milford chose Liquid Oxygen (LOX) as an oxygen source, but alternatively gaseous oxygen could also have been inexpensively generated on demand with an on-site oxygen generator. The system utilized to dissolve the oxygen in the wastewater stream is the ECO_2 SuperOxygenation System, furnished by ECO Oxygen Technologies, LLC. The heart of the system is the Speece Cone, which disperses the oxygen into the wastewater and dissolves oxygen at an average 95%

transfer efficiency (Testing done during startup of the system indicated 95% to 98% oxygen transfer efficiency). The system employs no moving parts other than the side stream pump and all openings are a minimum of 4'' in diameter, capable of passing dirty wastewater, and minimizing maintenance requirements.

The oxygen system is sized to provide sufficient dissolved oxygen to satisfy the oxygen uptake of the sewage in the force main during its travel from the pump station to the point of discharge.

The basic concept of the oxygen system for the Gulf Pond Pump Station is that it is only required when flows are at or below average flow, when detention time in the force main is approaching two hours or more. An estimated value, based on experience, of 5 MGD was chosen as the break point, with the oxygen system turned off for flows above this value. This value is operator adjustable in the oxygen system control panel; however this value has proven to be acceptable so far in practice.

The sizing of the cone and the magnitude of the sidestream flow were determined by the system supplier based on the concentration of oxygen required in the force main and the pressure in the system. The oxygen system was designed to deliver 1,000 lbs/day to the 24" force main and 650 lbs/day to the 20" force main.

Performance Testing

Performance testing of the oxygen system was done in June 2012. During the week of sampling, typical wastewater flows were between 3.8 and 4.4 MGD, which is higher than what would be expected under dry, summertime conditions. As a result, wastewater sulfide concentrations and headspace H_2S levels were lower than under peak, summer conditions. Hydrogen sulfide was continuously monitored in the headspace of a sewer manhole just downstream from the discharge of the Gulf Pond force mains (Figure 2) and in the headspace of a sewer manhole one mile downstream in the East/West Interceptor just upstream of the West Avenue Pump Station (Figure 3). Odalog H_2S dataloggers were utilized to monitor the H_2S Both figures demonstrate that when oxygen was added to the force main at the Gulf Pond PS, sulfide generation in the force main was eliminated. At the FM discharge prior to oxygenation, H_2S peaks of close to 90 ppm were

recorded, with an average H_2S of 3.8 ppm. At the West Ave manhole, peaks were over 40 ppm H2S with an average of 7.3 ppm. As shown in Figure 3, a small peak of H_2S was noted on June 22 after the oxygenation system had been operating. This was due to a brief outage of the system caused by a "communication failure". Oxygen flow was re-established within one hour of the shut-down and the H_2S concentrations returned to zero.

The oxygenation system has proven to be highly effective in preventing the generation of hydrogen sulfide in the Gulf Pond force main. At the design oxygen dosage of 1,000 lbs/day at a wastewater flow rate of approximately 4 MGD, the dissolved oxygen concentration at the end of the force main increased by an average of 7 mg/L over background levels without oxygen. With the oxygenation system operating, no sulfide was detected in the force main discharge, and hydrogen sulfide levels in the headspaces of two downstream manholes were reduced to 0 ppm.

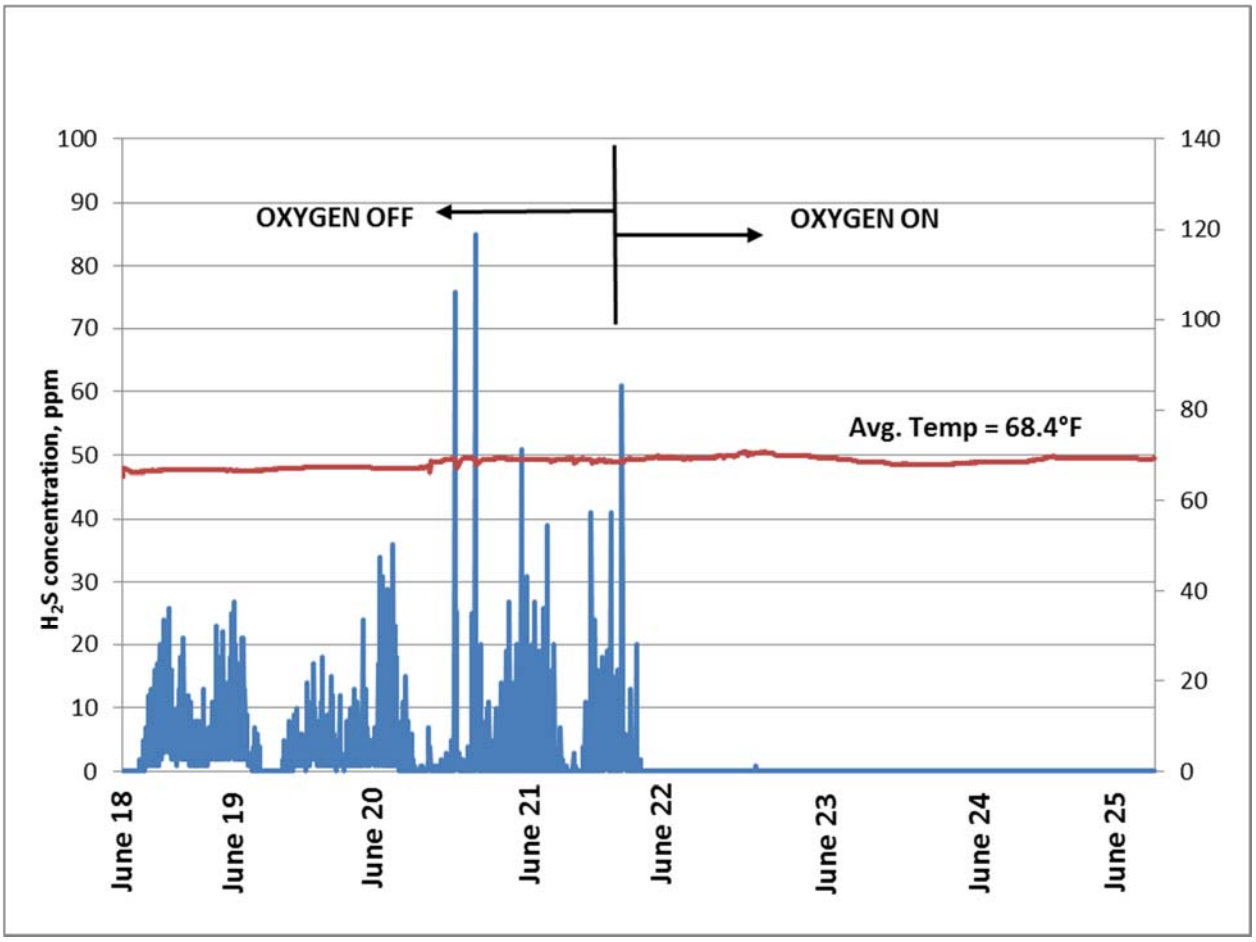

FIGURE 2: H_2S Concentrations at Gulf Pond Force Main Discharge (SuperOxygenation System off and on)

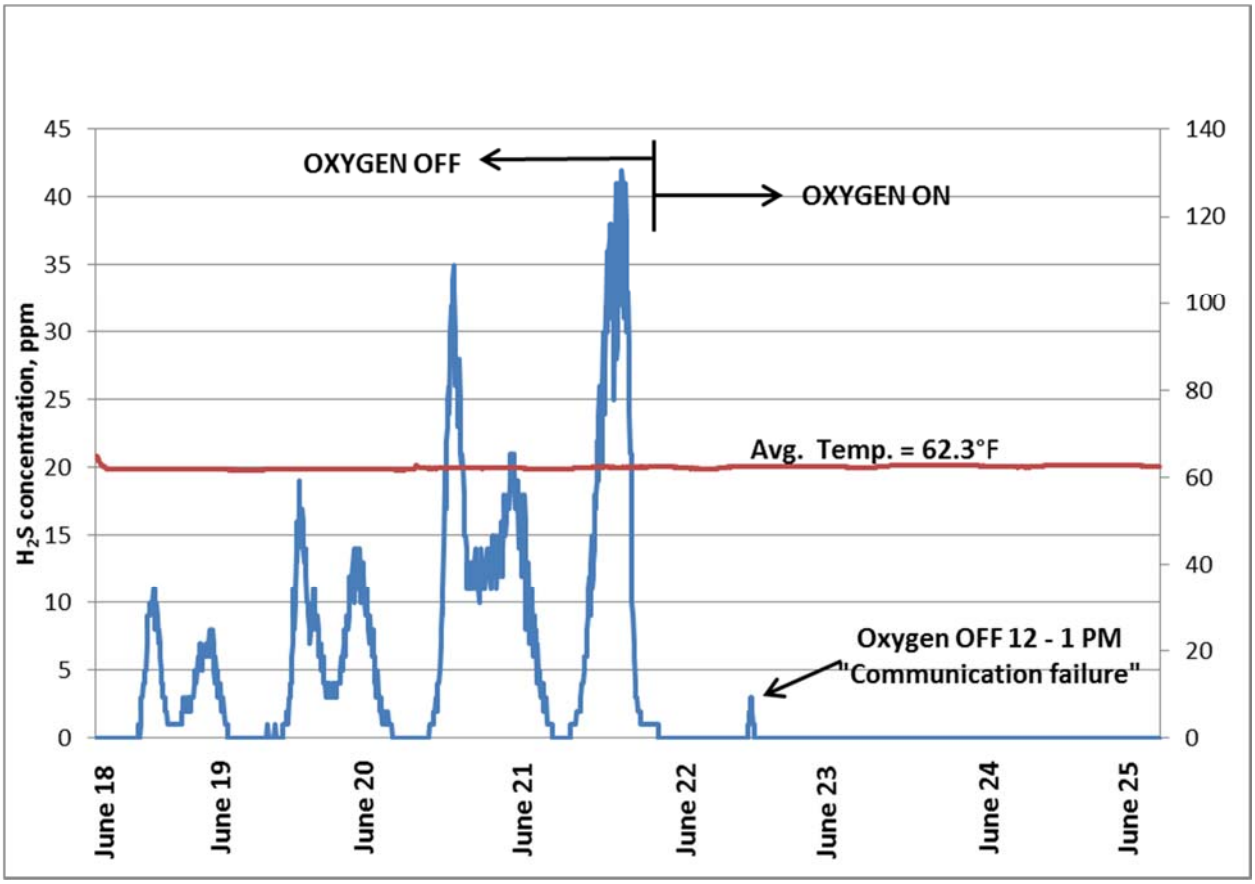

FIGURE 3: H_2S Concentrations at West Ave Pump Station 1mile downstream
(SuperOxygenation System off and on)

Summary: A success for the community and City workers

Prior to the installation of the oxygen system at the Gulf Pond Pump Station, the odors along the downstream sewer route were pervasive. Odors were noticeable to cars driving by on the nearby interstate highway, and odors limited any outdoor activities in the senior condominium complex adjacent to the West Ave Pump station.

When the oxygen system was turned on for the first time in April 2012, the change was immediate. An area known for its sickening odor now had clean air, with no hint of hydrogen sulfide. The West Avenue Pump Station wet well, previously a dangerous work environment now had zero levels of

hydrogen sulfide. Work has recently been completed to repair the damage done to the concrete structure in the West Avenue Pump Station. The East-West Interceptor was replaced after it was severely corroded. The usage of the oxygen system will prevent damage to the new systems in the future as well as damage to the downstream wastewater treatment facilities.

The City of Milford has found that operation of the system is very economical, approximately $60/d at its maximum oxygen usage. Minimal maintenance of the system is required. In the future as they gain experience with the system it is expected that they will be able to fine tune the process by varying the oxygen feed rates, perhaps on a seasonal basis. They will also be able to better determine the range of flows where oxygen usage is not necessary.

Gulf Pond Pump Station, Milford, CT

Milford SuperOxygenation System & Controls