SAMPLING SAVVY

Operators find better ways to collect gas samples and test dissolved oxygen

Sam McAdoo

The Hampton Roads Sanitation District (HRSD; Virginia Beach, Va.) completed a hydrogen sulfide baseline monitoring program throughout its interceptor sewer system as part of a consent decree requirement. The program sought to establish relationships between hydrogen sulfide in the wastestream and internal collection systems corrosion so that HRSD can prevent or minimize odor complaints, protect assets against corrosion, and minimize health and safety concerns related to hydrogen sulfide. The program involved collecting headspace gas samples and testing the dissolved oxygen (DO) content of the water in the interceptors.

About 90% of the interceptor sewer pipeline is pressurized leading to challenges to assess the characteristics of the wastewater in the pipeline and the characteristics of gas pockets. Throughout the program, HRSD staff made several improvements to the sampling techniques to obtain more accurate results. The improvements increased safety (switch to nonsparking equipment) and decreased and/or isolated potential sources of contamination.

BY USING TUBING INSIDE BLOW PIPES, HRSD OPERATORS WERE ABLE TO REDUCE THE AMOUNT OF GAS TO BE PURGED FROM 3 L TO 0.3 L. THIS CHANGE HELPED TO COLLECT MORE RELIABLE HEADSPACE GAS SAMPLES.

All photos courtesy of Sam McAdoo

Less purge

HRSD uses blow-off pipes to collect headspace gas samples. Initially HRSD's blow-off pipe was adapted to collect a large air sample in a Tedlar bag. This required samplers to bleed off the 3 L of air that the blow-off pipe housed to get a good sample of the headspace gas. Using this method led to samples containing high levels of nitrogen and oxygen from being contaminated by the ambient air in the blow-off pipe.

So, the first fix HRSD created was a reduced volume air-sampling device to minimize the gas purge volume. The modified air sample tube uses a small hose to reduce the internal volume of the vent tube by 99% from 3 L of ambient air to 0.3 L. This allowed for quick purging of ambient air, which proved to be very valuable, especially during winter months where gas pockets were much smaller and there was less gas to sample.

Force main gas samples generally require a full 5-L Tedlar bag. In cases of limited gas, more reliable samples

can be obtained with the reduced volume-sampling device. Samples that were fully purged showed greatly reduced oxygen levels.

DO stick

HRSD also developed a method for *in situ* DO sampling. At the beginning of the program, DO readings were higher than expected in the 0.2 to 0.6 mg/L range likely due to air entrainment during sample transfer. The existing technique for sampling was to collect a wastewater sample from the force main in a small container and insert a DO probe into that container. The free fall of the wastewater into the container concerned the team that the wastewater may be getting aerated during sample collection. That concern led to the creation of the DO insertion probe, which is inserted directly into the pressurized main to collect a DO sample.

The solution involved fabricating a device that allows for the insertion of an optical DO probe into a pressurized force main. The first step was identifying the depths of the air vents that would need to be sampled so that the probe apparatus would be long enough to reach undisturbed wastewater in the force main. Next, HRSD implemented a squeeze-plug design that is used for stopping air vent riser leaks and modified it to allow a tight tolerance around a shaft that would be used to push the probe into place while keeping back pressure – typically between 138 and 207 kPa (20 and 30 lb/in.^{2}) – from spraying around the shaft and exposing employees and the environment to wastewater.

The optical probe was sensitive to contact with debris. To keep the probe from getting contaminated, the operators machined an aluminum housing to allow the probe to come into contact with wastewater in the force main without encountering the heavy debris that can be expected in a collections system.

The apparatus was used successfully in the field at multiple sites, but after comparing the DO levels between the two collection methods there proved to be very little variation in the results. The insertion probe being the more difficult of the collection methods was retired, but it did relieve concerns of contaminated samples with the preliminary DO sampling method.

Sam McAdoo *is a system manager for the Hampton Roads Sanitation District (Virginia Beach, Va.).*

THE LONG RISER PIPE HAS A TAPERED END TO MAKE INSERTION EASIER. THE RISER COUPLING (COPPER PIPE AT LEFT) ATTACHED TO THE FORCE MAIN AIR RELEASE VALVE. THE HANDLE ASSEMBLY (RIGHT) ENABLED THE OPERATOR TO GRIP THE RISER PIPE AS IT IS SHOVED INTO THE FORCE MAIN. AN OPTICAL DISSOLVED OXYGEN PROBE IS INSIDE THE RISER PIPE. THE HOLES PARTWAY UP ALLOW THE WASTEWATER TO CONTACT THE PROBE WHILE PROTECTING IT FROM DEBRIS IN THE LINE.

USING AN *IN SITU* OPTICAL DISSOLVED OXYGEN PROBE – SEEN HERE INSERTED INTO THE BOTTOM PORTION OF THE RISER PIPE – IN THE FORCE MAIN ELIMINATED WORRIES THAT PULLING SAMPLES OUT OF THE PIPE FOR MEASUREMENT WAS INTRODUCING EXTRA DISSOLVED OXYGEN.