

Odor and Corrosion Control in Wastewater Collection Systems

Utilizing Sustainable Treatment Gases: Oxygen and Ozone

Part 4 of 5

See Parts 1–3 on modernpumpingtoday.com

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In order to effectively rate the successful treatment of the force main, a background against which to make a comparison must be provided. In this instance, the municipality had used the same third party testing service to quantify H₂S emissions from MH1 and 3. The

baseline data, provided from June 30 – July 8, July 12 – 22 at MH1 and July 15 – 21, 2011 at MH3, does not occur immediately before the MDU test, but is recent enough to provide a good representation of the potential H₂S levels present in these manholes. The OdaLog charts for these dates are

included below, figures 1 – 3 are for MH1 and 4 – 6 for MH3.

The first thing that should be noted is that in each chart there is significant “clipping”, as indicated by the plateau’s that occur at the peak values on each chart. This indicates that the H₂S concentrations

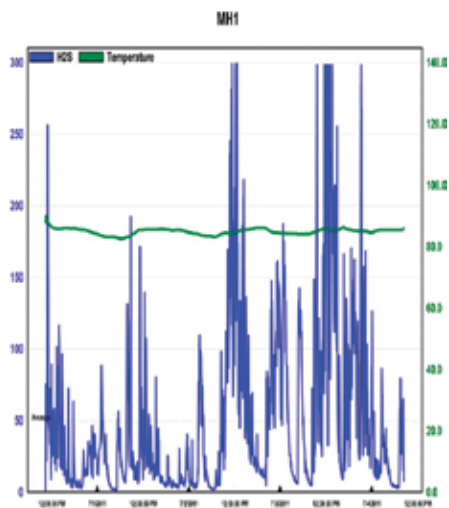


Figure 1: Baseline H₂S Concentrations at MH1, 6/30 - 7/4/11

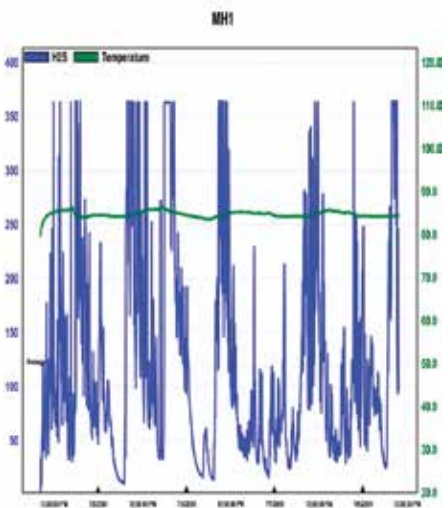


Figure 2: Baseline H₂S concentrations at MH1, 7/4 - 7/8/11

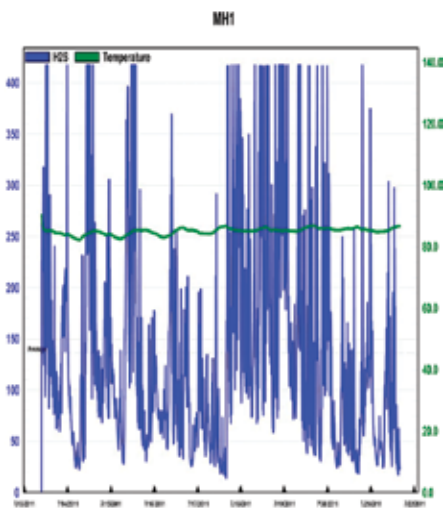


Figure 3: Baseline H₂S Concentrations at MH1, 7/12 - 7/22/11

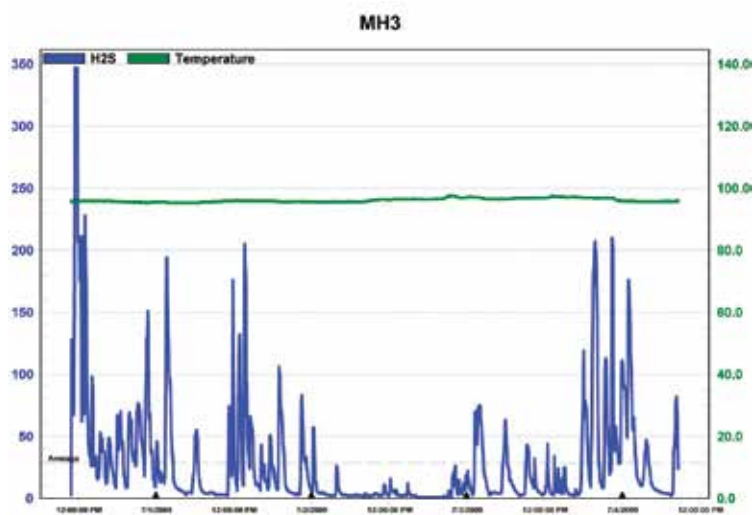


Figure 4: Baseline H₂S Concentrations at MH3, 6/30 - 7/4/11

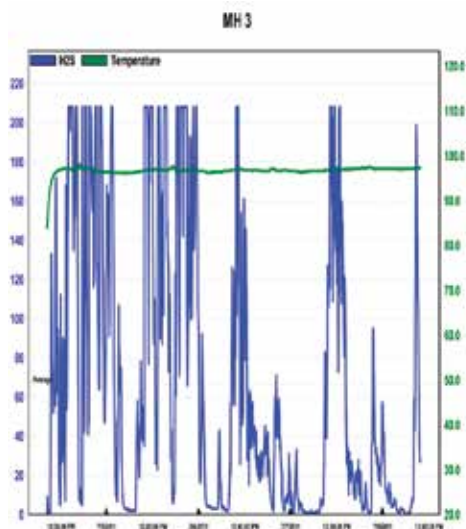


Figure 5: Baseline H₂S Concentrations at MH3, 7/4 - 7/8/11

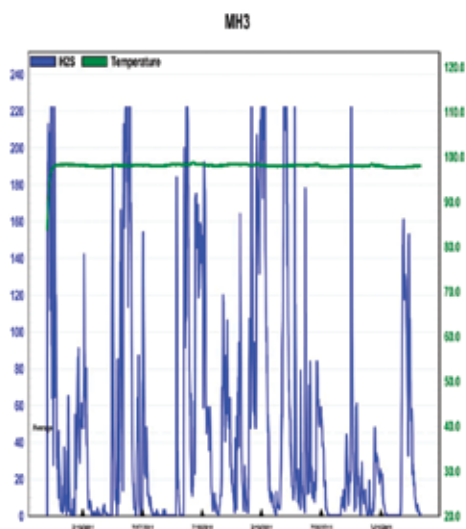


Figure 6: Baseline H₂S Concentrations at MH3, 7/15 - 7/21/11

were outside the detection limit of the instrument, meaning that actual values were likely higher. Ignoring this clipping, the highest value provided for background H₂S concentrations was 417 parts per million and occurred at MH1 multiple times over the date range 7/7 – 7/12, as shown in figure 3. The highest value recorded at MH3 is 347 parts per million and occurs on 6/30, as shown in figure 4.

What is also shown in this data is the general nature of the systems behavior at this point in time. The wide range of concentrations covered within a very short period appears similar to the oscillations typically associated with an uncontrolled system. Variations to system conditions, such as in flow or wastewater chemical composition, yield a clear response, rather than maintaining a quasi “buffered” state with apparent stability within the environment, which would be

indicative of overall system health. Due to the clipping it is hard to know exactly how extreme the concentrations are, but they are at least above 200 parts per million throughout the entire system and definitely reaching levels above 300 parts per million at MH1. These are levels which can present the risk of respiratory irritation as well as more severe threats to human health and they are being achieved on a regular basis while under chemical treatment. In addition to odor and health risks, these concentrations present a significant risk of infrastructure corrosion.

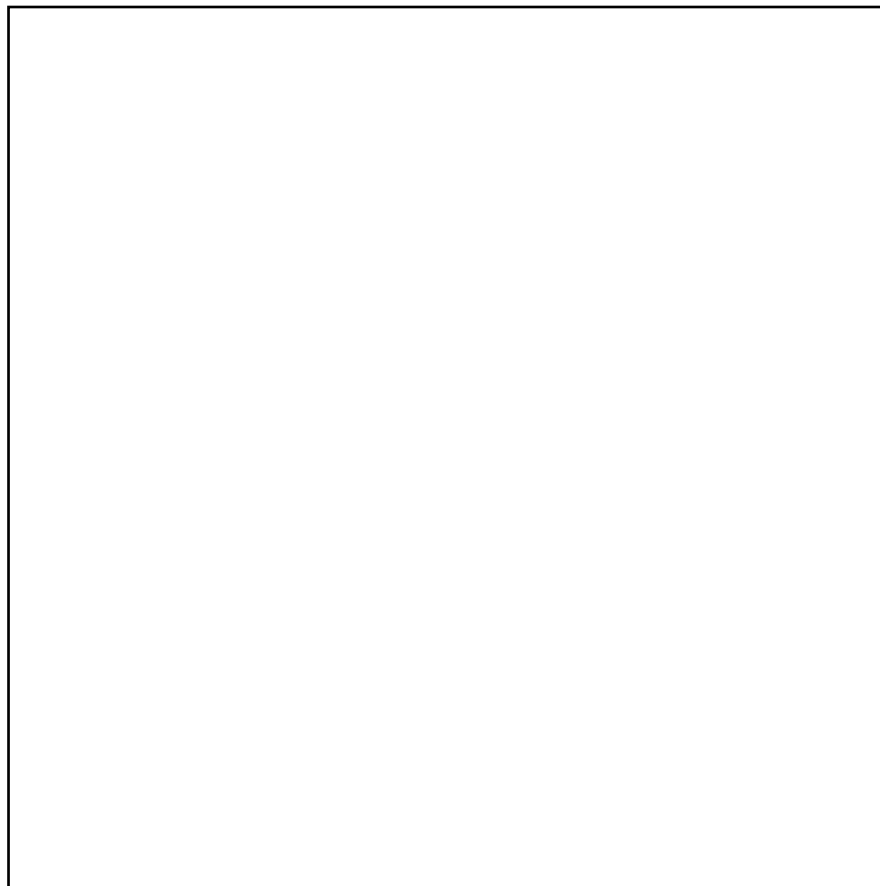


Figure 7 is from an OdaLog placed by AWT in MH1 and shows a small section of H₂S concentrations prior to system activation, as well as the effect of the MDU treatment.

The concentrations recorded between August 17 and 18 present and even more illuminating picture of the H₂S generation potential in this portion of the collection system. The maximum and average values were recorded as 3469 parts per million and 343 parts per million, respectively. There was a heavy rain event that occurred over night between August 18 and 19 that is likely responsible for the extreme spike above 3400 parts per million, but the concentrations preceding this spike are realistic and quite elevated; typically in the 500 – 1500 parts per million range, and up to 2000 parts per million. This also supports the suspicion that the third party OdaLog units were reaching detection limits very quickly and were not indicating the full extent of actual conditions.

The system was turned on around 1:00 PM on August 18. From figure 7 it is apparent that approximately twenty-four hours later the H₂S concentration begins an extreme decline that ends at less than 10 parts per million, where it stays the remainder of the test period. Detention time for this 2 mile stretch of force main was calculated to be twenty-five hours, which is in direct agreement with the OdaLog data.

As confirmation of these results, OdaLog data from the third party's sampling is shown in figures 8, 9, and 10.

With the exception of the data out of range for this OdaLog, figure 8 behaves very similarly to figure 7, providing confirmation that the extreme drop that started in the middle of the day on August 19 is realistic and that the treatment was able to significantly and

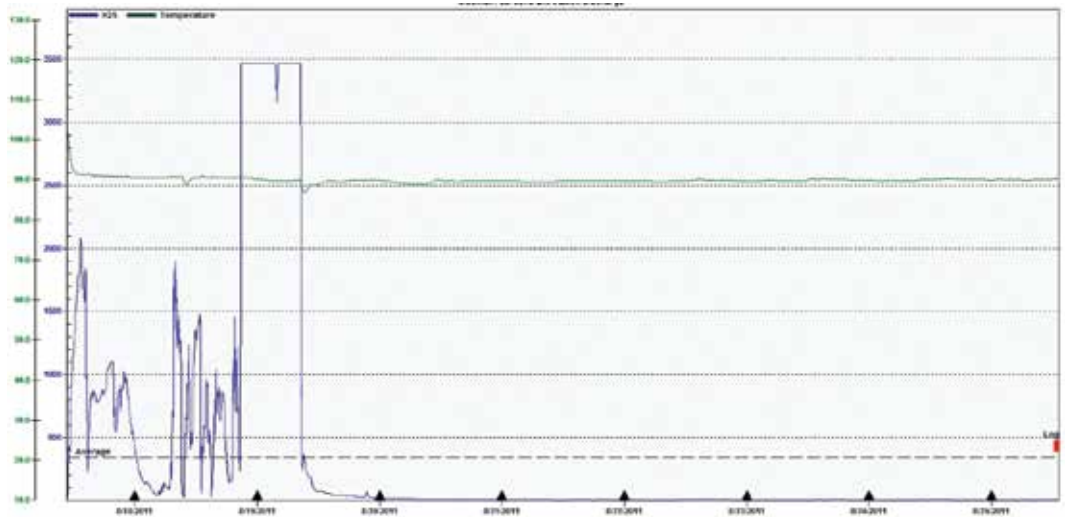


Figure 7: OdaLog H₂S concentrations Prior to and During Treatment at MH1, 8/17 - 8/25

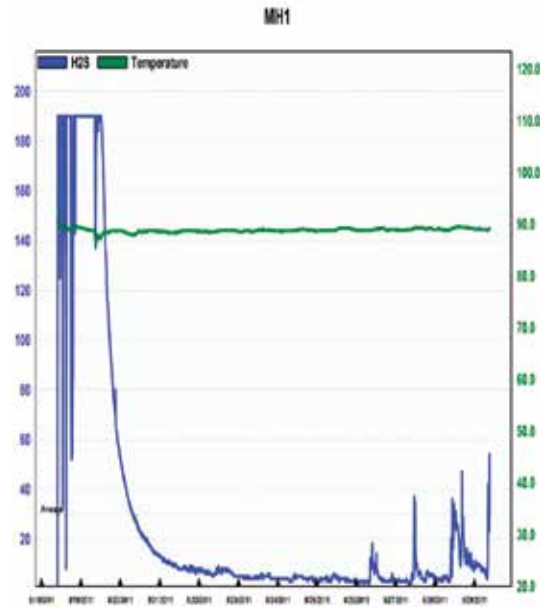


Figure 8: H₂S Concentrations Prior to and During Treatment at MH1, 8/17 - 8/25

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consistently decrease H₂S concentrations. Again, by the end of the test, H₂S had stabilized at less than 10 parts per million. There is some discrepancy between figures 7 and 8 in the rate at which this decrease happened, and the reason for this is unknown at this time. It may have had to do with variances in saturation and subsequent rate of desaturation of the sensors on the two individual OdaLog units. The following two figures, 9 and 10, undergo a very similar pattern and rate of decline as that shown in figure 7, which provides some indication that the rate of decline was greater than what is implied by figure 8 alone.

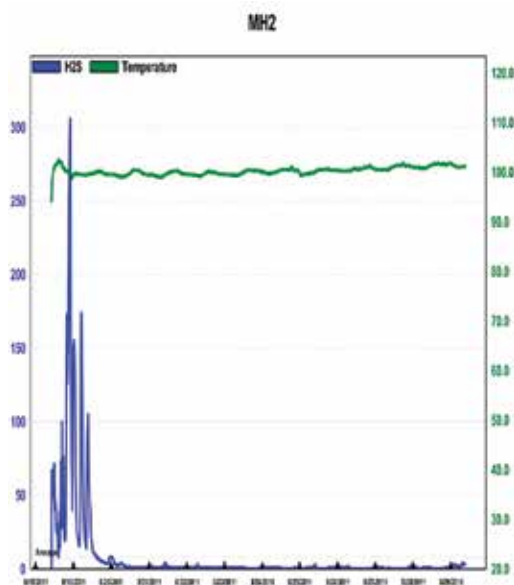


Figure 9: H₂S Concentrations Prior to and During Treatment at MH2, 8/17 - 8/25

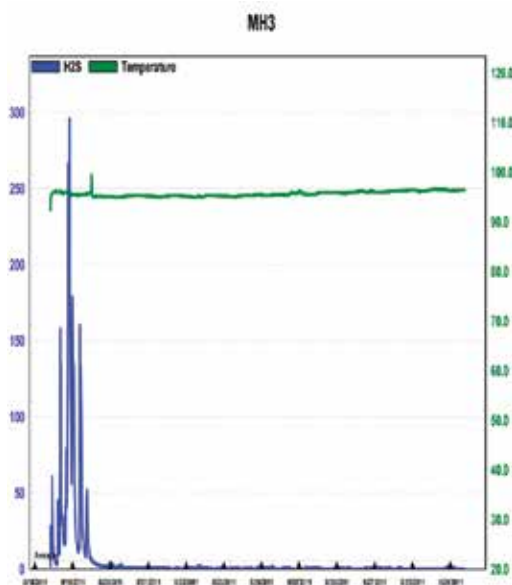


Figure 10: H₂S Concentrations Prior to and During Treatment at MH3, 8/17 - 8/25

Figures 9 and 10, from MH2 and 3, again show very similar reduction trends to figure 3; a peak followed by a steep, continuous drop to less

than 10 parts per million, in about a day. Grab samples were collected concurrently, the results of which are shown in figure 11.



AWT collected grab samples while a technician was in the field, through August 20. These results are shown in the figure 11 above as well as table 3. Figure 12 and Table 4 contain the grab sample results from the third party.

CORRELATION OF VAPOR TO LIQUID GRAB SAMPLES

Total and dissolved sulfides represent the liquid phase precursor to H₂S gas. By monitoring these values for reductions, we can verify treatment of the source is taking place, rather than simply a reduction in experienced odor. For example, at a pH of 7, H₂S is approximately 50 percent of the dissolved sulfide value, at pH 6 it is approximately 90 percent. By ensuring the source is being treated, the effectiveness of the treatment system is better established and it can be better assured that the detrimental effects of sulfide compounds are being actively prevented.

Both sets of the liquid grab samples have a high correlation, in terms of data trends, with the vapor phase data taken from the OdaLog units. In both tables above, there is a definitive decrease in H₂S, total and

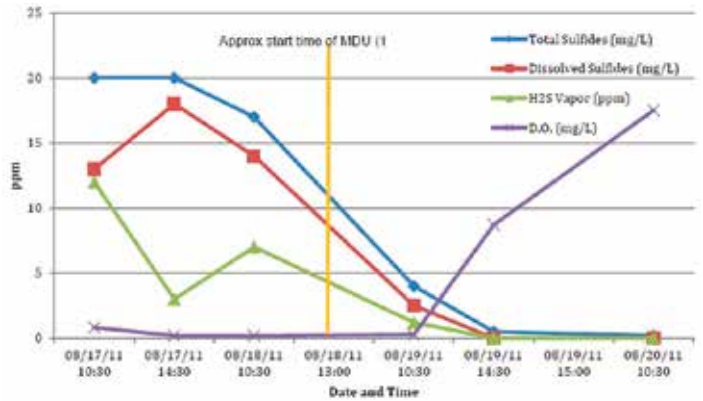
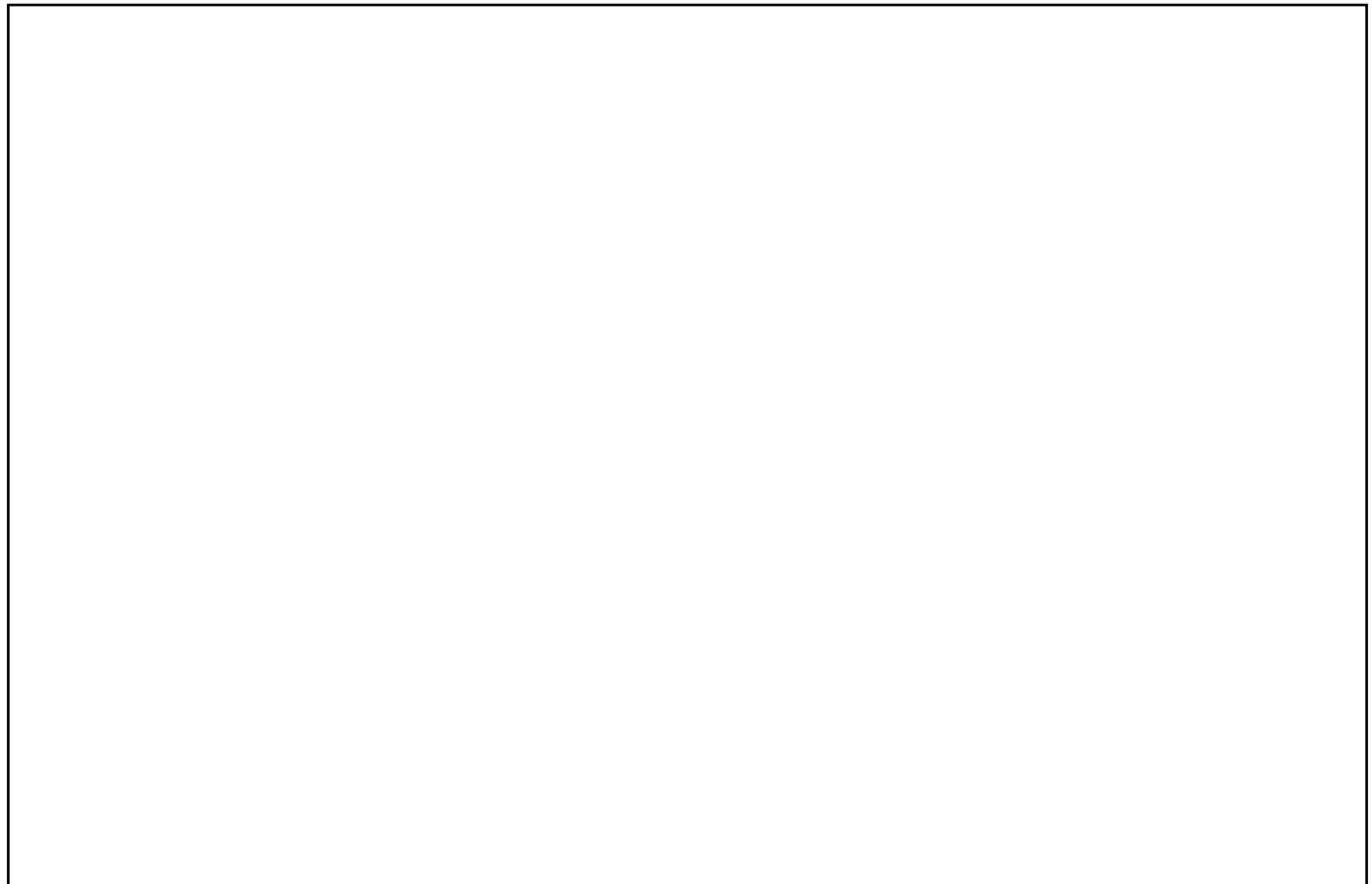


Figure 11: AWT Grab Sample Results, MH1

Time	Date	D.O. (mg/l) Hatch Meter	H ₂ S Vapor (ppm)	Total Sulfides (ppm)	Dissolved Sulfides (ppm)	Output: O ₂ (l/m)	Output: O ₂ (g/h)	System Status
10:30 AM	8/17/2011	0.82	12	20	13	N/A	N/A	OFF
2:30 PM	8/17/2011	0.18	3	20	18	N/A	N/A	OFF
10:30 AM	8/18/2011	0.18	7	17	14	N/A	N/A	OFF
1:00 PM	8/18/2011	--	--	--	--	40	120	ON
10:30 AM	8/19/2011	0.26	1.2	4	2.5	40	120	ON
2:30 PM	8/19/2011	8.71	0	0.5	0	40	120	ON
3:00 PM	8/19/2011	--	--	--	--	20	60	ON
10:30 AM	8/20/2011	17.52	0	0.2	0	20	60	ON

Table 3: AWT Grab Sample Results at MH1 and System Status



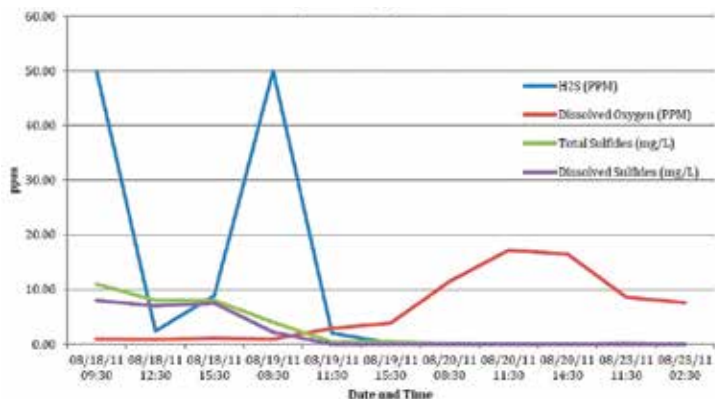


Figure 12: Third Party Grab Sample Results at MH1

Date	Time	H ₂ S (PPM)	pH	Dissolved Oxygen (PPM)	Temperature (°C)	Total Sulfides (mg/L)	Dissolved Sulfides (mg/L)
8/18/2011	9:30	>50	6.92	0.94	34.1	11.0	8.0
8/18/2011	12:30	2.4	7.12	0.85	33.8	8.0	7.0
8/18/2011	15:30	8.9	7.11	1.10	35.2	8.0	7.5
8/19/2011	8:30	>50	7.25	0.92	27.1	4.0	2.2
8/19/2011	11:30	2.0	7.05	2.90	33.6	0.4	0.0
8/19/2011	15:30	0.16	7.02	3.85	35.0	0.5	0.0
8/20/2011	8:30	0.124	7.18	11.50	27.9	0.0	0.0
8/20/2011	11:30	0.053	7.15	17.20	33.5	0.0	0.0
8/20/2011	14:30	0.053	7.14	16.50	31.4	0.0	0.0
8/23/2011	11:30	0.015	7.12	8.60	33.5	0.2	0.0
8/23/2011	2:30	0.017	7.10	7.60	31.7	0.0	0.0

Table 4: Third Party Grab Sample Results at MH1

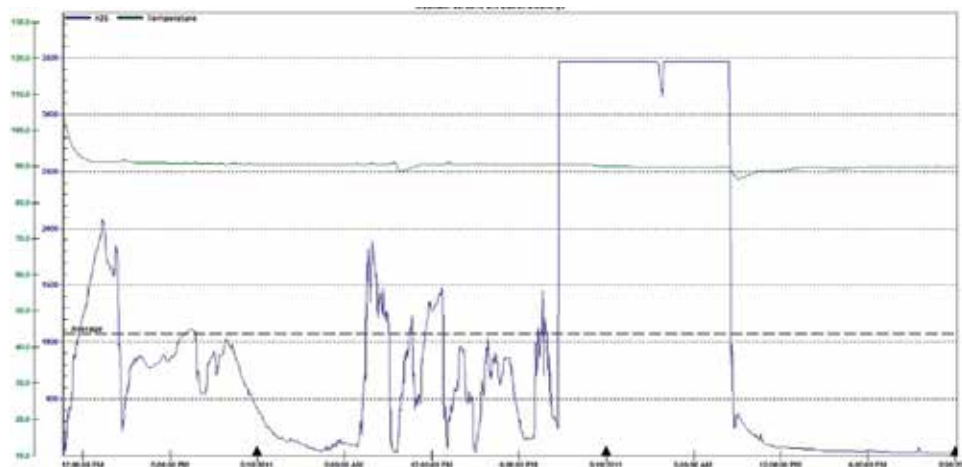


Figure 13: AWT OdaLog Data Immediately Prior to System Effect, 8/17 – 8/20

dissolved sulfides. A desirable inverse relationship of increasing DO levels to decreasing sulfide levels is also evident. The results from all these tests arrive at the same conclusion, indicating that the liquid phase infusion of ozone and oxygen into the force main was able to very effectively induce a significant reduction to H₂S and sulfide levels as well as increasing the DO to well above the point where the environment within the force main would be considered aerobic.

DISCUSSION

Figure 13 below is a “zoomed-in” view of the data that was collected by AWT’s OdaLog prior to the infusion process showing an effect in the force main that allows a more representative view of untreated system conditions.

As we have already seen, H₂S levels were very elevated. The average H₂S indicated on figure 13 is 1070 parts per million and even if the extreme spike above 3000 parts per million is ignored, the average concentration is still about 700 parts per million. After treatment, concentrations as low as 1 parts per million were achieved; however, for calculation purposes a more realistic average is 7 parts per million H₂S, based on OdaLog values following the steep drop, which were considered treatment induced values. This equates to a 99 percent reduction in H₂S levels in a matter of days, with real results starting in about a day, as shown in figure 14.

This is the same chart that was shown as figure 4, but now includes some interesting time data. The start up of the system is clearly indicated as well as the calculated detention time range, approximately twenty-five hours. What should be noticed from this chart is how the H₂S concentration begins a rapid descent almost exactly at this twenty-five hour mark (14a). Additionally, the system shut off is included in this chart and about twenty-five hours later, the H₂S levels begin to experience peaks again. When AWT returned to disconnect the system, it was discovered that there was an impingement on

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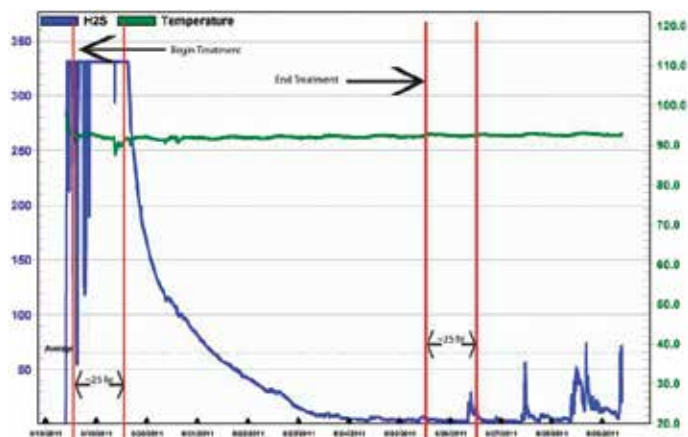


Figure 14: Third Party OdaLog H₂S Concentrations and Response Times

the gas feed line and infusion (treatment delivery rate) had significantly decreased. This could be one explanation for the fact that it took slightly less than twenty-five hours for the increase in concentrations to resume following the system deactivation.

Another very important fact that must be pointed out is that, although the H₂S concentration does begin to increase following system deactivation, as would be expected, the peaks are only in the 25 – 80 parts per million range. And

they stay there for at least four days, which is all the data available. This is very significant as ten days prior the untreated H₂S concentrations had been spiking, at times, in excess of 1500 parts per million, and suggests that the environment within the force main is directly affected by the infusion of oxygen and ozone in a positive manner.

A LOOK AHEAD

In next month's installment, we'll conclude this series by illustrating the detailed benefits of sustainable treatment gases in wastewater collection systems. ♦

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