



STX Catalytic Process

Pilot Study for Hydrogen Sulfide Control:

Slater Lift Station

Durham County Utilities Division

November 21st – December 21st, 2017

Technology for a cleaner environment

Background:

September 5th, 2017

Source Technologies Project Managers, Marcus Bullock and Jarus Cox, met with officials from the Engineering and Environmental Services of Durham County Utilities Division to discuss alternatives to treating hydrogen sulfide gas in the wastewater collections system.

Source Technologies specializes in controlling odors and corrosion in collections systems and wastewater treatment plants by using advanced oxidation. Instead of just feeding sulfide reducing bacteria an alternative food source or adjusting pH to manipulate hydrogen sulfide formation, Source's proprietary catalysts, STX and VSP, combine with an oxidant to create a hydroxyl free radical that reduces hydrogen sulfide compounds down to elemental sulfur, carbon dioxide, and water.

At the conclusion of the meeting it was decided to start gathering water and air samples from the two main lift stations, Slater LS and Stirrup Iron LS, to gather information needed to make a cost estimate.

September 15th, 2017

An Odatrac® hydrogen sulfide Odalog was hung at the gravity manhole for the Slater LS (T-23-012). The chemical addition of calcium nitrate (Bioxide™) was left on for the first three days. It was turned off on the 18th to get untreated levels of hydrogen sulfide gas and total sulfides in the water.

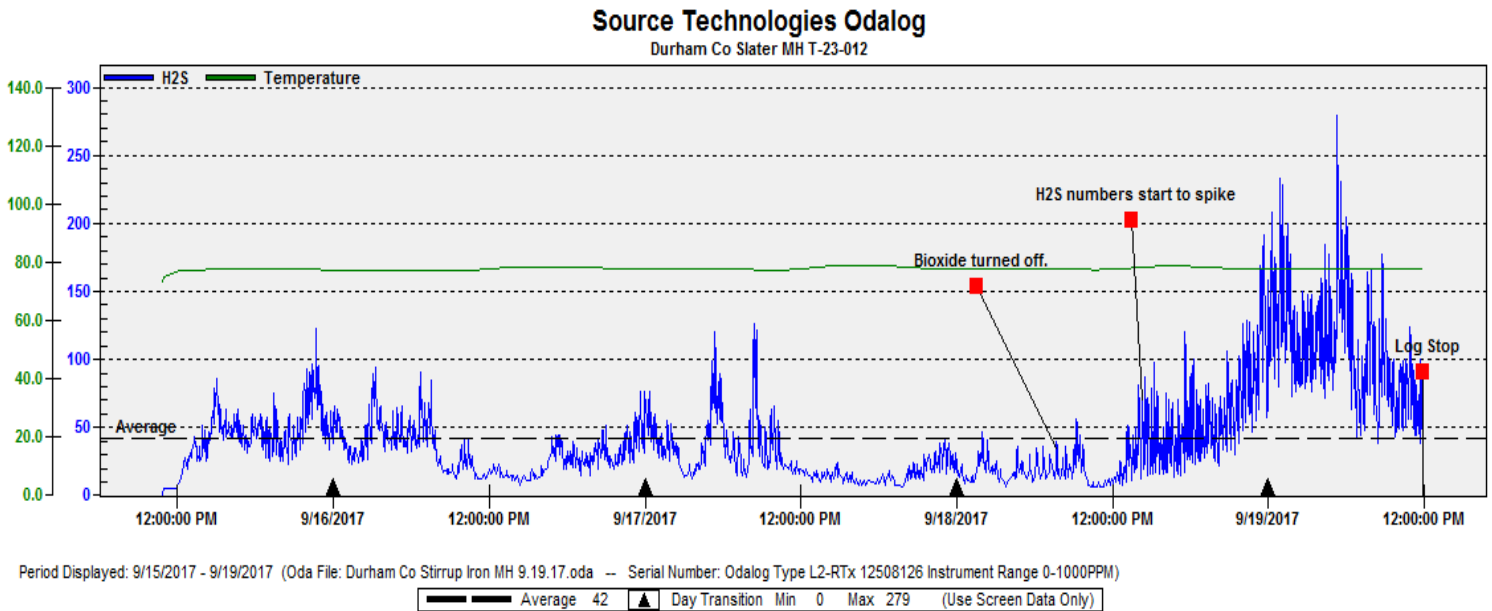
September 19th, 2017

Using a Hach Colorimeter DR900 and USEPA's *Methylene Blue Method* water samples were drawn to see how much sulfide was coming in to the Slater Lift Station. The average of the samples drawn was 4.4 mg/L. Comparatively; the average Total Sulfides for Franklin County, NC is 1.8 mg/L (10/21/2017).

Location	Date	Time	Total Sulfide
Slater PS	9/5/2017	9:35	2.5
Slater PS	9/5/2017	9:45	2.75
Slater PS	18-Sep	10:00	1
Slater PS	18-Sep	10:15	1.25
Slater PS	18-Sep	10:30	4.25
Slater PS	18-Sep	11:30	8
Slater PS	19-Sep	12:30	8
Slater PS	18-Sep	13:30	7.25
Slater PS	18-Sep	14:30	5.5

Slater PS	18-Sep	15:30	7.75
Slater PS	18-Sep	16:30	4.25
Slater PS	18-Sep	17:30	4.25
Slater PS	18-Sep	18:30	6
Slater PS	18-Sep	19:30	5.5
Slater PS	18-Sep	20:30	4.25
Slater PS	18-Sep	21:30	4
Slater PS	18-Sep	22:30	4.5
Slater PS	18-Sep	23:30	5.5
Slater PS	19-Sep	0:30	3.75
Slater PS	19-Sep	1:30	4.75
Slater PS	19-Sep	2:30	3.25
Slater PS	19-Sep	3:30	2.5
Slater PS	19-Sep	4:30	3
Slater PS	19-Sep	5:30	3
Slater PS	19-Sep	6:30	1.5
Slater PS	19-Sep	7:30	3
Slater PS	19-Sep	8:30	5.5
Slater PS	19-Sep	9:30	6.5

Below: Moderate levels of H2S while the Calcium Nitrate is being added. Once the chemical pumps are turned off the H2S levels raise into the high category (See Table 1.) Note scale set to 300ppm.



Effect of Sulfide on Infrastructure Life Expectancy

Target: 3' Diameter Concrete Pipe (1" Cover)

<u>H₂S (ppm)</u>	<u>Life Expectancy (Years)*</u>
0.5	>50
1.0	25-50
2.0	10-25
3.0	10
4.0	5-10
7.0	5
>7.0	<5

***Neutral pH scenario**

The economic impact of hydrogen sulfide not only involves concrete. Hydrogen sulfide is also an aggressive corrosion agent for electrical components and metal surfaces. Most wastewater facilities spend a significant amount of money to coat metal surfaces with paints designed to resist the corrosion impact of hydrogen sulfide. It is well understood that a drastic reduction in sulfides in the collections system as well as headworks of municipal wastewater plants will result in significant long-term capital expenditure savings over time.¹

TABLE 1. Symptoms from low to high concentrations of H₂S

Exposure level	Concentration, ppmv	Symptom
Low	0–10	Irritation of the eyes, nose, and throat
Moderate	50–200	Coughing Hoarseness Shortness of breath Pneumonia Loss of smell (> 100 ppmv)
High	200–500	Changes in respiratory tissue (200–400 ppmv per laboratory animals) Rapid respiratory distress and failure (acute exposure at > 500 ppmv for 1 to 4 hours) ²
Very high	> 2,000	Coma and death after single breath ⁴ Known as "knockdown effect" with immediate immobilization and unconsciousness, possibly from disruption of oxidative metabolism in the brain

¹ "Results of the VTX Process Sulfide Treatment Pilot Study Conducted at the Hampton Road's Sanitary District's York River Wastewater Treatment Facility" By Buck Cox PhD. February, 2004

Slater Lift Station STX Pilot Study

Slater Lift Station pumps approximately 130,000 gallons per day of wastewater in force main nearly 5,000 feet before going gravity behind the shopping center located at the corner of South Miami Boulevard and Slater Rd. Source Technologies estimates the retention time in the force main to be 4.5 hours before going to gravity and the Total Sulfides per day to be just under 5 pounds.

November 20th, 2017

A 300 gallon IBC tote of 30% Hydrogen Peroxide (H₂O₂) and 30 gallons of STX were placed in secondary containment. Peristaltic pumps were placed on top and Nitrile tubing was ran into the wetwell to drip into the influent wastewater

2:00 pm: Bioxide wet well drip was turned off. No other chemical addition took place to get untreated levels of H₂S in the colder temperatures.

2:20 pm: Odalog hung at the T-23-012 gravity manhole. Sulfide sample of 1.75 mg/L

November 21st, 2017

8:00 am: Initial startup of chemistry; 15 gallons per day H₂O₂ and 3 gallons per day STX. Influent sulfide sample of 1.5 mg/L

November 22nd, 2017

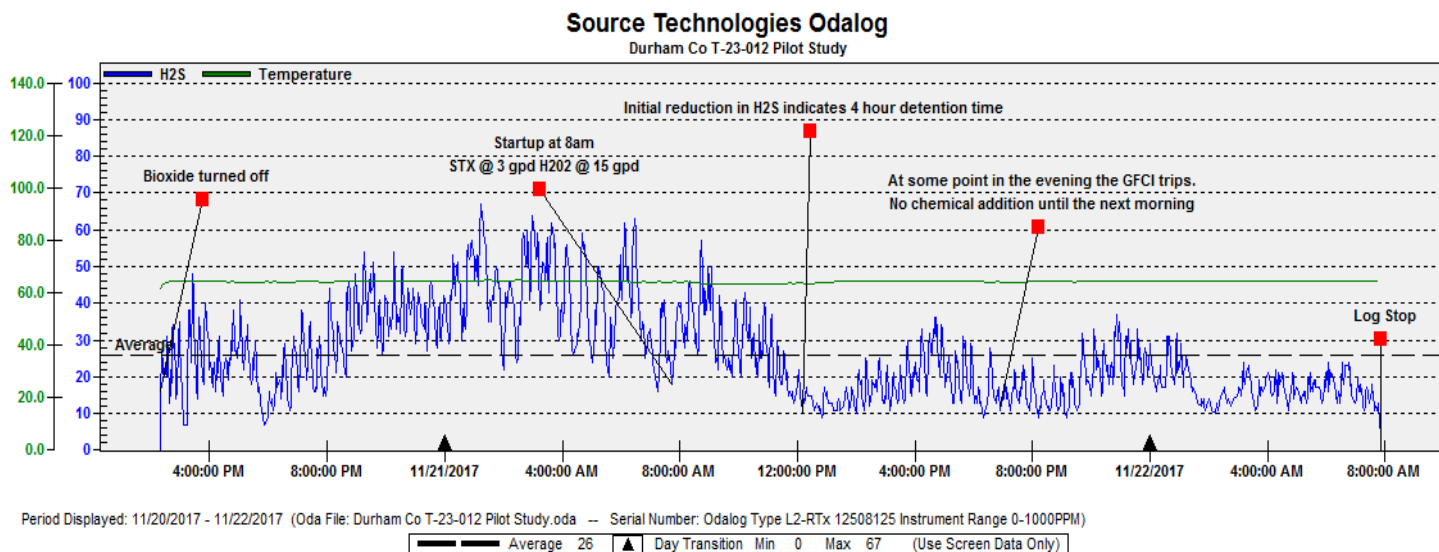
8:30 am: GFCI outlet was tripped. The extension cord was moved to another outlet and all connections covered up to prevent further interruption of electrical power.

With the H₂S numbers higher than desired; Hydrogen Peroxide rates were greatly increased in an effort to “burn” off the some of the slime layer that builds up in pipe. It is a frequent occurrence that the Sulfide Reducing Bacteria grow disproportionate when given an environment with elevated food sources, i.e. Calcium Nitrate.

Feed rates increased to 50gpd H₂O₂ and 5 gpd STX

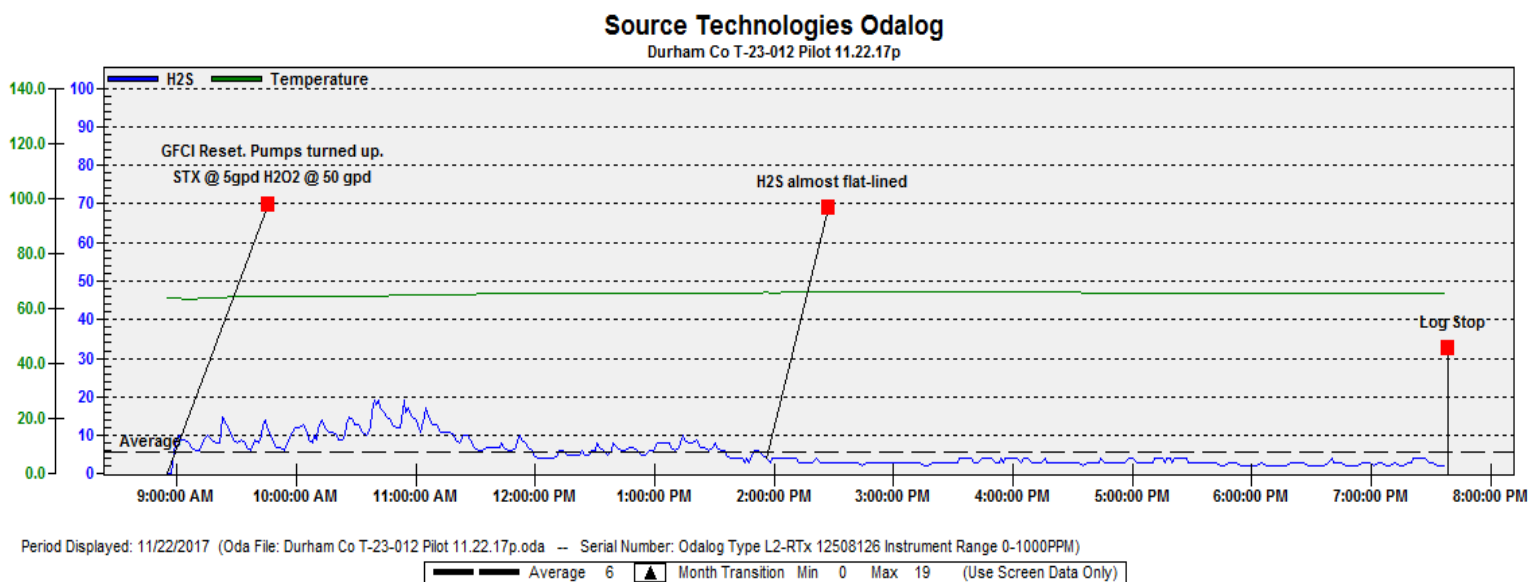
Below: Graph shows reduction in H₂S at just over 4 hours. Reduction in H₂S was less than desired, but do to power failure it is tough to discern how effective the first day of pumping truly was.

Note scale to 100 ppm



8:00 pm: Chemical feed rates reduced. 25 gpd H₂O₂ and 3 gpd STX

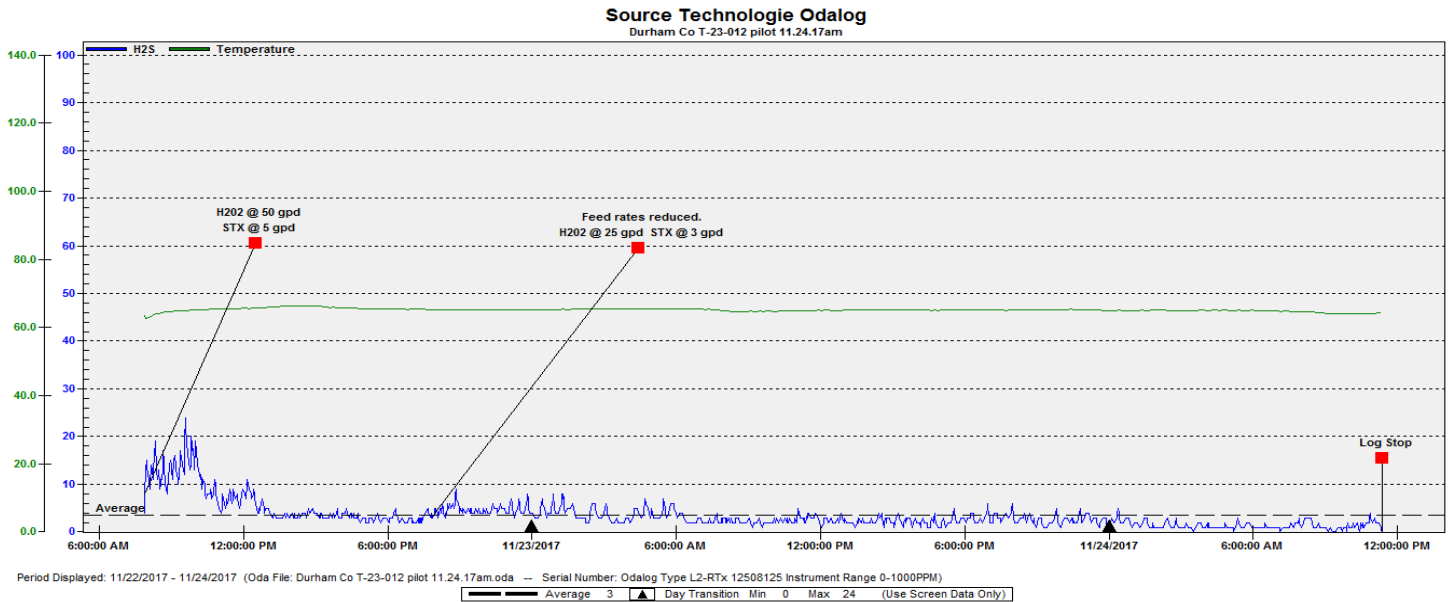
Below: After a high dose of H₂O₂, hydrogen sulfide numbers settle down to very low numbers.



November 24th, 2017

11:45 am: Pump rates reduced again to 15 gpd H₂O₂ and 2.5 gpd STX. Influent sulfide 2.25 mg/L

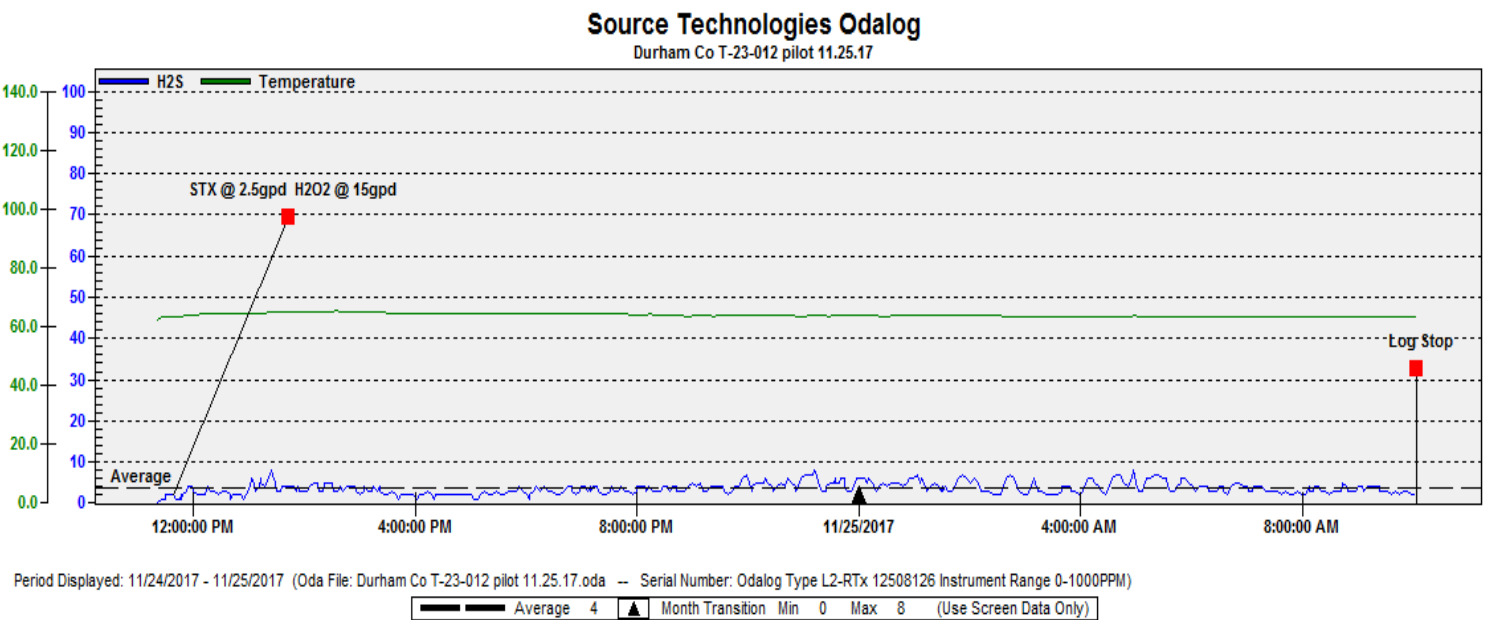
Below: H₂S levels stay below 5ppm after chemical reduction.



November 25th, 2017

10:15 am: Feed rates reduced to 10 gpd H₂O₂ and 1.7 gpd STX. Influent Sulfide of 2.75 mg/L

Below: Excellent results maintaining under 8 ppm.



November 26th, 2017

11:30 am: A second odalog was hung alongside the first to ensure accuracy. Total sulfide at 3.25 mg/L

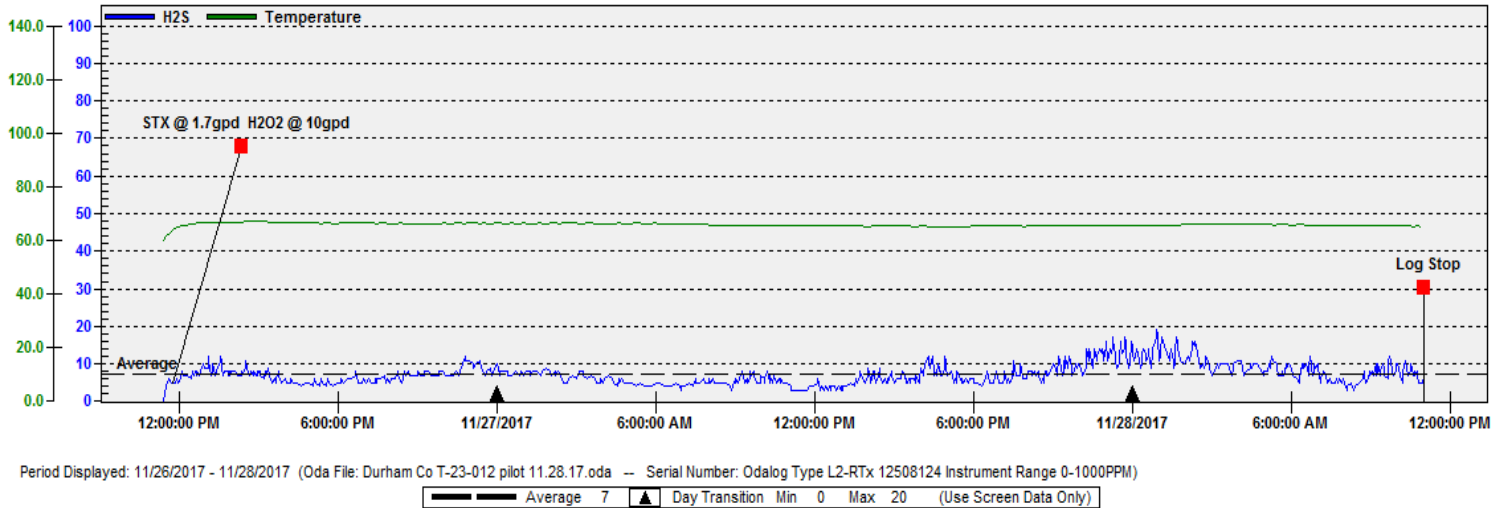
November 28th, 2017

11:00 am: Pumps reduce to 8 gpd H₂O₂ and 1 gpd STX. Influent sulfide at 3.5mg/L

Below: Very good results with a slight increase of H₂S overnight on the 28th.

Source Technologies Odalog

Durham Co T-23-012 pilot 11.28.17



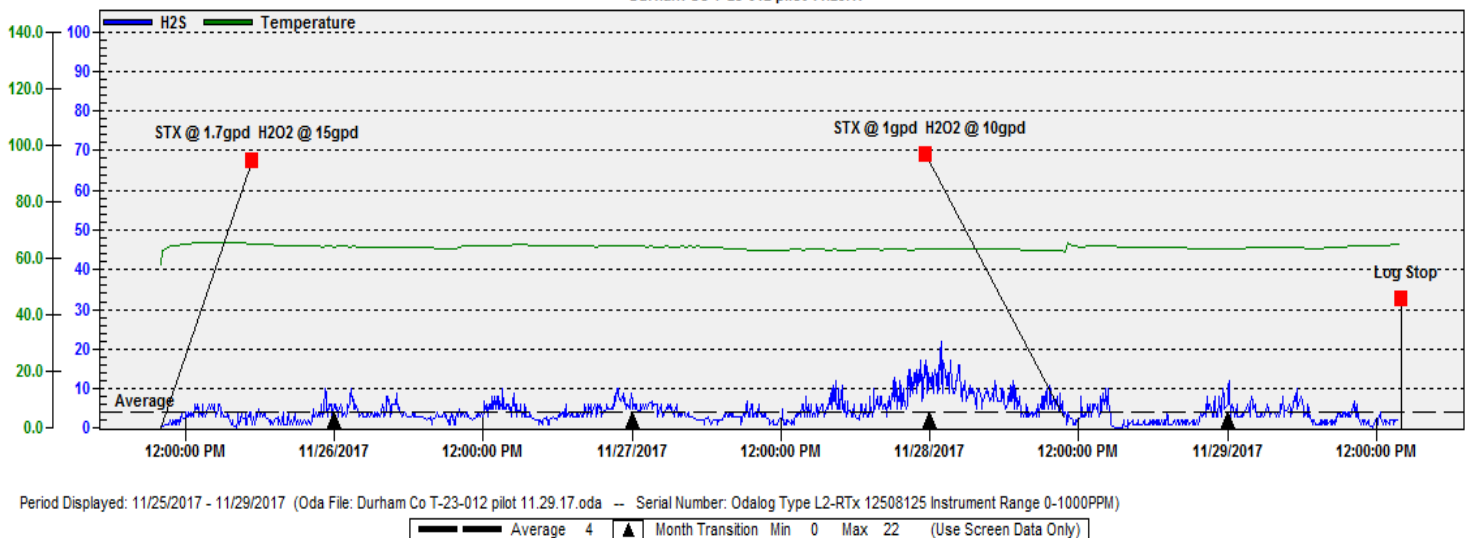
November 29th, 2017

12:15 pm: Influent sulfide at 2.25 mg/L

Below: Second odalog is very consistent with previous graph.

Source Technologies Odalog

Durham Co T-23-012 pilot 11.29.17



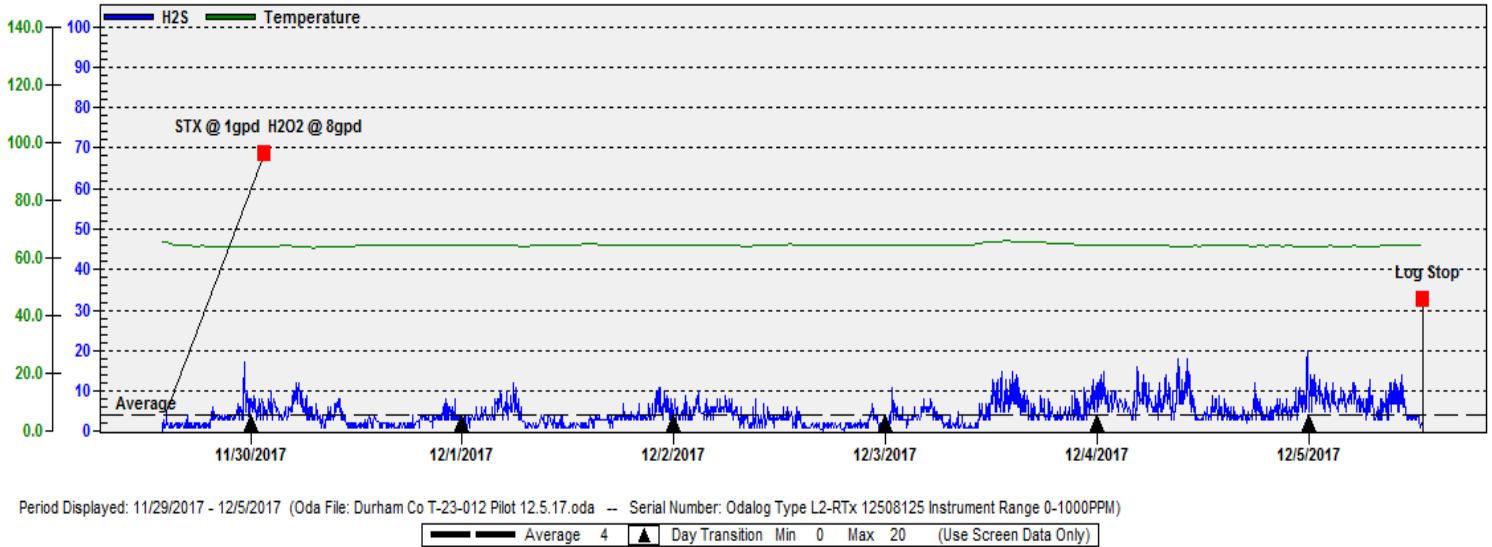
December 5th, 2017

12:15 am: Sampler set up for over night. Influent sulfide at 3mg/L

Below: Very good results with slight increase to H2S numbers starting on the 4th. Possible indication of another wastewater source coming into the lift station

Source Technologies Odalog

Durham Co T-23-012 Pilot 12.5.17



December 6th, 2017

Sampler Results: Average out to 2.4mg/L. Considerably lower than the samples taken on September 18th, but consistent with sulfide formation taking place at higher temperatures

Location	Date	Time	Total Sulfide
Slater PS	12/5/2017	13:15	2.5
Slater PS	12/5/2017	14:00	3
Slater PS	5-Dec	14:45	3
Slater PS	5-Dec	15:30	3.25
Slater PS	5-Dec	16:15	2.5
Slater PS	5-Dec	17:00	2.75
Slater PS	5-Dec	17:45	2.75
Slater PS	5-Dec	18:30	3
Slater PS	5-Dec	19:15	2.75
Slater PS	5-Dec	20:00	2.5
Slater PS	5-Dec	20:45	2.75
Slater PS	5-Dec	21:30	2.5
Slater PS	5-Dec	22:15	2.5
Slater PS	5-Dec	23:00	2.5
Slater PS	5-Dec	23:45	2
Slater PS	6-Dec	0:30	2
Slater PS	6-Dec	1:15	2
Slater PS	6-Dec	2:00	2

Slater PS	6-Dec	2:45	2
Slater PS	6-Dec	3:30	1.75
Slater PS	6-Dec	4:15	1.25
Slater PS	6-Dec	5:00	1.5
Slater PS	6-Dec	5:45	1.5
Slater PS	6-Dec	6:30	2.5

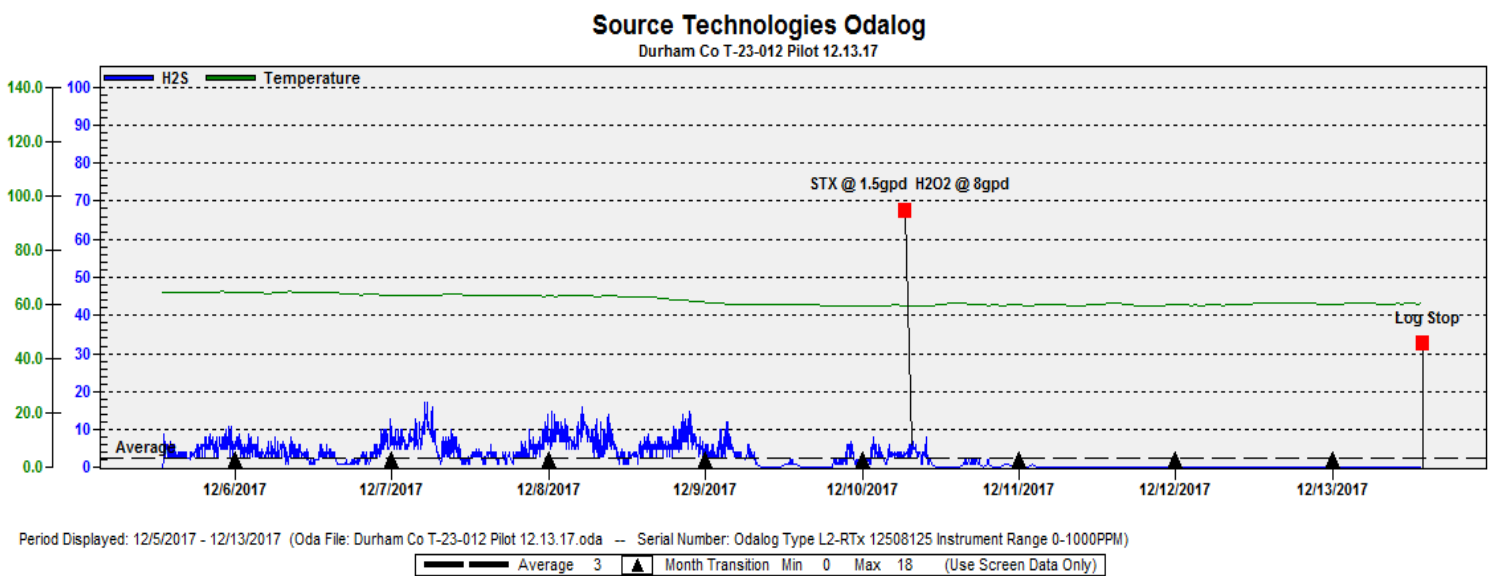
December 10th, 2017

7:15 am: Raised feed rates on the STX to use up remaining chemistry by trial completion. Influent sulfide at 1.25 mg/L

December 13th, 2017

10:00 am: Influent sulfide at .5 mg/L

Below: Very good H2S numbers turn into flat-line zeros. The temperature has dropped enough to hinder H2S formation, but possibly explained by a wastewater source being reduced by a local business.



December 19th, 2017

Sampler Results: Average of 1.2 mg/L

Location	Date	Time	Total Sulfide
Slater PS	12/18/2017	13:15	0.75
Slater PS	12/18/2017	14:00	1.25
Slater PS	18-Dec	14:45	2.5
Slater PS	18-Dec	15:30	3

Slater PS	18-Dec	16:15	1.25
Slater PS	18-Dec	17:00	1.5
Slater PS	18-Dec	17:45	1.5
Slater PS	18-Dec	18:30	2
Slater PS	18-Dec	19:15	2
Slater PS	18-Dec	20:00	1.75
Slater PS	18-Dec	20:45	1.75
Slater PS	18-Dec	21:30	1.5
Slater PS	18-Dec	22:15	1.25
Slater PS	18-Dec	23:00	1.5
Slater PS	18-Dec	23:45	1
Slater PS	19-Dec	0:30	0.75
Slater PS	19-Dec	1:15	0.5
Slater PS	19-Dec	2:00	0.5
Slater PS	19-Dec	2:45	0.5
Slater PS	19-Dec	3:30	0.75
Slater PS	19-Dec	4:15	0.25
Slater PS	19-Dec	5:00	0.25
Slater PS	19-Dec	5:45	0.5
Slater PS	19-Dec	6:30	1

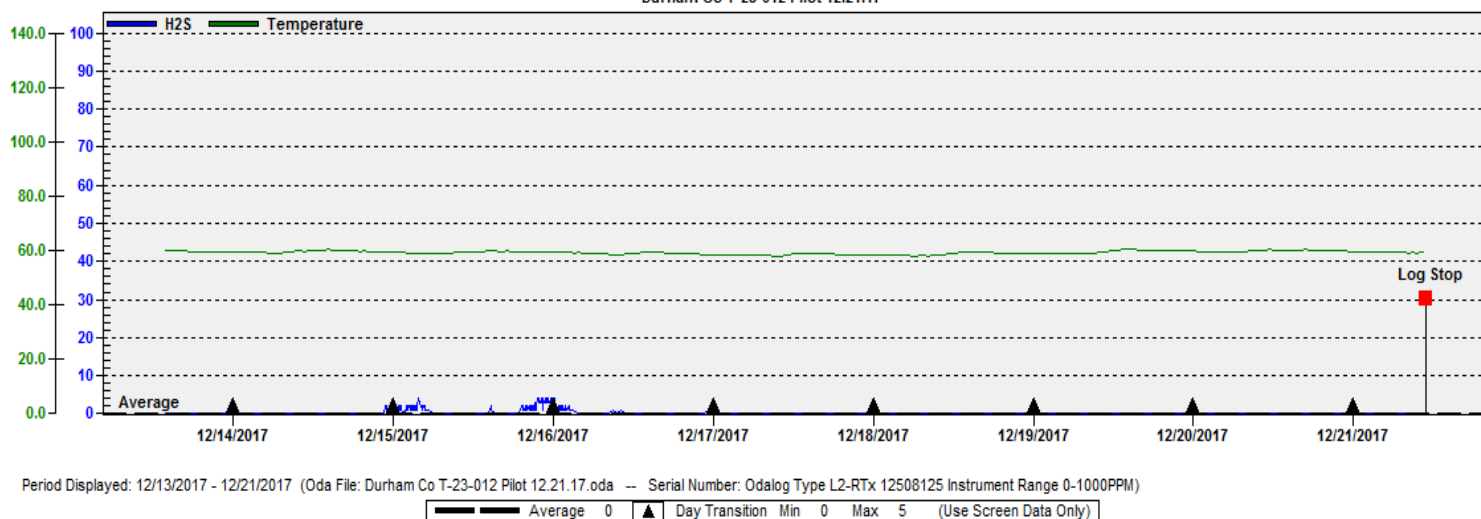
December 21st, 2017

1:15 pm: Influent sulfide at .50 mg/L

Below: Flat-lined zeroes except for brief numbers coming around midnight on the 16th and 17th.

Source Technologies Odalog

Durham Co T-23-012 Pilot 12.21.17



December 22nd, 2017

8:00 am: System turned off and removed from Slater Lift Station.

Conclusion

With the location of the gravity manhole (T-23-012) being so close to a shopping center, and the population density of the area continuing to grow, even very small levels of hydrogen sulfide gas will become a nuisance and cause odor complaints. If the hydrogen sulfide gas levels are allowed to reach moderate levels, severe degradation to the surrounding concrete and metal will occur and in just a few years the entirety of the manhole will need to be replaced.

Source Technologies main goal in running any pilot is to prove how effective the chemistry is and to find a baseline cost so we can provide the customer with as much information as they need to make an informed decision. Based on those criteria; this trial was very successful. At the manhole T-23-012 monitoring point we were able to reduce the H_2S to near non-existent levels for extended periods of time and to find the feed rates when hydrogen sulfide would start to develop, giving us a very good indicator of what the dosing rates should be.

As with any collections system, wastewater flow will continue to change as the collections system grows and more people and businesses move in. Source Technologies is committed to work with the Durham County Utilities to ensure that odor and corrosion throughout their collections systems don't become a concern.