SOURCE TECHNOLOGIES

DECEMBER 2024

Comparative Technology Assessment

Central Kentucky Pump Station

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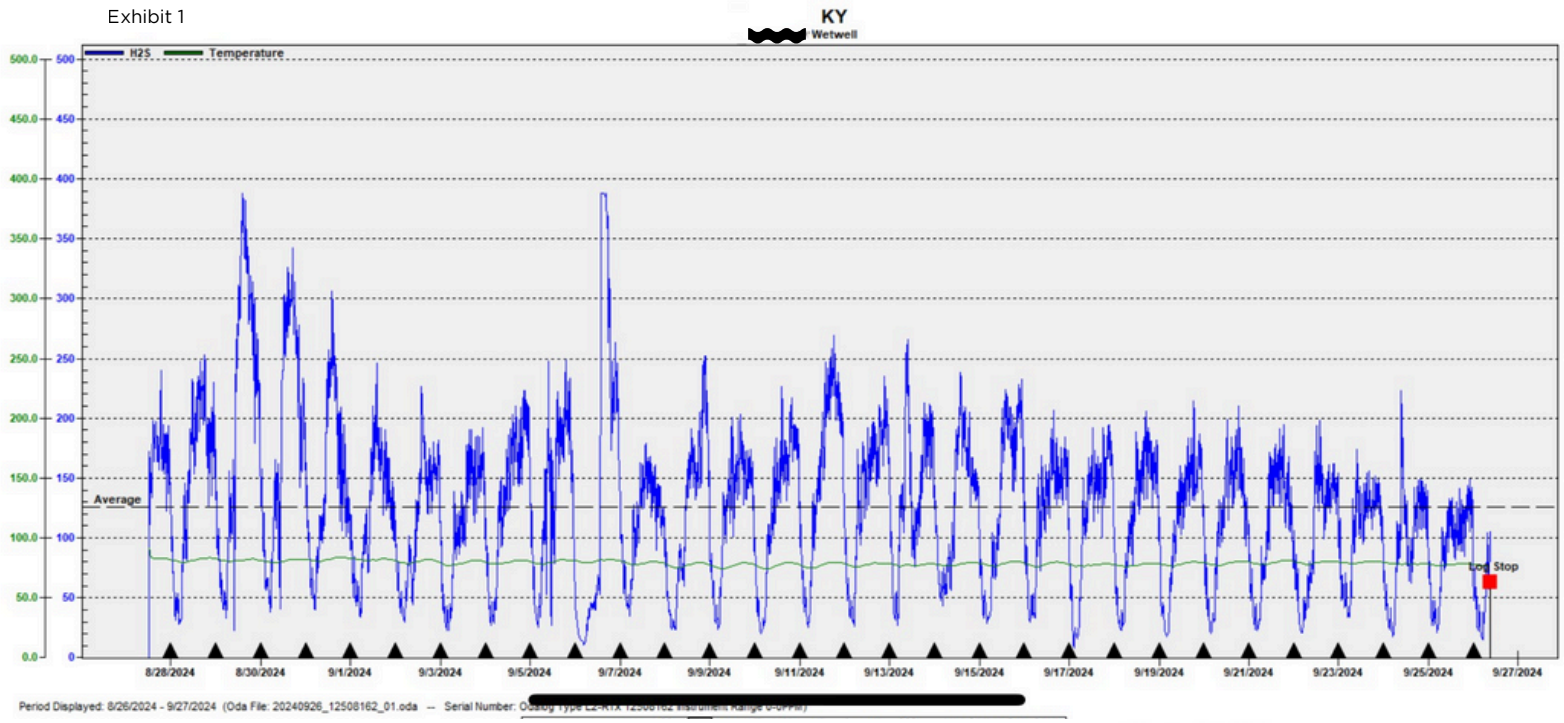
Observations

Central Kentucky Pump Station

This Pump Station located in Central Kentucky is an ideal candidate for an odor control system. Receiving a daily average flow of 2 million gallons per day, the PS averages 126 PPM H_2S with Peak H_2S readings in the wet well reaching 388 PPM. (Exhibit 1) Sulfide loading in solution averages 10.28 mg/L (S=) with a peak of 13.25 mg/L (S=) as seen in Exhibit 2. This equates to roughly 179 pounds of sulfide entering this facility every 24 hours.

Exhibit 1



Sulfide Sampling

Date	Location	Time	Sulfide mg/L	pH
8/27/2024	[redacted] WW	12:15:00 PM	9.5	6.9
8/27/2024	[redacted] WW	12:20:00 PM	8.75	6.94
8/27/2024	[redacted] WW	12:25:00 PM	8	6.86
9/26/2024	[redacted] WW	9:00:00 AM	9	6.66
9/26/2024	[redacted] WW	9:02:00 AM	8	6.68
9/26/2024	[redacted] WW	9:04:00 AM	11.25	6.68
9/26/2024	[redacted] WW	9:10:00 AM	12	6.75
9/26/2024	[redacted] WW	9:15:00 AM	12.75	6.75
9/26/2024	[redacted] WW	9:20:00 AM	13.25	6.76
	Averages		**10.28**	**6.78**

Exhibit 2

Target: 3′ diameter concrete pipe (1″ cover)

Neutral pH scenario

Effect of Sulfide on Infrastructure Life Expectancy

Sulfide (mg/L)	Life Expectancy
0.5	>50 yrs
1.0	25-50 yrs
1.5	25 yrs
2.0	10-25 yrs
2.5	10 yrs
3.0	10yrs
4.0	5-10 yrs
7.0	5 yrs
>7.0	< 5 yrs

Exhibit 3

Based on a study conducted by the Environmental Protection Agency (Exhibit 3), the life expectancy for this particular infrastructure is **less than 5 years** given the average sulfide loading in solution.

Current Condition

Central Kentucky Pump Station

The effluent vault bears testimony to the active effects of corrosion from sulfide as seen in Exhibit 4 taken at the pump station.

Exhibit 4

The impact of corrosion downstream at the outfall manhole from the pump station is more severe seen in Exhibit 5 and 6. At points, the rebar is visible, and the ductile iron pipe at the discharge has broken off and fallen to the bottom of the manhole.

Exhibit 5

Exhibit 6

Assessment - STX Process

Central Kentucky Pump Station

The value of an odor control system is the abatement of offensive odors and the reduced economic impact of corrosion on infrastructure. The primary methods for achieving these goals are upstream liquid chemical injection and scrubbers.

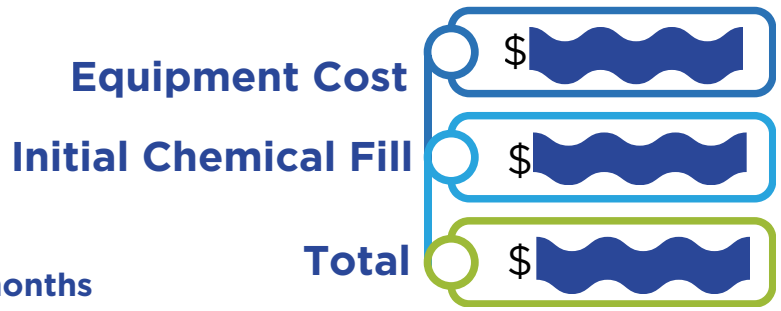
Liquid Chemical Injection

For liquid chemical injection to be most effective at this PS, chemical injection would need to be introduced before the wastewater outfalls at the pump station, at least 750 ft upstream from where the force main outfalls based on average daily flows. The recommended solution for this system is the STX Process, which needs at minimum 3 minutes of contact time in a force main to achieve sulfide reduction goals. Reducing sulfide to less than 0.5 mg/L (S=) in solution in the influent force main would mitigate odor issues and would prevent corrosion from occurring. Given the hydraulic retention time of this region, injecting the STX Process before this PS would also remove odor and corrosion downstream, protecting this PS, the outfall manhole, and a subsequent pump station. Based on the existing corrosion damage observed on-site and downstream, an STX system would provide more long-term economic benefits to the city's infrastructure. This solution would also remove the need for a scrubber at this PS and the subsequent PS.

STX Process

Initial Cost Estimate

(Initial fill should last 2-3 months based on estimated dose rates)



+ Ongoing Chemical Costs

Assessment - Scrubber

Central Kentucky Pump Station

Scrubber technologies pull air from an existing space and reduce the volume of offensive odors at that location. This provides localized benefits to the environment and reduces the amount of H_2S that can become sulfuric acid at the point of treatment. Because H_2S has already formed, corrosion can and will still occur, though it can be reduced. Some types of scrubbers have limitations when treating various reduced sulfur compounds or treating large, fluctuating volumes of H_2S. Chemical scrubbers are the most efficient scrubber method for removing wide ranges of localized sulfide issues. However, traditional chemical scrubbers often require the use of toxic and hazardous chemicals, such as Sodium Hydroxide and/or Sodium Hypochlorite (also known as Caustic Soda and Bleach). Additionally, scrubbers utilizing these chemicals can be expensive to maintain. Other scrubber options are Carbon bed scrubbers or Bio scrubbers. These scrubbers do not typically require harmful chemicals; however, they are unable to handle wide ranges of sulfide loading, working best when H_2S averages 50 PPM or less, with peak H_2S levels below 200 PPM. Those ranges are below the average and peaks seen at this PS and therefore are not advised for this location.

Fortunately, Source Technologies' Evergreen scrubber utilizes a pH-neutral, organic chemistry that is environmentally friendly and unbiased towards a wide range of H_2S spikes. Evergreen is also capable of removing other malodorous Reduced Sulfur Compounds aside from H_2S. It has a small footprint, easily powered by 110v or any 3-phase available, and simply hooks up to existing SCADA systems. The main disadvantage to a stand alone scrubber system at this PS versus a liquid injection system is that it would not provide downstream benefits. While on-site corrosion would be reduced, it would not be eliminated as aforementioned.

Scrubber

Initial Estimated Cost

Equipment $

Monthly $

Service Fee

Annual Total $

*Based on estimated needs and are subject to change

Assessment - Combination

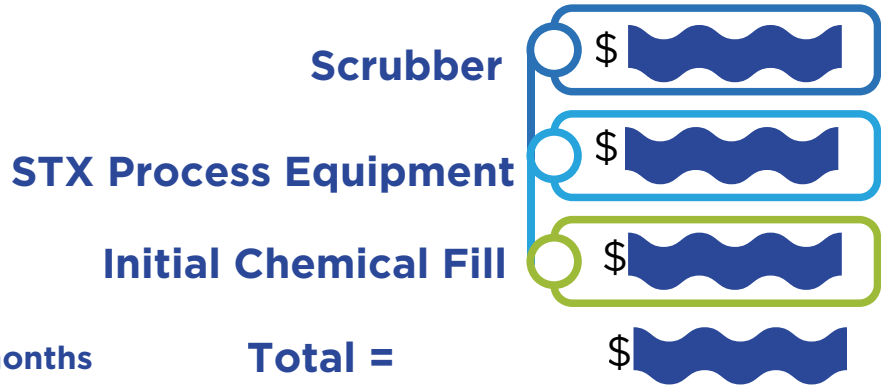
Central Kentucky Pump Station

A combination of both liquid chemical injection and scrubber technology at this PS may also be of interest. This approach would provide a localized economical solution in the scrubber to remove on-site odors and reduce corrosion while delivering downstream odor and corrosion prevention by injecting the STX Process at the Pump Station. This would eliminate the need for a farther upstream chemical dosing location that would require an easement, power, fencing, and a concrete pad. This approach would require a larger footprint but would provide a centralized odor control facility at this PS, making deliveries easier, reducing scrubber service costs, and simplifying O&M.

Combined System

Initial Estimated Cost

(Initial fill should last 2-3 months based on estimated dose rates)



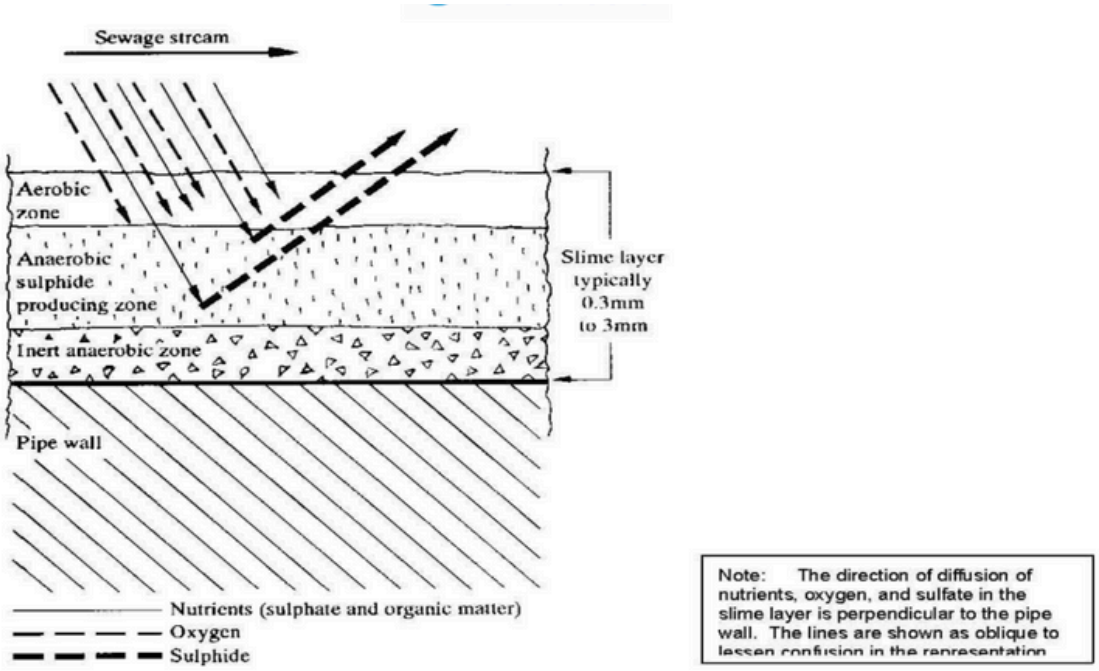
+ Ongoing Chemical Costs

*Based on estimated needs and are subject to change

Appendix 1 - Sulfide Formation

Central Kentucky Pump Station

Sulfide formation is a naturally occurring process in wastewater. Sulfide forms when sulfate (SO4=) is reduced by Sulfate Reducing Bacteria (SRBs) in anaerobic conditions. SRBs live in a “slime layer” that forms along sewer pipes. In force mains where oxygen is no longer being introduced, SRBs consume the oxygen molecules in sulfate, producing sulfide (S=). Example 1 details slime layer build up on sewer pipe wall.



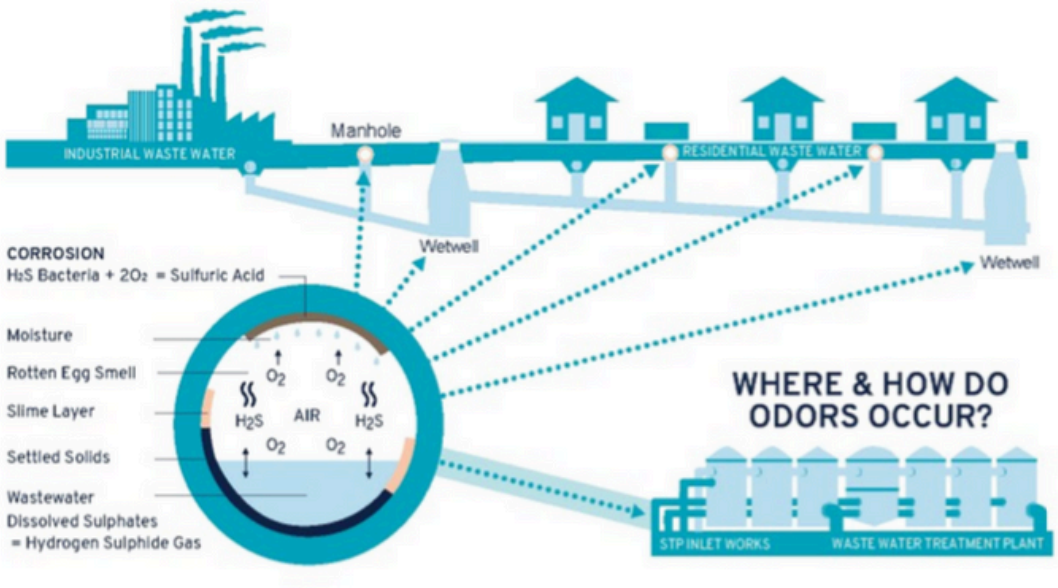
Example 1

Once produced, sulfide in solution forms hydrosulfide (HS-). When a force main discharges into a gravity manhole or when oxygen is introduced at an Air Release Valve (ARV), hydrogen sulfide (H_2S) can form. H_2S is commonly identified as having a rotten egg odor. At a neutral pH and in the presence of oxygen, 50% of sulfide will be in the vapor phase and 50% in liquid phase.

Appendix 2 - Sulfide & Infrastructure

Central Kentucky Pump Station

One of the methods for determining sulfide loading in solution is to use a portable colorimeter device and the methylene blue method. This test helps identify how many milligrams per liter (mg/L) of sulfide are in solution. 1 mg/L of S= can form up to roughly 250 parts per million (ppm) H_2S. Gas detection equipment can be deployed throughout the collection system to determine the concentrations of H_2S in specific locations. **Once H_2S has formed, corrosion will occur.**



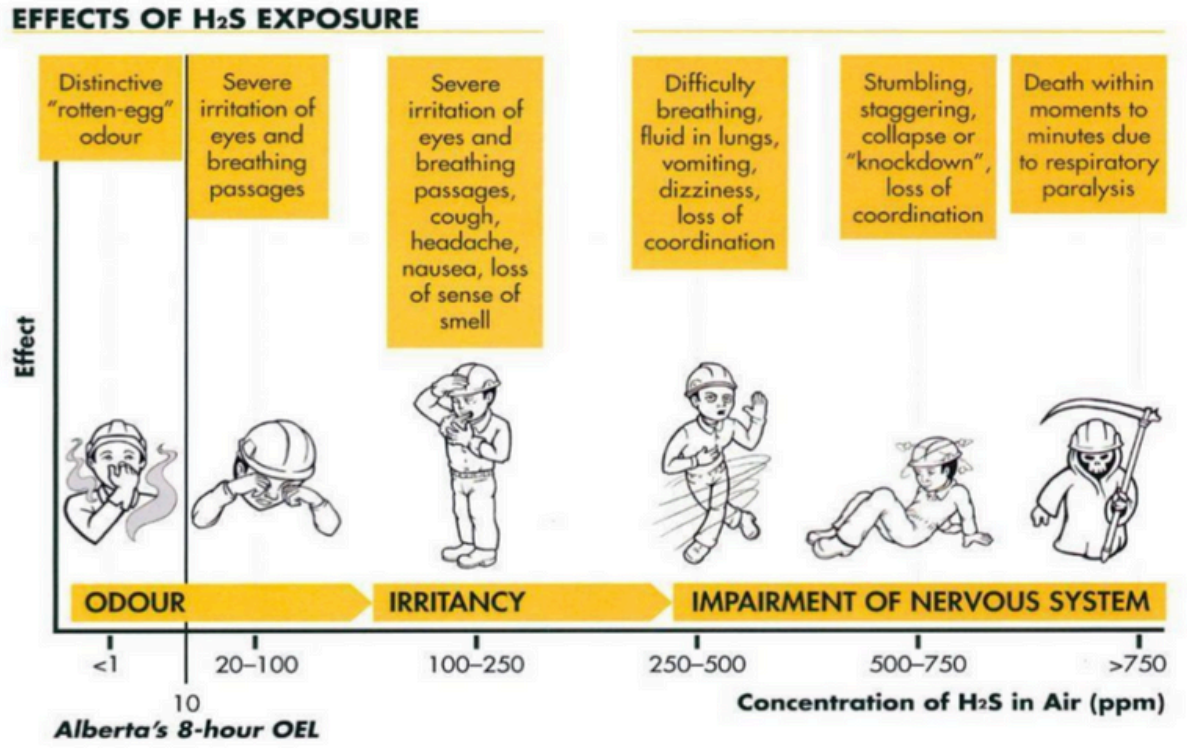
Example 2: Hydrogen Sulfide formation in wastewater systems

Depending on turbulence and pH, understanding the concentrations of sulfide in solution can help determine the life expectancy of infrastructure. The goal of most liquid chemical injection technologies is to reduce sulfide loading in solution to below 0.5 mg/L (S=). The Environmental Protection Agency (EPA) conducted a study on the effects of corrosion on concrete in a pH-neutral scenario. Their study showed that 0.5 mg/L (S=) in solution in a pH-neutral environment would increase the life expectancy of concrete infrastructure to over 50 years. Conversely, a sulfide loading over 7 mg/L (S=) in solution decreases the same infrastructure life expectancy to 5 years or less. This PS averages 10.28 mg/L (S=).

Appendix 3 - Sulfide & Health

Central Kentucky Pump Station

Hydrogen sulfide exposure is associated with many health risks. The example below shows how exposure over an 8 hour period can adversely affect an individual. Longer term exposure can carry increased risks, including impairment of the nervous system which may result in death. Every individual is affected differently and elimination is the only 100% effective solution for protection from the effects of H_2S.



Example 4: Hydrogen Sulfide with regard to exposure levels

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Odor and corrosion from wastewater is problematical whether occurring at the treatment plant or in the collection system winding through neighborhoods. While most of the general public recognizes hydrogen sulfide (H_2S) as the “rotten egg” smell associated with sewage treatment, facility managers know H_2S is a far more destructive and corrosive compound for wastewater treatment facilities and the collection systems that feed them. Additionally, H_2S is not only a costly nuisance, it can be a serious health and safety problem as well.

Source Technologies, whose principals have long been involved with environmental remediation and municipal wastewater treatment, formed the company to deploy the latest cutting edge technologies that apply to municipal wastewater treatment facilities, industrial pre-treatment activities and environmental restoration.

Under the leadership of CEO Suzie Richards, Source Technologies is proud to be a provider of one of the most powerful, comprehensive and cost-effective odor treatment technologies in the municipal wastewater market space. Our family of advanced oxidation and catalyzed oxygenation technologies are “green”, best-in-class, scalable and simple to operate.

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