Transportable Solids Case Study

Northern Virginia

The ETX Process

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Pilot Study

Northern Virginia Advanced Water Reclamation Facility

Background: This northern Virginia AWRF processes on average 140,000 gallons of sludge per day producing roughly 8,000 pounds of transportable solids per hour. Sludge travels from the holding tanks through 1 of 4 pumps in the basement of the centrifuge building. After the pumps, the sludge goes up into the centrifuge and is processed into transportable solids. These solids can sit in storage for multiple days before being transported to a landfill or given to Synagro to produce fertilizer. The landfill and Synagro regularly refuse the product due to its foul smell, disrupting and limiting the production of solids. These foul odors come from a variety of reduced sulfur compounds that continually form in sludge due to the biological activity in anaerobic conditions.

Goal: Reduce and prevent the formation of malodorous compounds in Transportable Solids and increase acceptable landfill transported solids.

Success defined as: Total Reduced Sulfur (TRS) in the treated batches of transportable solids maintain an acceptably low to non-detectible level of odor development.

Process: Preliminary sulfide data was gathered by sampling the transportable solids to estimate feed rates for treatment. Based on that data and the desire to maintain low levels of malodourous off-gassing for multiple days, the ETX process was deemed the most likely product to provide success. The ETX process is a combination of Source Technologies' patented ETX catalyst and hydrogen peroxide that creates a chemical reaction resulting in the separation of volatile compounds on the atomic level. The process was injected before the centrifuge near the sludge pumps to ensure proper mixing and contact time (Picture 1 seen below).

Picture 1: (Left) 50% H_2O_2 and (Right) ETX catalyst temporary chemical injection system.

ETX Process

Northern Virginia AWRF

The ETX Process feed rates were calculated to test the effectiveness of treatment based on average and peak levels of total sulfide seen in the aforementioned sampling. Bench testing was conducted by injecting the ETX process into the sludge stream at the desired feed rates. Transportable solids were then contained in sealed 50-gallon plastic containers to mirror anaerobic conditions (seen in Picture 2 below). An untreated control sample was taken as well as two treated samples, labeled MinF (Minimum Feed Rate) and PeakF (Peak Feed Rate). The MinF for ETX was 2.12 gallons per hour (GPH) and 1.47 GPH for 50% hydrogen peroxide. The PeakF for ETX was 4.22 GPH and 2.94 GPH for 50% hydrogen peroxide.

Picture 2: Control, MinF-treated sample and PeakF-treated sample from left to right.

Sulfur analysis samples were taken utilizing 1.0 L Vacuum sealed containers. The samples were analyzed for twenty sulfur compounds using a gas chromatograph equipped with a sulfur chemiluminescence detector. All compounds except hydrogen sulfide and carbonyl sulfide were quantified against the initial calibration curve for methyl mercaptan. Vacuum canister samples were taken through ½" ball valves (seen above in picture 2) after being sealed within the container, then again after 24 hours.

Pilot Results

Northern Virginia AWRF

INSTANT Untreated vs Peak Feed Rate

Compound	Untreated µg/m³	PeakF µg/m³	Delta
Hydrogen Sulfide	24	0	100.0% reduction
Carbonyl Sulfide	9,500	29	99.7% reduction
Methyl Mercaptan	39	0	100.0% reduction
Dimethyl Sulfide	30,000	550	98.2% reduction
Dimethyl Disulfide	72,000	190	99.7% reduction

INSTANT Untreated vs Minimum Feed Rate

Compound	Untreated µg/m³	MinF µg/m³	Delta
Hydrogen Sulfide	24	16	33.3% reduction
Carbonyl Sulfide	9,500	1,800	81.1% reduction
Methyl Mercaptan	39	0	100.0% reduction
Dimethyl Sulfide	30,000	1,400	95.3% reduction
Dimethyl Disulfide	72,000	4,100	94.3% reduction

24 HOURS Untreated vs Peak Feed Rate

Compound	Untreated µg/m³	PeakF µg/m³	Delta
Hydrogen Sulfide	220,000	1,100	99.5% reduction
Carbonyl Sulfide	7,800	2,500	67.9% reduction
Methyl Mercaptan	4,600,000	130,000	97.2% reduction
Dimethyl Sulfide	490,000	1,700	99.7% reduction
Dimethyl Disulfide	1,800,000	150,000	91.7% reduction

24 HOURS Untreated vs Minimum Feed Rate

Compound	Untreated µg/m³	MinF µg/m³	Delta
Hydrogen Sulfide	220,000	170,000	22.7% reduction
Carbonyl Sulfide	7,800	4,500	42.3% reduction
Methyl Mercaptan	4,600,000	5,600,000	21.7% increase*
Dimethyl Sulfide	490,000	43,000	91.2% reduction
Dimethyl Disulfide	1,800,000	1,600,000	11.1% reduction

After 24 hours, PeakF continued to show excellent results. MinF was not able to maintain the same levels of control over an extended period of time. *Most likely an outlier.

Detailed lab results found in Appendix A

Conclusion

Northern Virginia AWRF

The successful pilot study at this Northern Virginia AWRF wrapped up with initial data proving very successful for both the Minimum Feed Rate and Peak Feed Rate. Injecting the ETX Process into the influent sludge line before the centrifuge allowed for rapid mixing to occur, which led to the successful control over reduced sulfur compounds. Data showed substantial reductions across the board. While the MinF was able to provide excellent immediate results treating the transportable solids, the PeakF was successful for up to 24 hours maintaining hydrogen sulfide, carbonyl sulfide, methyl mercaptan, dimethyl sulfide and dimethyl disulfide levels to a significant reduction from the control.

Both treatment options showed great value based on the desired control range.

Appendix A

Untreated

Instant

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV
7783-06-4	Hydrogen Sulfide	**24**	9.4	**17**	6.8
463-58-1	Carbonyl Sulfide	**9,500**	17	**3,900**	6.8
74-93-1	Methyl Mercaptan	**39**	13	**20**	6.8
75-08-1	Ethyl Mercaptan	ND	17	ND	6.8
75-18-3	Dimethyl Sulfide	**30,000**	17	**12,000**	6.8
75-15-0	Carbon Disulfide	**840**	11	**270**	3.4
75-33-2	Isopropyl Mercaptan	ND	21	ND	6.8
75-66-1	tert-Butyl Mercaptan	ND	25	ND	6.8
107-03-9	n-Propyl Mercaptan	**42**	21	**14**	6.8
624-89-5	Ethyl Methyl Sulfide	**24**	21	**7.7**	6.8
110-02-1	Thiophene	ND	23	ND	6.8
513-44-0	Isobutyl Mercaptan	ND	25	ND	6.8
352-93-2	Diethyl Sulfide	ND	25	ND	6.8
109-79-5	n-Butyl Mercaptan	**32**	25	**8.8**	6.8
624-92-0	Dimethyl Disulfide	**72,000**	13	**19,000**	3.4
616-44-4	3-Methylthiophene	ND	27	ND	6.8
110-01-0	Tetrahydrothiophene	ND	24	ND	6.8
638-02-8	2,5-Dimethylthiophene	ND	31	ND	6.8
872-55-9	2-Ethylthiophene	ND	31	ND	6.8
110-81-6	Diethyl Disulfide	ND	17	ND	3.4

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

24 Hours

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV
7783-06-4	Hydrogen Sulfide	**220,000**	1,900	**160,000**	1,400
463-58-1	Carbonyl Sulfide	**7,800**	3,400	**3,200**	1,400
74-93-1	Methyl Mercaptan	**4,600,000**	2,700	**2,400,000**	1,400
75-08-1	Ethyl Mercaptan	ND	3,500	ND	1,400
75-18-3	Dimethyl Sulfide	**490,000**	3,500	**190,000**	1,400
75-15-0	Carbon Disulfide	ND	2,200	ND	700
75-33-2	Isopropyl Mercaptan	ND	4,300	ND	1,400
75-66-1	tert-Butyl Mercaptan	ND	5,100	ND	1,400
107-03-9	n-Propyl Mercaptan	ND	4,300	ND	1,400
624-89-5	Ethyl Methyl Sulfide	ND	4,300	ND	1,400
110-02-1	Thiophene	ND	4,800	ND	1,400
513-44-0	Isobutyl Mercaptan	ND	5,100	ND	1,400
352-93-2	Diethyl Sulfide	ND	5,100	ND	1,400
109-79-5	n-Butyl Mercaptan	ND	5,100	ND	1,400
624-92-0	Dimethyl Disulfide	**1,800,000**	2,700	**470,000**	700
616-44-4	3-Methylthiophene	ND	5,600	ND	1,400
110-01-0	Tetrahydrothiophene	ND	5,000	ND	1,400
638-02-8	2,5-Dimethylthiophene	ND	6,400	ND	1,400
872-55-9	2-Ethylthiophene	ND	6,400	ND	1,400
110-81-6	Diethyl Disulfide	ND	3,500	ND	700

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

PeakF

Instant

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV
7783-06-4	Hydrogen Sulfide	ND	10	ND	7.2
463-58-1	Carbonyl Sulfide	**29**	18	**12**	7.2
74-93-1	Methyl Mercaptan	ND	14	ND	7.2
75-08-1	Ethyl Mercaptan	ND	18	ND	7.2
75-18-3	Dimethyl Sulfide	**550**	18	**220**	7.2
75-15-0	Carbon Disulfide	**35**	11	**11**	3.6
75-33-2	Isopropyl Mercaptan	ND	22	ND	7.2
75-66-1	tert-Butyl Mercaptan	ND	27	ND	7.2
107-03-9	n-Propyl Mercaptan	ND	22	ND	7.2
624-89-5	Ethyl Methyl Sulfide	ND	22	ND	7.2
110-02-1	Thiophene	ND	25	ND	7.2
513-44-0	Isobutyl Mercaptan	ND	27	ND	7.2
352-93-2	Diethyl Sulfide	ND	27	ND	7.2
109-79-5	n-Butyl Mercaptan	**36**	27	**9.7**	7.2
624-92-0	Dimethyl Disulfide	**190**	14	**49**	3.6
616-44-4	3-Methylthiophene	ND	29	ND	7.2
110-01-0	Tetrahydrothiophene	ND	26	ND	7.2
638-02-8	2,5-Dimethylthiophene	ND	33	ND	7.2
872-55-9	2-Ethylthiophene	ND	33	ND	7.2
110-81-6	Diethyl Disulfide	ND	18	ND	3.6

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

24 Hours

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV
7783-06-4	Hydrogen Sulfide	**1,100**	46	**790**	33
463-58-1	Carbonyl Sulfide	**2,500**	82	**1,000**	33
74-93-1	Methyl Mercaptan	**130,000**	65	**64,000**	33
75-08-1	Ethyl Mercaptan	ND	84	ND	33
75-18-3	Dimethyl Sulfide	**1,700**	84	**660**	33
75-15-0	Carbon Disulfide	**1,200**	52	**380**	17
75-33-2	Isopropyl Mercaptan	**160**	100	**50**	33
75-66-1	tert-Butyl Mercaptan	ND	120	ND	33
107-03-9	n-Propyl Mercaptan	ND	100	ND	33
624-89-5	Ethyl Methyl Sulfide	ND	100	ND	33
110-02-1	Thiophene	ND	110	ND	33
513-44-0	Isobutyl Mercaptan	ND	120	ND	33
352-93-2	Diethyl Sulfide	ND	120	ND	33
109-79-5	n-Butyl Mercaptan	ND	120	ND	33
624-92-0	Dimethyl Disulfide	**150,000**	64	**39,000**	17
616-44-4	3-Methylthiophene	ND	130	ND	33
110-01-0	Tetrahydrothiophene	ND	120	ND	33
638-02-8	2,5-Dimethylthiophene	ND	150	ND	33
872-55-9	2-Ethylthiophene	ND	150	ND	33
110-81-6	Diethyl Disulfide	ND	83	ND	17

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MinF

Instant

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV
7783-06-4	Hydrogen Sulfide	**16**	9.4	**11**	6.8
463-58-1	Carbonyl Sulfide	**1,800**	17	**720**	6.8
74-93-1	Methyl Mercaptan	ND	13	ND	6.8
75-08-1	Ethyl Mercaptan	ND	17	ND	6.8
75-18-3	Dimethyl Sulfide	**1,400**	17	**560**	6.8
75-15-0	Carbon Disulfide	**120**	11	**40**	3.4
75-33-2	Isopropyl Mercaptan	ND	21	ND	6.8
75-66-1	tert-Butyl Mercaptan	ND	25	ND	6.8
107-03-9	n-Propyl Mercaptan	ND	21	ND	6.8
624-89-5	Ethyl Methyl Sulfide	ND	21	ND	6.8
110-02-1	Thiophene	ND	23	ND	6.8
513-44-0	Isobutyl Mercaptan	ND	25	ND	6.8
352-93-2	Diethyl Sulfide	ND	25	ND	6.8
109-79-5	n-Butyl Mercaptan	ND	25	ND	6.8
624-92-0	Dimethyl Disulfide	**4,100**	13	**1,100**	3.4
616-44-4	3-Methylthiophene	ND	27	ND	6.8
110-01-0	Tetrahydrothiophene	ND	24	ND	6.8
638-02-8	2,5-Dimethylthiophene	ND	31	ND	6.8
872-55-9	2-Ethylthiophene	ND	31	ND	6.8
110-81-6	Diethyl Disulfide	ND	17	ND	3.4

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

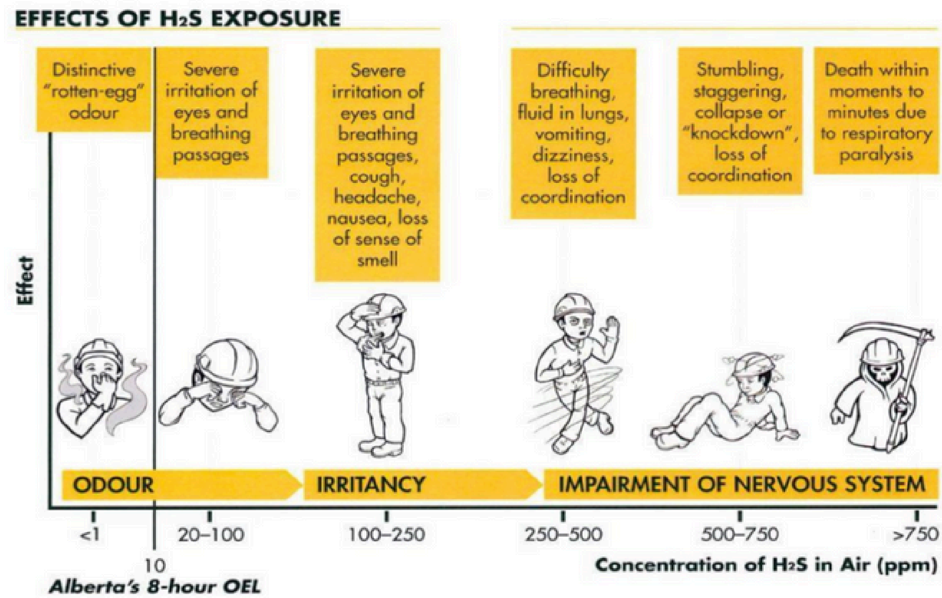
24 Hours

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV
7783-06-4	Hydrogen Sulfide	**170,000**	970	**120,000**	700
463-58-1	Carbonyl Sulfide	**4,500**	1,700	**1,800**	700
74-93-1	Methyl Mercaptan	**5,600,000**	1,400	**2,900,000**	700
75-08-1	Ethyl Mercaptan	ND	1,800	ND	700
75-18-3	Dimethyl Sulfide	**43,000**	1,800	**17,000**	700
75-15-0	Carbon Disulfide	**1,700**	1,100	**560**	350
75-33-2	Isopropyl Mercaptan	**4,900**	2,200	**1,600**	700
75-66-1	tert-Butyl Mercaptan	ND	2,600	ND	700
107-03-9	n-Propyl Mercaptan	ND	2,200	ND	700
624-89-5	Ethyl Methyl Sulfide	ND	2,200	ND	700
110-02-1	Thiophene	ND	2,400	ND	700
513-44-0	Isobutyl Mercaptan	ND	2,600	ND	700
352-93-2	Diethyl Sulfide	ND	2,600	ND	700
109-79-5	n-Butyl Mercaptan	ND	2,600	ND	700
624-92-0	Dimethyl Disulfide	**1,600,000**	1,300	**410,000**	350
616-44-4	3-Methylthiophene	ND	2,800	ND	700
110-01-0	Tetrahydrothiophene	ND	2,500	ND	700
638-02-8	2,5-Dimethylthiophene	ND	3,200	ND	700
872-55-9	2-Ethylthiophene	ND	3,200	ND	700
110-81-6	Diethyl Disulfide	ND	1,700	ND	350

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

Appendix B

Effects of H_2S



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.

Depending on turbulence and pH, understanding the concentrations of sulfide in solution can help determine the life expectancy of infrastructure.

Effect of Sulfide on Infrastructure Life Expectancy

Target: 3′ diameter concrete pipe (1″ cover")
*neutral pH scenario
*Source of chart
EPA website

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

Source Technologies, LLC

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.

For additional information, contact us.

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