32nd Annual Industrial Waste Seminar SWOWEA Section



D3W Topline Company Profile

D3W Industries was founded in 2007 as a division of Jack Doheny Companies as an employee-led, customer and community driven organization, focused on being a partner and provider of odor control solutions.

Today, D₃W Industries tailors treatments to fit specific needs for each customer, evaluating;

Background

Applications

Expectations

Providing solutions, for wastewater, collection system, water and industrial. H_2S Mitigation and Odor Experts focused on;

Science Service Safety Results

D3W Topline Company Profile

D3W Team - Presenter introductions

Nick Lionas President

Joined today by

Mauricio Perez Sales Operations

Michael Lionas Sales Operations

D₃W Industries is committed to providing each customer with sound treatment solutions, proactively problemsolving, while offering excellent customer service.

In addition to an excellent and knowledgeable management and sales staff, D3W Industries is privileged to have the support of:

Dr. Frank Kitakis, Cellular Microbiology Director of Science

Daniel Collins, PE Biosolids & Environmental Management





Discussions Agenda

Odor Science

Regulators

Safety

Odor Evaluation

Odor Monitoring





With Congratulations and Appreciation to

Empire Packing



Thank you

Kris Berry and the Executive Team

Also to

Mike Otter and his Facilities/Engineering Team

John, Brandon, James E, Perrin, Russell, Michael and James R





Much Appreciation to

The City Of Mason Public Utilities Department



Thank you

Shawn Hollon

Ed Smith

Josh Creech





Odor Science





<u>Odor</u>

Is defined as the property of a substance that activates the sense of smell.

- Odorous matter is identified as a disagreeable smell
- Fragrance typically is viewed as a agreeable scent.



Odor Science

Odors or Olfaction (sense of smell), is considered the least understood of the five senses.

Odor scientists have been trying for decades to establish comprehensive standards for odor descriptors, odor intensity measurements and predictive odor characteristics.

Some strides have been made through the use of olfactometers and the measurement of ambient dilution thresholds.

Specifically, in collections and wastewater, the biggest strides today have been made through the use of Continuous Emission Monitoring (CEM) devices.

Odor Science



Characterizations

There are significant differences in individuals between the most sensitive and least sensitive people in terms of odor acuity.

These differences can be attributed to multiple factors:

- Age generally, the olfactory sensory nerves atrophy from the time of birth to the extent that only 82 percent of the acuity remains at the age of 20; 38 percent at the age of 60 and 28 percent at the age of 80
- Gender females tend to have a keener sense of smell than males
- Sinus Conditions
- Prescription Drugs
- Urban Vs. Rural
- Tobacco Use non-smokers typically have better acuity than smokers

lowa State University of Science and Technology, Ames, Iowa The Science of Smell Part 1 Odor Perception and Physiological Response



Characterizations

Humans are able to distinguish between more than 5,000 odors

In many cases, people develop smell amnesia for familiar odors

Wastewater's two prevalent odor culprits, H_2S and ammonia, often cause olfactory losses due to prolonged exposure

Effects of Hydrogen Sulfide



lowa State University of Science and Technology, Ames, Iowa The Science of Smell Part 1 Odor Perception and Physiological Response



Quantification of Odor

Odor Threshold or Dilution Threshold – identifies the concentration of odors of which 50% of a human panel can identify the presence of an odor or odorant without characterizing the stimulus.

Recognition Threshold - is the concentration at which 50 percent of the human panel can identify the odorant or odor, such as the smell of H_2S , ammonia or peppermint.

Ammonia and Hydrogen Sulfide are the two biggest contributors to wastewater odor issues and concerns and are quantifiable through electronic continuous emissions monitoring.



Odor Science



Odor Science

The CDC provides national odor thresholds identifying nuisance odors using the FIDO Wheel.

How offensive is the environmental odor?

- a. Find more specific odors in the outer circle below.
- b. Find the general type of odor in the inner circle.
- c. Find the environmental odor or type of odor in the lists below to determine how offensive the odor is.



Not Unpleasant	Unpleasant	Offensive	Highly Offensive					
1. Floral and herbal smells	5. Fishy smells	2. Pungent and rancid smells	3. Putrid smells					
7. Pine and minty smells	6. Earthy, musty, musky, stale smells	4. Fecal smells	10. Rotten and marshy smells					
	8. Chemical smells							
	9. Medicinal and soapy smells							
Alcohols	Sewage during treatment	Landfill garbage/waste	Untreated or barely treated					
Fresh-cut grass or hay	Cattle operation under best	Cattle lagoon cleanout	sewage					
Normal coffee roasting	management practices	Confined hog operations	Decaying animals/fish					
Normal food preparation	Water-based painting	Confined poultry operations	Animal hide processing					
Bakery	Gasoline, diesel fuel	Decaying compost	Rotten grease					
Perfume	Diesel exhaust	Unprocessed material and	Blood drying operations					
Spice packaging	Asphalt odors	wastewater from dead	[e.g., animal staughter houses] Hydrogen sulfide (H.S) [landfill gas, paper mill gas, rotten egg etc.] Mercaptans [cause of natural gas odor]					
Winery	Burned coffee/food	animal recycling plants						
	Burning brush or wood	Typical grease trap odor						
	Ammonia	plastic, tires, other non-						
	Chlorine	wood materials]						
	Tobacco smoke	Failing or improperly						
	Marijuana smoke	operated septic systems						
	Dry cleaner odors	body paint & styrene						
	Constant BBQ odors							
	Local industry or manufacturing (specify)							
	Natural gas drilling/fracking							
	Asphalt plants							
Choose the <u>durat</u> How long does	<u>tion</u> of the environmental the odor last?	odor.						
	🗆 1 minut	te						
	10 min	utes						
	1 hour							
	More t	han 12 hours						



Odor Identification

Non-nuisance odors

These odors can be measured using an olfactometer and are typically not objectionable.

Often, masking agents or air scents are used to offset negatively perceived odors.

The U.S. EPA regulates pollutants in the outside air through the National Ambient Air Quality Standards (NAAQS).

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
			8 hours	9 ppm	
Carbon Monoxide (CO)		primary	1 hour	35 ppm	Not to be exceeded more than once per year
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 µg/m ^{3 (<u>1)</u>}	Not to be exceeded
Nitrogen Dioxide.(NO ₂)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb ⁽²⁾	Annual Mean
<u>Ozone (O3)</u>		primary and secondary	8 hours	0.070 ppm ⁽³⁾	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
			1 year	12.0 µg/m ³	annual mean, averaged over 3 years
	DM	secondary	1 year	15.0 µg/m ³	annual mean, averaged over 3 years
Particle Pollution (PM)	1 112.5	primary and secondary	24 hours	35 µg/m ³	98th percentile, averaged over 3 years
	PM ₁₀	primary and secondary	24 hours	150 µg/m ³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide.(SO ₂)		primary	1 hour	75 ppb ^{(<u>4)</u>}	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year



Odor Identification

Nuisance odors that create a safety concern

These harmful gases can be precisely monitored and mitigated to protect workers and neighbors:

Hydrogen Sulfide – see chart

Mercaptans

Chemical Odors

Concentration (ppm)	Symptoms/Effects
0.00011- 0.00033	Typical background concentrations
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor described as sweet or sickeningly sweet.
2-5	Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep. Airway problems (bronchial constriction) in some asthma patients.
20	Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness.
50-100	Slight conjunctivitis ("gas eye") and respiratory tract irritation after 1 hour. May cause digestive upset and loss of appetite.
100	Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death



Plant Processes and Equipment Common Odors

Wastewater collection system and plant odors are typically driven by ammonia flares and hydrogen sulfide gas.

Plant odor can occur in all phases of wastewater treatment and are typically:

- From the anaerobic decomposition of organic compounds.
- A natural by-product of anaerobic digestion is hydrogen sulfide.
- Amines and Mercaptans are typical additional odor causing organic compounds containing sulfur or nitrogen, the human nose can detect at extremely low concentrations.
- Plant maintenance, planned or unplanned, and or upgrades to treatment processes can affect severity of odors.





Predictive Analysis

Predictable odor causing situations include:

- Oversized pipes
- Low flow situations in collection systems
- Sludge retention
- Poor anaerobic digestion
- Increased summer activity
- Infrastructure maintenance
- Operator changes to treatment process
- Lack of treatment

Preconceived notions of Wastewater Facility 'It's a wastewater plant, it's supposed to smell'

Odor Science



Additional Criteria in Evaluating Wastewater Odors

Weather

- Temperature
- Humidity
- Barometric Pressure
- Wind Direction

Temperature inversions, wind velocity, and wind direction contribute to how far odor emissions drift. Odors are typically worse at higher temperatures.

These conditions could effect the volatility of odor compounds, preventing or enhancing movement into the gaseous phase where odor can be dispersed downward.

For example, Hydrogen Sulfide gas is more dense than air. Hydrogen Sulfide concentrations are typically higher in low-lying surfaces.

Safety

• Employee and community safety is typically under-evaluated and contributes to a significant risk.





H2S, Infrastructure, Cost

Our industry typically views odors as a necessary nuisance and often does not take the corrective actions necessary to provide a safe work and community environment, nor does it consider the long-term cost of infrastructure degradation often spending millions of dollars on infrastructure repair/replacement as opposed to preventative maintenance.

 H_2S causes severe corrosion—5 to 10 ppm, if left unsolved, can cause concrete corrosion of several millimeters per year potentially translating to complete deterioration of a three inch thick concrete pipe in less than 25 years!





10ppm average $H_2S = 1/16^{th}$ inch annual concrete deterioration rate¹

Premature sewer deterioration and rehabilitation are major costs for municipalities.

Odor Science



H2S, Infrastructure, Cost



Correct pre-treatment can positively impact odors by reducing Hydrogen Sulfide and the infrastructure as a result of the reduced gas.

This is identifiable and measurable and can be a significant cost-savings on repair and maintenance.



ACGIH ~ NIOSH ~ OSHA Regulators





Who Is OSHA

Occupational Safety and Health Administration

With the Occupational Safety and Health Act of 1970, Congress created the Occupational Safety and Health Administration (OSHA) to assure safe and healthful working conditions for working men and women by setting and enforcing standards, and by providing training, outreach, education and assistance. OSHA is part of the United States Department of Labor.

Who Is NIOSH

The Center for Disease Controls (CDC) - National Institute for Occupational Safety and Health

The Occupational Safety and Health Act of 1970 established NIOSH as a research agency focused on the study of worker safety and health, and empowering employers and workers to create safe and healthy workplaces. It has the mandate to assure "every man and woman in the Nation safe and healthful working conditions".

Who Is ACHIH

Association Advancing Occupational and Environmental Health

ACGIH is dedicated to the advancement of occupational and environmental health, and recognized as a worldwide premier scientific organization advancing occupational and environmental health. ACHIH works closely with OSHA and NIOSH.

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H₂S Limit Overview OSHA

<u>H₂S CAS Number : 7783-06-04</u>

Description of Substance: Colorless gas with a strong odor of rotten eggs Immediately Dangerous to Life or Health Concentrations (IDLH)

<u>1989</u> OSHA Permissible Exposure Limit (enforceable) (PEL):

10 ppm (14 mg/m³) Time Weighted Average (TWA) for a 8 Hour Day

> 15 ppm (21 mg/m³) Short term Exposure Limit (STEL)

<u>Current</u> <u>OSHA Permissible Exposure</u> <u>Limit</u> <u>(enforceable) (PEL):</u>

20 ppm CEILING

50 ppm 10 Minute MAXIMUM PEAK

29 CFR 1910.1000 TABLE Z-2, Toxic and hazardous substances

Exposures **must not exceed** 20 parts per million (ppm) (ceiling) with the following exception: if no other measurable exposure occurs during the 8-hour work shift, exposures may exceed 20 ppm, but not more than 50 ppm (peak), for a single time period up to 10 minutes.



H₂S Limit Overview OSHA

Much of OSHA's Permissible Exposure Data is based on studies from the 1960's 70's and 80's

industries









10 ppm (15mg/m³ CEILING)



H₂S Limit Overview ACGIH

<u>H₂S CAS Number : 7783-06-04</u>

Description of Substance: Colorless gas with a strong odor of rotten eggs Immediately Dangerous to Life or Health Concentrations (IDLH) ndustries



H₂S Limit Overview ACGIH



Many organizations **are not** using the new TLV standard of 1ppm

They are typically measuring H₂S alarm levels at:

- 39% use 10ppm and 15ppm
- 35% use 5ppm and 10ppm
- 15% use 10ppm and 20 ppm

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CSHA Standards Hazards Hydrogen Sulfide in Workplac Evaluating/Controlling Exposu Additional Resources	PRESENT Preserve Preserve Source to the test of test	Other Exposure Limits for Hydrogen Sulfide NIOSH Recommended Exposure Limit (REL): 10 ppm, 10-minute ceiling Concentration considered immediately dangerous to life and health (IDLH): 100 ppm ACGIH [®] recommends a threshold limit value (TLV [®]) of 1 ppm as an 8-hour time weighted average (TWA) and a short-term exposure limit (STEL) of 5 ppm.



H₂S Safety



Safety Must Always Be Our 1st Priority

Safety Hazards

Hydrogen Sulfide is a highly flammable, explosive gas, and can cause possible life-threatening situations if not properly handled.

Hydrogen Sulfide gas burns and produces other toxic vapors and gases, such as Sulfur Dioxide. In addition to exposure to Hydrogen Sulfide in the air, exposure to liquid hydrogen sulfide can cause "blue skin" or frostbite. If clothing becomes wet, avoid ignition sources, remove the clothing and isolate it in a safe area to allow it to evaporate.

The effect called knockdown (rapid unconsciousness), often results in falls that can seriously injure the worker.

OSHA outlines potential longer term health effects

Some people who breathed in levels of **Hydrogen Sulfide** high enough to become unconscious continue to have headaches and poor attention span, memory, and motor function after waking up.

Problems with the cardiovascular system have also been reported at exposures above permissible exposure limits.

People who have asthma may be more sensitive to Hydrogen Sulfide exposure; i.e., they may have difficulty breathing at levels lower than people without asthma.



<u>Safety Must Always Be Our 1st Priority</u>

Hazardous Atmosphere - H₂S Hydrogen Sulfide

 $\rm H_2S$ can be instantly fatal at high levels – Never enter confined spaces without proper safety equipment.

The EHS safe limits for H₂S are 1PPM as a 8 hour TWA¹ and 5 PPM as a 15 minute STEL^{2*}





Safety Must Always Be Our 1st Priority

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		Biada	🗿 www.osł	na.gov/hydrogen	-sulfide				See all images	Workers' Rights	Hydrogen sulfide also occurs naturally in s wells, and volcanoes. Because it is heavier	ewers, manure pits, well water, oil and gas r than air, hydrogen sulfide can collect in low-	
						War	s this helpful? 🍙 🗭	Hydrogen sulfide Chemical Compound			lying and enclosed spaces, such as manh vaults. Its presence makes work in confine	oles, sewers, and underground telephone of spaces potentially very dangerous.	Why is hydrogen sulfide so
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			What are th	e symptoms of h	ydrogen sulfide poisoning	?	\sim	Underson sulfide is a shaminal assumption	ith the formula 11 O. M. in a		from mild, headaches or eye irritation, to v	ery serious, unconsciousness and death.	 It is highly flammable and toxic, even at low concentrations.
			Is H2S toxic	?			~	colorless chalcogen hydride gas with the chal	aracteristic foul odor of		health, where you might find it, and how to	prevent harmful exposures.	 It is heavier than air and may travel along the ground.
			Is hydrogen	sulfide safe?			\sim	rotten eggs. It is poisonous, corrosive, and fla sulfide is often produced from the microbial b	ammable. Hydrogen breakdown of organic		Standards	Hazards	 It can build up in low-lying areas, and in confined spaces (including
			What is the	exposure limit fo	or hydrogen sulfide?		\sim	matter in the absence of oxygen, such as in se	swamps and sewers +		Hydrogen sulfide exposure	Provides information on the safety	enclosed, poorly ventilated areas, such as manure pits, sewers,
							Feedback	W Wikipedia			addressed in specific OSHA standards for general Industry,	and health effects of hydrogen sulfide.	manholes, and underground vaults).
			Hydroger	Sulfide - Ove	rview Occupational	Safety and		Chemical formula: H2S			maritime, and construction.	More »	 After a while at low or more quickly at high concentrations,
			https://www Hydrogen.sul	v.osha.gov/hydro	ogen-sulfide -	as inhalation death	in the United	Boiling point: -76°F (-60°C)			More »		you can no longer smell it to warn you it's there.
			States. Accor	ding to the Bureau	of Labor Statistics (BLS) , hyd	irogen sulfide cau	sed 46 worker	Average Molar mass: 34.08 g/mol					 It can quickly, almost immediately, overcome
				HS AND ILLNI	ESS FROM HYDROGE	N SULFIDE	(*)	Classifications: Sulfide - Sulfur compounds			Hydrogen Sulfide in Workplaces	Evaluating/Controlling Exposure	unprepared workers, including rescue workers.
			the United St.	ates Bureau of Lab tween 1993 and 19	or Statistics (USBLS), 52 work 99. One fifth of these 52 deat	ers died of hydrog hs were accompan	en sulfide ied by a co	People also search for	See all (20+)				

Deaths in our industry occur because we miss opportunities to provide a safe environment



Safety Must Always Be Our 1st Priority

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		Linder			Fuchation	Oraclea King Francisco		immediately, overcome unprepared workers, including rescue workers.		

HIGHLIGHTS

Hydrogen sulfide is one of the leading causes of workplace gas inhalation deaths in the United States. According to the <u>Bureau of Labor Statistics (BLS)</u>, hydrogen sulfide caused 46 worker deaths between 2011 and 2017.

WHY is HYDROGEN SULFIDE SO DEADLY

- It is highly flammable and toxic, even at low concentrations.
- It is heavier than air and may travel along the ground.
- It can build up in low-lying areas, and in confined spaces (including enclosed, poorly ventilated areas, such as manure pits, sewers, manholes, and underground vaults).
- After a while at low or more quickly at high concentrations, you can no longer smell it to warn you it's there.
- It can quickly, almost immediately, overcome unprepared workers, including rescue workers.



Odor Complaints



Odor Complaints



Community Driven Odor Complaints

Odors are the cause for most air pollution complaints reported by citizens living near odorous facilities

Wastewater treatment plants

Landfills

Composting operations

Food & byproduct processes

Factories

Agricultural activities, e.g. livestock facilities

These complaints are typically measured in four descriptive factors

Odor Complaints



Community Driven Odor Complaints

Four parameters make up the hierarchy of a complaint:

- 1. Character/offensiveness the actual description of what the odor smells like. This parameter is sometimes called the "quality" or "offensiveness" of the odor.
- 2. Strength the overall intensity or concentration of the odor. The stronger the odor, the more likely a citizen is to be annoyed. Even pleasant odors, such as perfumes, can be annoying at high odor strength.
- 3. Duration the elapsed time of each odor episode. Longer duration odor episodes can lead to more drastic changes in plans around a citizen's home or community. Episodes of very short duration may be over before a citizen changes plans.
- 4. Frequency how often the citizen experiences odor episodes. The more frequent the intrusion into the citizen's life, the more annoying each experience becomes.

The cumulative effect of these four parameters: character, strength, duration, frequency creates the nuisance experience and the likely citizen complaint. This conceptual model helps define odor episodes and assists in the development of a credible odor monitoring program.



Odor Monitoring Procedures



Odor Monitoring



Odor Monitoring Devices Advancement

Odor Scientists have been trying for decades to establish comprehensive standards for odor descriptors, odor intensity measurements and predictive odor characteristics.

While some strides have been made through the use of olfactometers and the measurement of ambient dilution thresholds (specifically in collections and wastewater), the biggest strides today have been made through the use of Continuous Emission Monitoring (CEM) devices.



Odor Sampling Techniques

- Human Nose
 - Gives immediate personal alert
- Field Olfactometer
 - Determination performed under same conditions used for sample analysis and only reported with those analyses. It should be stressed that this value is only an estimate of the expected performance.
- CEM
 - CEM devices provide accurate, measurable, trackable data

Of all current techniques, the best by far is electronic continuous emissions monitoring systems which allow for immediate alerts to mobile devices with consistent tracking regardless of environmental conditions or operator inconsistencies.





industries





Odor Monitoring Procedures and Equipment

Olfactometer

The Nasal Ranger Field Olfactometer quantifies the perceived odor level as dilutions-tothreshold (D/T). This is determined as the number of dilution needed to make the ambient air odor just detectable.



sto n	er Name: Pontiac WWTP			ол		Descriptor	Date: 10/20/2016
					a	2 Descriptor	0000000
0 PM	South side Maintenance Bldg	X				515 Sewer	Sludge odor
5PM	North side Maintenance Bldg		X			411 Musty	Earthy odor
0 PM	West edge of pad	Х				515 Sewer	Sludge odor
5 PM	Road Northeast of pad					N/A	No odor
0 PM	Fence line due south of pad					N/A	No odor
25 PM	Opdyke Rd entrance					N/A	No odor
60 PM	Fence line next to sign #3					N/A	No odor
		-					
Wina	ther Conditions: Precipitation: Sunny None			Wind Di	nection: ((Blowing From)	Wind Spend:
	Partly Cloudy Fog			NW	A.	NE	Light Breeze (1-5 mph)
	Mostly Cloudy Rain			-	Ć		Moderate Wind (S-15 mph)
	Overcast Sleet			w \			Strong Wind (+15 mph)
	Hazy Snow			SW	s	SE .	
Tamy	perature: 37%			Relative H	umiality:	85%	Borometric Pressure: 30.39
mment	Base line readings prior to Pine	Scen	tmas	k.			

D3W industries

Odor Monitoring Procedures and Equipment



Continuous Emission Measuring Devices (CEM)

Electronic continuous measurement systems exceed past technologies ability to provide quantifiable metrics and measurements to evaluate odors and problem areas.

Portable Data-Logger units are designed to survive in the harsh environments typically found within the wastewater industry.

Personal Protection Devices are designed for employee protection and safety.

Loggers measure and track H_2S parts per million (PPM) or billion monitor (PPB) and are portable and designed for indoor and outdoor environmental applications, to record low levels (0-2000PPB) of Hydrogen Sulfide (H_2S), at sampling intervals of between 10 minutes and 1 hour.

Ammonia Loggers track NH₃ concentrations up to 100 PPM.

CEM Devices provide accurate, measurable, trackable data that provides less labor intensive odor monitoring, saving costs, in a safer manner.





D3W industries

Odor Resolution



Odor Resolution



Where do I get Help?

Identify trained and qualified odor inspectors – review qualifications including EPA approvals

Conduct Baseline Testing

- Use metrics that are not solely based on perception or subjective values. Leverage objective observation and track for environmental changes.
- When available, leverage data and readings from available tools that can provide Continuous Emission Monitoring (CEM).
- Create regular scheduled review of data. Log, review and adjust as the odorous environment changes.





Thank You

