Odor Treatment

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What is Odor

- Offensive Odors and **smells** contribute to the level of air **pollution** in our local communities.
- They may be harmful to our health and affect the use and enjoyment of property.
- Industrial/Municipal - **Smells** from industrial and Municipal activities are common causes of complaints to local councils.

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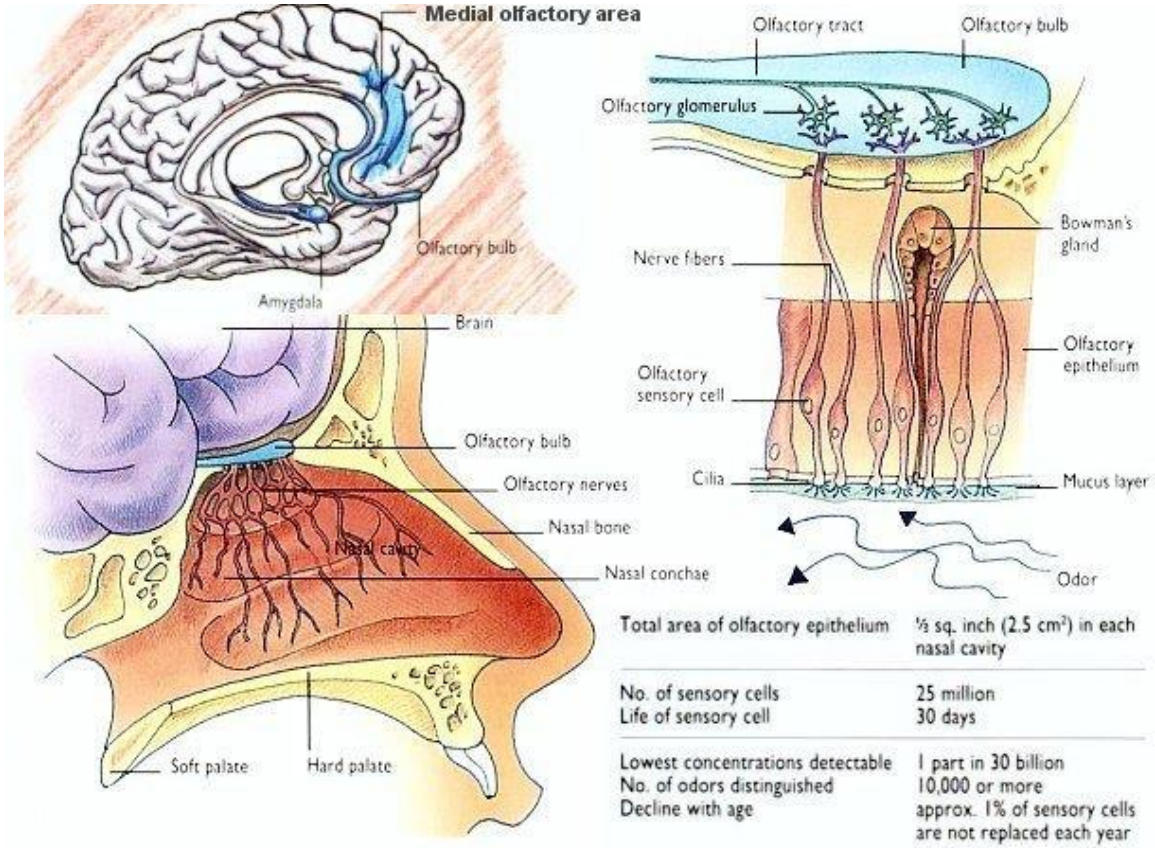
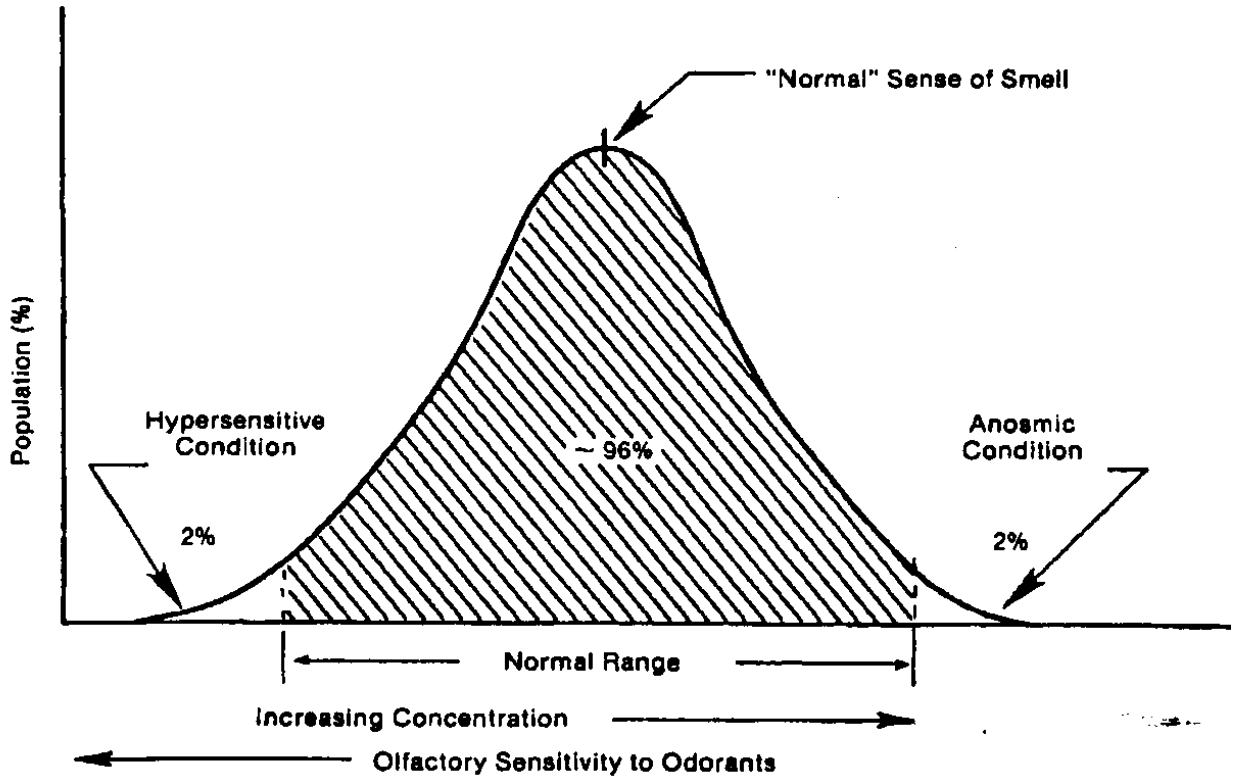
Sense of Smell





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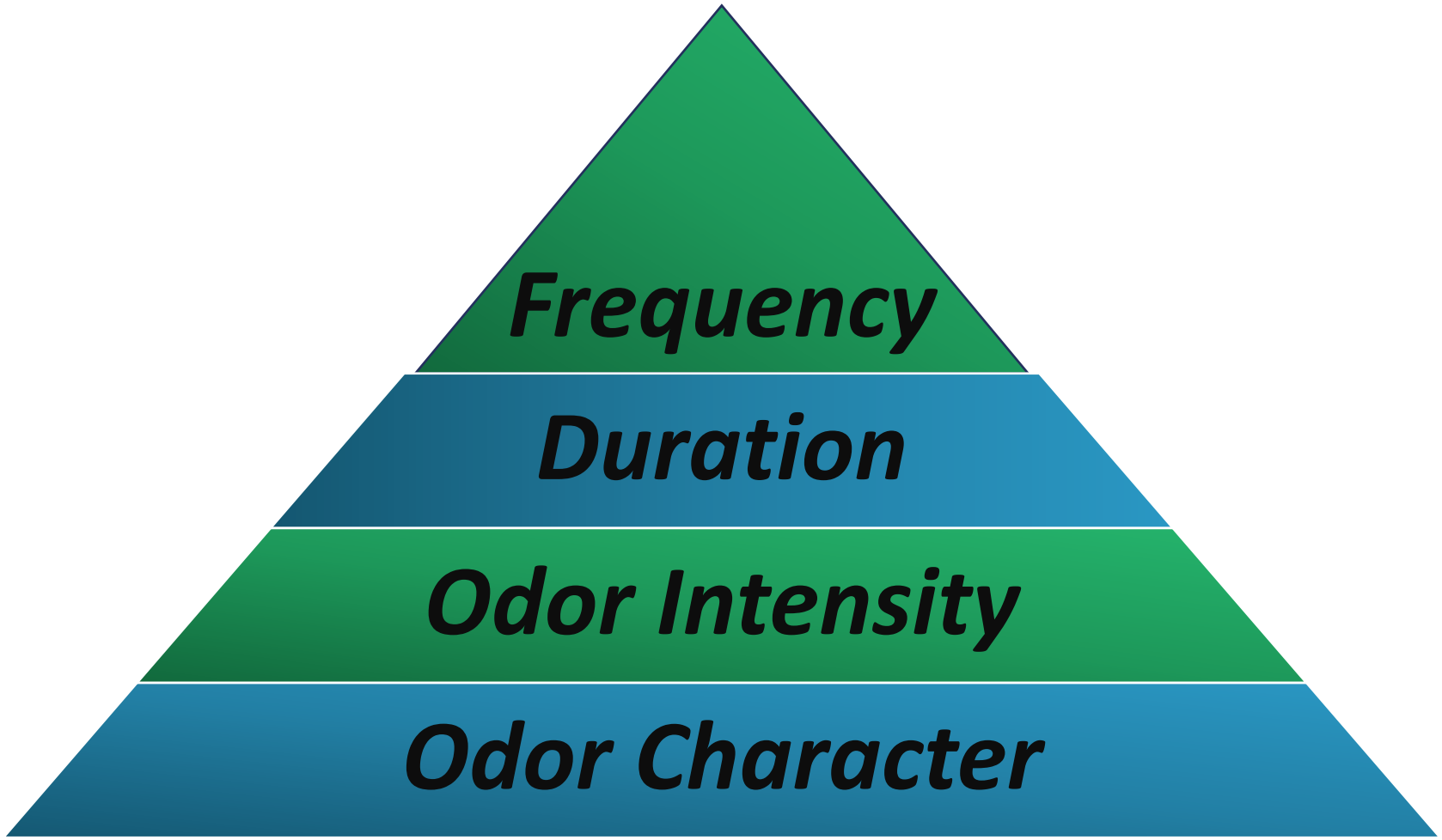
Components of an Odor Complaint



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Measurement of Odor

- Olfactometer Test and Odor Panel
- Diluted odorous mixture and an Odor-free gas (as a reference) are presented separately
- They are asked to compare the gases emitted from each sniffing port, along with a confidence level such as guessing, or certainty of their assessment.
- The gas-diluting ratio is then decreased by a factor of two
- The panellists are then asked to repeat their judgment. This continues for a number of dilution levels.
- The responses of the panellists over a range of dilution settings are used to calculate the concentration of the Odor in terms of European Odor units (ouE/m^3).
- The main panel calibration gas used is butan-1-ol, which at a certain diluting gives 1 ouE/m^3.

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Odor Threshold Values of Different Chemicals

Chemical	ppm	mg m^3
Ammonia	46.8	33
Benezene	4.68	15
Dimethylsulphide	0.001	0.0025
Ethyl acrylate	0.00047	0.0019
Ethyl mercaptan	0.001	0.0025
Formaldehyde	1.0	1.2
Hydrogen sulphide	0.00047	0.00066
Methyl mercaptan	0.0021	0.0042
Methyl methacrylate	0.21	0.85
Phenol	0.047	0.18
Toluene	2.14	8.1
Trimethylamine	0.0002	0.0005

Definition: Detection Threshold

Dilution factor at which the sample has a probability of 0.5 of being detected under conditions of the test

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Guidance for Industrial Applications

- What is a Percentile?
- Number of Hours of Odor
- Purpose of Percentile

5 ouE/m^3 as a 98th Percentile Hourly Average

Percentile	Corresponding Hours
98	175
99	88
99.5	44

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Air Dispersion Modelling

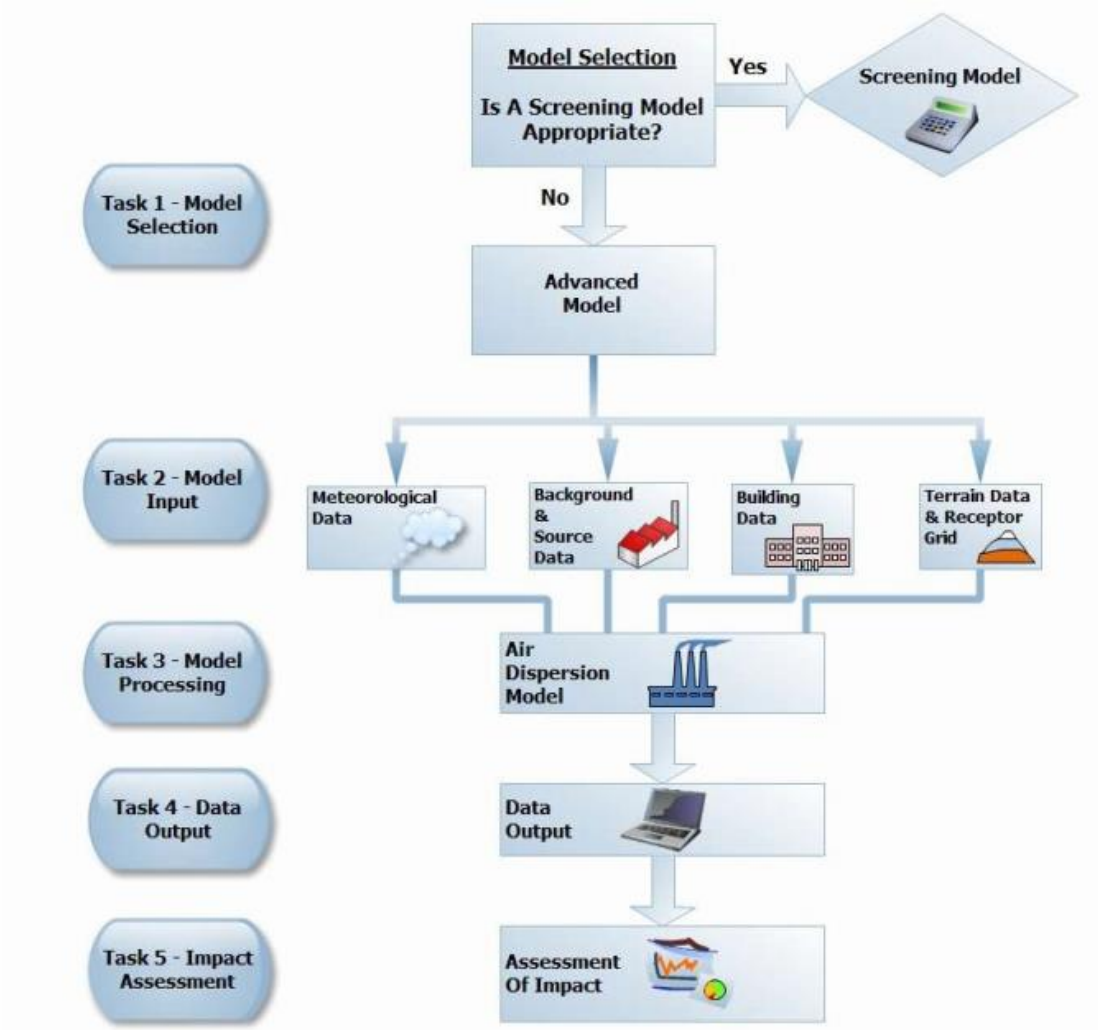

Figure 2.1 Flowchart of the tasks required when undertaking an air dispersion modelling assessment

Before selecting an appropriate model, the question should be asked as to whether an air dispersion model is required at all. In some cases, it may be possible to scope out an emission point which is clearly insignificant and does not merit a screening modelling assessment (see Section 5.0).

Shown in Figure 2.1 is a brief overview of the steps which are required in order to undertake an air dispersion modelling assessment.

Task 2, model input, is generally the most critical aspect of the modelling process and requires the most time and resources to ensure that the modelling assessment is undertaken successfully.

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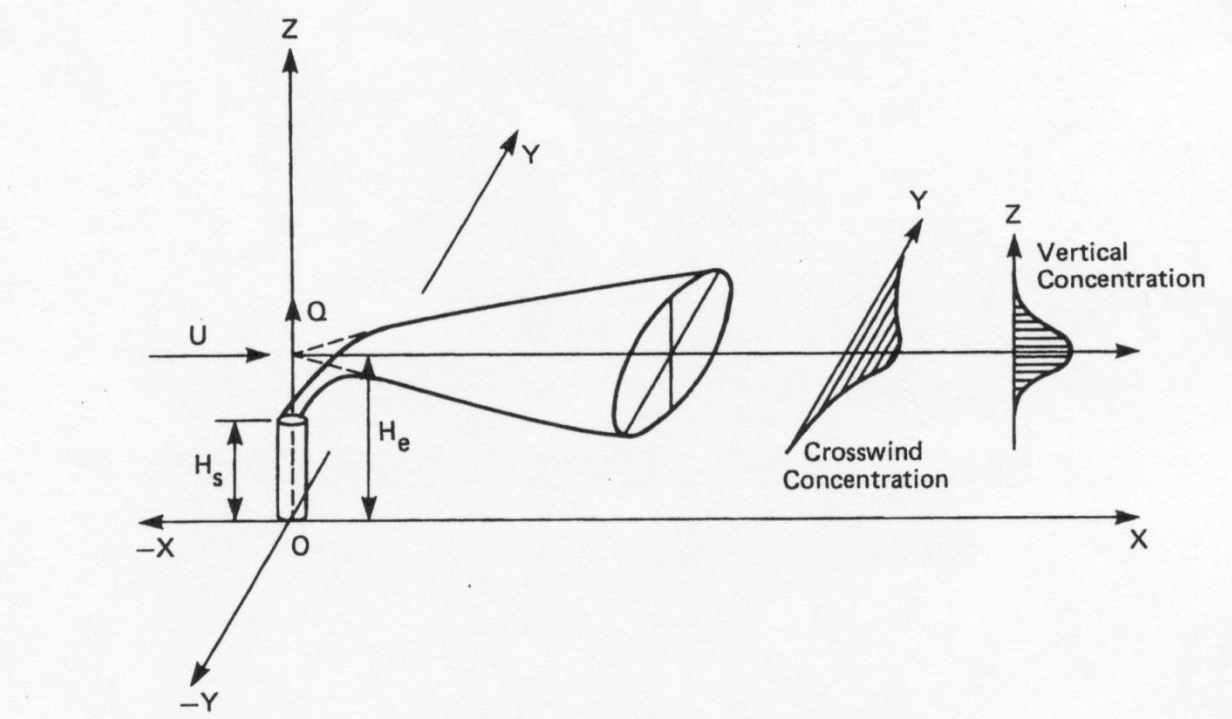
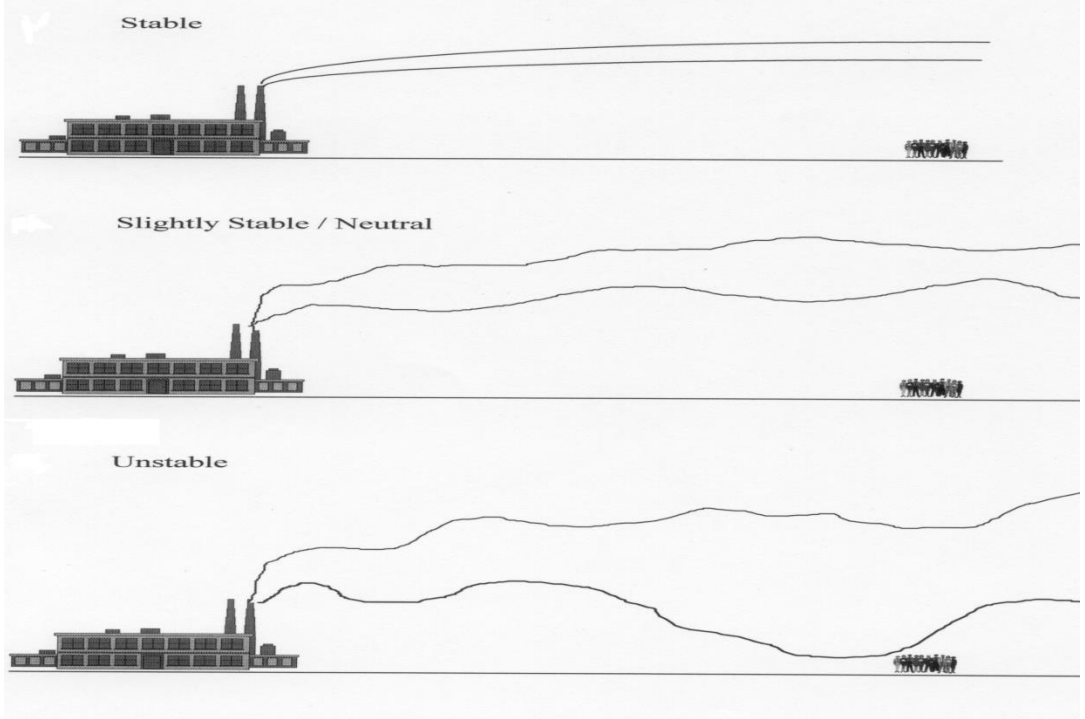
Gaussian Distribution





H_s – Height of Stack
H_e – Effective Height of Stack [Cone & Thermal Uplift]
Q – Stack Exit Velocity

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Guidance for Industrial Applications

- Boundary
- Nearest Sensitive Receptor
- The benchmarks are:
  - 1.5 ouE/m^3 [98th percentile of the time] for most offensive Odors
  - 3 ouE/m^3 [98th percentile of the time] for moderately offensive Odors
  - 6 ouE/m^3 [98th percentile of the time] for less offensive Odors

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Minimum Ventilation Rates for Odor Control

Process stage	Ventilation rate (larger of)	Comments
Sewage channels	1 to 2 air change per hour (ac/h) for empty volume or 1.25 times aeration rate	The higher extract rate is required where good sealing of covers is not possible. Vent along flow of sewage to minimize air stripping.
Screens	2 ac/h for enclosure volume	
Grit channels	1 ac/h for empty volume or 1.25 times aeration rate	
Primary settlement tanks	1 ac/h for volume above top water level (TWL) if no personnel access.	
	For personnel access this will be dependent on detailed design.	Dependent on detailed design.
Sludge and sludge liquor chambers and wet wells	2 ac/h for empty volume or 1.25 times maximum fill rate	
Buildings housing sewage or sludge processes	Typically, 3 ac/h	Dependent on detailed design. See also SPD E04
Sludge holding tanks (raw, co-settled, imported, blending)	1 ac/h for empty volume or 1.25 times maximum fill rate or 1.25 times the aeration rate	
Picket fence thickeners	1 ac/h for volume above TWL	
Pasteurisation/heat treatment of raw sludge	Off gases only	Where possible, off-gases shall be retained within the system. Operation of units may be seasonal or intermittent.
Secondary digesters & digested sludge holding tanks	If possible, connect to biogas system or to a passive filter.	Off gas is predominantly methane
Mechanical thickening and dewatering	1 to 20 ac/h for container volume	Units are very variable in the degree of containment that can be achieved, leading to H&S problems at some sites. Advice should be sought from the supplier.
Digested sludge press	At least 12 ac/h	As indicated by SPD E04
Sludge cake storage silo	1 ac/h for empty volume or 1.25 times maximum fill rate	

Process Design – Covered Processes

- Ventilation of covered processes shall be set with extraction from the Odor source at the minimum rate necessary to achieve negative pressure under all operating conditions.
- Ventilation rates given are for the containment and conveyance of odorous air only and are not for corrosion control, the provision of a safe working atmosphere or to minimise the build up of explosive gases, which may require higher ventilation rates.
- Rates given assume that there is reasonable sealing of covers with appropriate seals for any required fittings through the covers, and with hatches kept closed. If this is not the case, higher ventilation rates may be required.
- Design of extract points from tanks and channels shall aim to minimise the stripping of Odors, for example, ventilation of covered channels shall ideally draw air along and not against the flow of liquid.

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Odor Loads at Ventilation Rates

Odor emission rate (ou_E/s) = Odor concentration (ou_E/m^3) x vented air flow rate (m^3/s)

Process stage	H_2S Average (ppm v/v)	H_2S Peak (ppm v/v)	Odour Average ou_E/m^3	Other compounds that may be present
Sewage in channels, preliminary treatment processes, screens, grit channels	5	50	20,000	• Trace quantities of volatile compounds from discharges to sewer
PSTs vented for personnel access	1	5	1000	
Raw, co-settled, blended and imported sludge tanks, picket fence thickeners, sludge and sludge liquor chambers, sludge screens.	150	500	1,000,000	• Total mercaptans 20% of H_2S (ppm) • Dimethyl sulphide 20% of H_2S (ppm) • Volatile fatty acids and their derivatives (e.g. butyrate)
Surplus activated sludge tanks and chambers	5	50	10,000	• Carbon dioxide
Pasteurisation/heat treatment/dryer off-gases	500	1000	15,000,000	• Volatile organic compounds • Total mercaptans 20% of H_2S (ppm) • Dimethyl sulphide 20% of H_2S (ppm)
Digesters and covered secondary digestion tanks (biogas)	1000	2000	2,000,000	• Methane • Total mercaptans 20% of H_2S (ppm) • Dimethyl sulphide 20% of H_2S (ppm)
Limed sludge (mixers, silo, storage)	Ammonia 150	Ammonia 500	50,000	• H_2S 1ppm • Amines
Composting bays	Ammonia 150	Ammonia 500	150,000	• H_2S 1ppm • Amines • Vented gas will be warm and humid
Buildings housing raw or digested sludge processes and cake storage	1	5	5000	• Methane may be present in off gas from digested sludge dewatering
Buildings housing surplus activated sludge processes	1	5	1000	
Buildings housing sewage processes (inlet buildings)	1	5	1000	
Buildings housing limed or composted sludge	Ammonia 10	Ammonia 25	10,000	

Process Design - Buildings

- Where there is to be personnel access, design of ventilation systems shall take into account the need to ensure sufficient ventilation to maintain safe working conditions.
- Design incorporating compartmentalisation, purging and access control systems may be considered to minimise ventilation rates whilst maintaining safe working conditions.
- Extraction vents in buildings shall be positioned as close as possible to Odor emitting processes, and not be extracted across working areas and access points.

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Odor Treatment Technology - Selection Guide

Composition	Air flow rate (m^3/h)			
	<500	500-10,000	10,000-50,000	>50,000
H_2S 1-50ppm	Dry chemical or carbon	Biofilter	Biofilter	Biofilter
H_2S 50-150ppm	Dry chemical or carbon	Biotrickling tower or bioscrubber	Biotrickling tower or bioscrubber	Biotrickling tower or bioscrubber
H_2S 150-300ppm	Dry chemical or carbon	Dilution plus biotrickling tower or bioscrubber	Dilution plus biotrickling tower or bioscrubber	Dilution plus biotrickling tower or bioscrubber
H_2S >300ppm	Dry chemical	Catalytic Iron Filtration plus biotrickling tower or bioscrubber	Wet chemical	Wet chemical
Ammonia 1-20	Dry chemical or carbon	Biofilter	Biofilter	Biofilter
Ammonia >20	Dry chemical or carbon	Wet chemical scrubbing stage required	Wet chemical scrubbing stage required	Wet chemical scrubbing stage required
VOCs <1000ppm	Dry chemical or carbon	Biofilter	Biofilter	Biofilter
VOCs >1000ppm	Dry chemical or carbon	Dilution plus biofilter	Dilution plus biofilter	Dilution plus biofilter
Outlet standard less than or equal to 1000 ou_E/m^3	As above	As above plus carbon	As above plus carbon	As above plus carbon

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Value Proposition

We offer proven, patented clean air bio-technologies, which provide best-in-class process performance with the lowest utility and life cycle costs.

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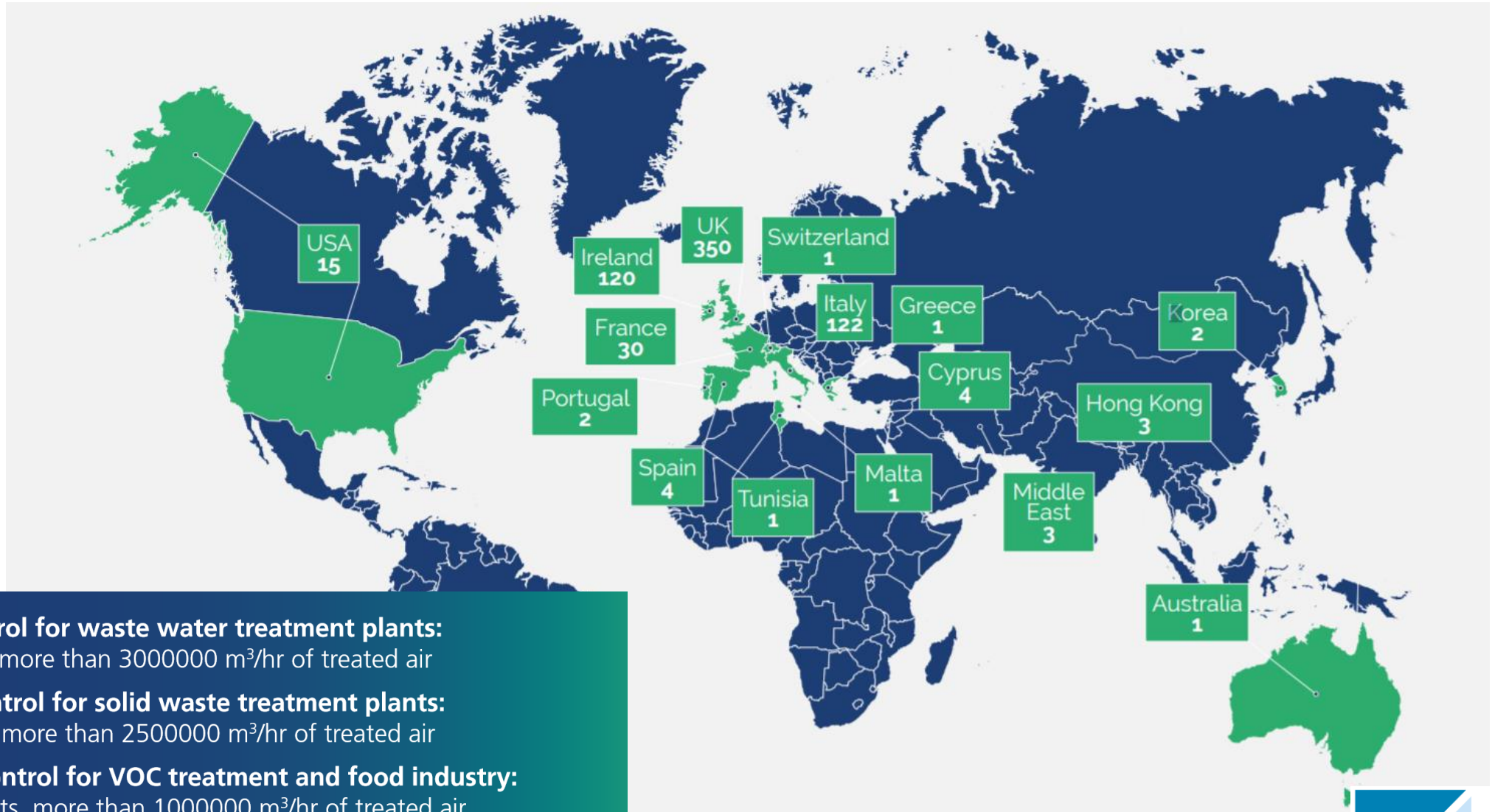
Plant Locations



- **Odour control for waste water treatment plants:**
  650 plants, more than 3000000 m³/hr of treated air
- **Odour control for solid waste treatment plants:**
  20 plants, more than 2500000 m³/hr of treated air
- **Odour control for VOC treatment and food industry:**
  150 plants, more than 1000000 m³/hr of treated air

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Our Proprietary Technologies

Mónafil

Mónashell

CrumRubber

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Our Non- Proprietary Technologies

Scrubbers

- Venturi
- Packed Tower
- Moving Bed

Activated Carbon Absorption

- Radial
- Deep Bed
- Impregnated Carbon

Biological Filters

- Peat Fibre and Heather Bed
- Lava Rock

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Typical Annual Operation Costs

Example: 500 m^3/h @ 50 ppm H_2S	*Media Usage/ Replacement Costs* €	*Water Costs* €	*Power Costs* €	*Total Operational Cost* €	*Typical System Efficiencies*
Wet Chemical Scrubbing	13,360	1,002	402.5	**14,764**	95 - 98%
Impregnated Activated Carbon	5,010	0	132	**5,142**	99%
Bioscrubber	668	3,340	218	**4,226**	75 - 85%
Biofiltration Conventional Media	1,670	1,837	113	**3,620**	95 - 98%
Mónashell	1,252	417.5	88.5	**1,758**	>99%

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Case Studies

WWTP

Ringsend, Dublin [2014]

- Biofilter – 28m^3 Dual Stage Mónashell OCU
- Application – Lamella Channels.
- Treated Airflow – 1,600 m^3/hr

Chemical Compound	Inlet	Removal Efficiency
H_2S	222 ppm	>99%

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WWTP

Cavan Town, Ireland [2015]

- Biofilter – 2 No. 45m^3 Dual Stage Mónashell OCU
- Application – WWTP
- Treated Airflow per OCU – 6,700 m^3/hr

Chemical Compound	Inlet	Removal Efficiency
H_2S	10 ppm	>99%
VOC	70 – 100 mgC/m^3	< 50 mgC/m^3
Odor	50,000 Ou_e/m^3	98%

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North Point – Hong Kong

- Hong Kong Main Sewage Pump Station
- Installed 2007
- 3 No. 78m^3 Mónashell OCU's
- Air Flow Rate – 7,500 CFM
- Inlet H_2S 5ppm
- > 99% Reduction

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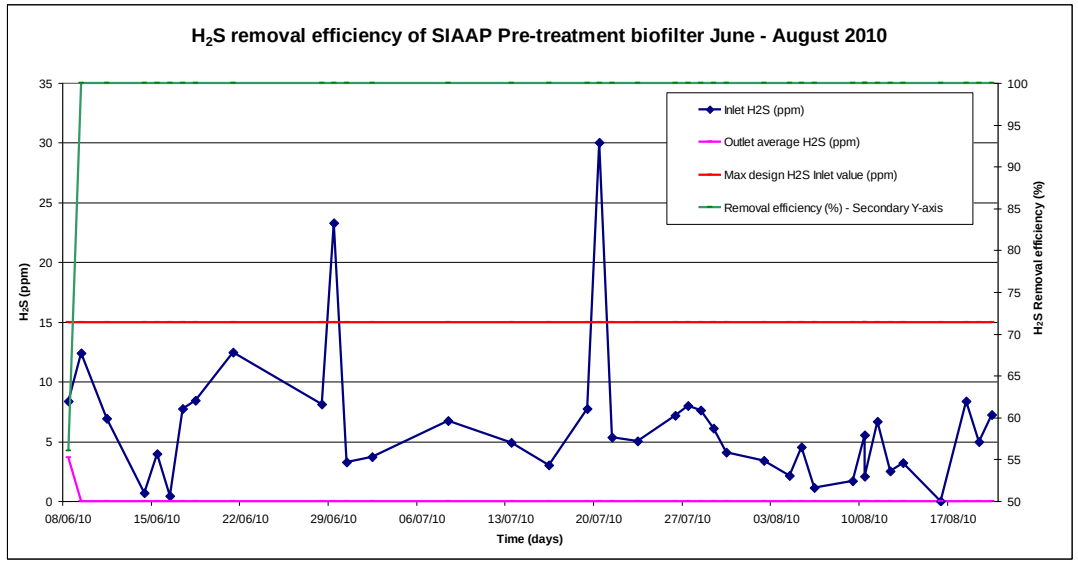
Paris - France



- Municipal WWTP
- Installed 2009
- 2 No 283m³ Onsite Mónashell OCUs
- Air Flow Rate – 44,150 CFM
- Inlet H_2S - 15ppm
- 99.5% Reduction

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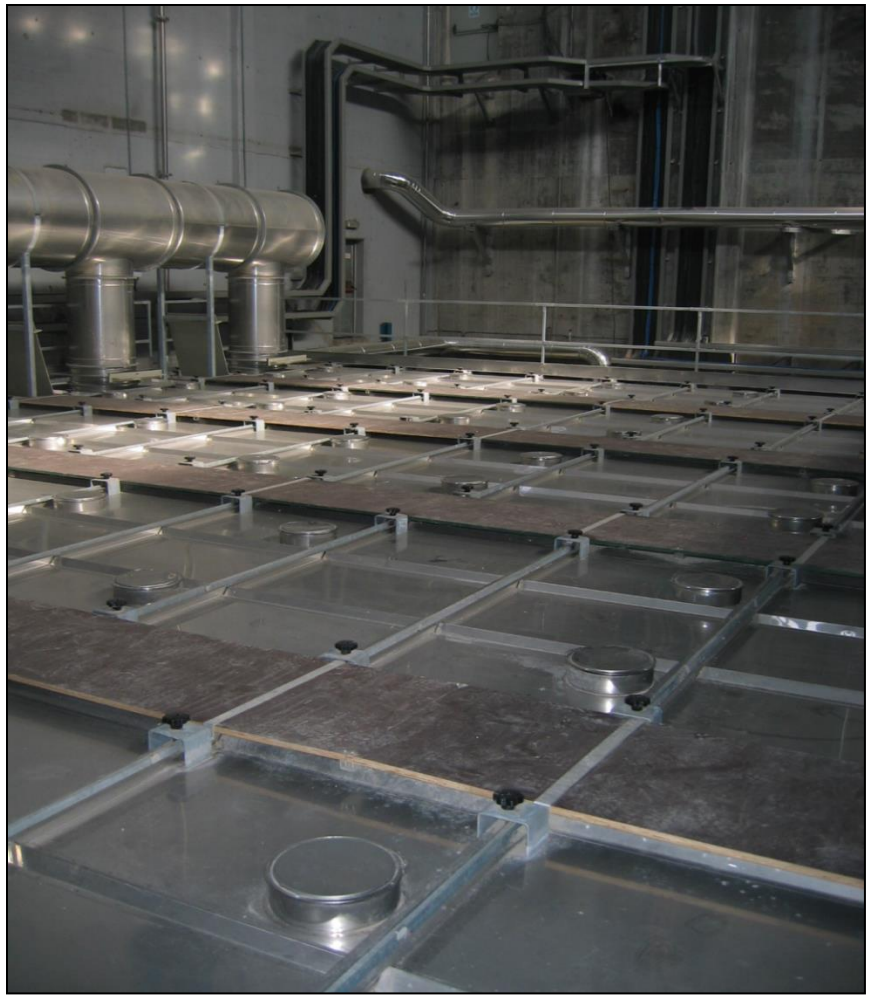
Barcelona - Spain



- Sludge Dryer Emissions
- Installed 2009
- Dual-Pass Onsite 78m^3 Mónashell OCU
- Air Flow Rate – 31,200 CFM
- Inlet H_2S - 10ppm
- > 99% Reduction

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Rendering Plant

Avellino, Italy [2012]

- Application – Rendering (Beef)
- Product – Biofilter
- Treated Airflow – 23,450 to 57,500 m^3/hr
- Pre-treatment
  - Chemical Scrubber
- Biofilter Size – 390m^3

Chemical Compound	Inlet	Efficiency
Odor	10,000 Ou/m^3	>90% *

** Depend on contact time applied*




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Fishmeal Processing Plant

Mayo, Ireland [1998]

- Application – Factory Ventilation Air & Process Gases
- Product – Peat Fibre and Heather Biofilter
- Treated Airflow – 130,000 m^3/hr
- Pre-treatment
  - Bag Filters for Dust Removal
- Biofilter Size – 600m^3

Chemical Compound	Inlet	Efficiency
Odor [After Pre-treatment]	>65,000 Ou/m^3	>99% *

** Depend on contact time applied*

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Rendering Plant

Madrid, Spain [2007]

- Application – Rendering (Beef) Cat. 1, Cat. 3
- Product – Mónafil
- Treated Airflow – 40,000 to 80,000 m^3/hr
- Biofilter Size – 520m^3

Chemical Compound	Inlet	Efficiency
Odor	10,000 Ou/m^3	75 – 95% *
Amines	5 mg/m^3	<0.5 mg/m^3
NH3	20 mg/m^3	<1.0 mg/m^3

** Depend on contact time applied*

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Rendering Plant

Cashel, Ireland [1992]

- Application – Factory Ventilation Air & Non-condensable Gases
- Product – Peat Fibre and Heather Biofilter
- Treated Airflow – 25,000 m^3/hr
- Pre-treatment of Non-condensable Gases
  - Cyclones for Removal of particulates
  - Packed Tower Acid Scrubber
- Biofilter Size – 240m^3

Chemical Compound	Inlet	Efficiency
Odor [After Pre-treatment]	10,000 to 50,000 Ou/m^3	99.5% *

** Depend on contact time applied*

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Fishmeal Processing Plant

Acona, Italy [2009]

- Application – Process Gases from Oven
- Product – Mónafil
- Treated Airflow – 15,000 m^3/hr
- Biofilter Size – 2 No. 75m^3

Chemical Compound	Inlet	Efficiency
Odor [After Pre-treatment]	7500 Ou/m^3	>97.6% *

** Depend on contact time applied*

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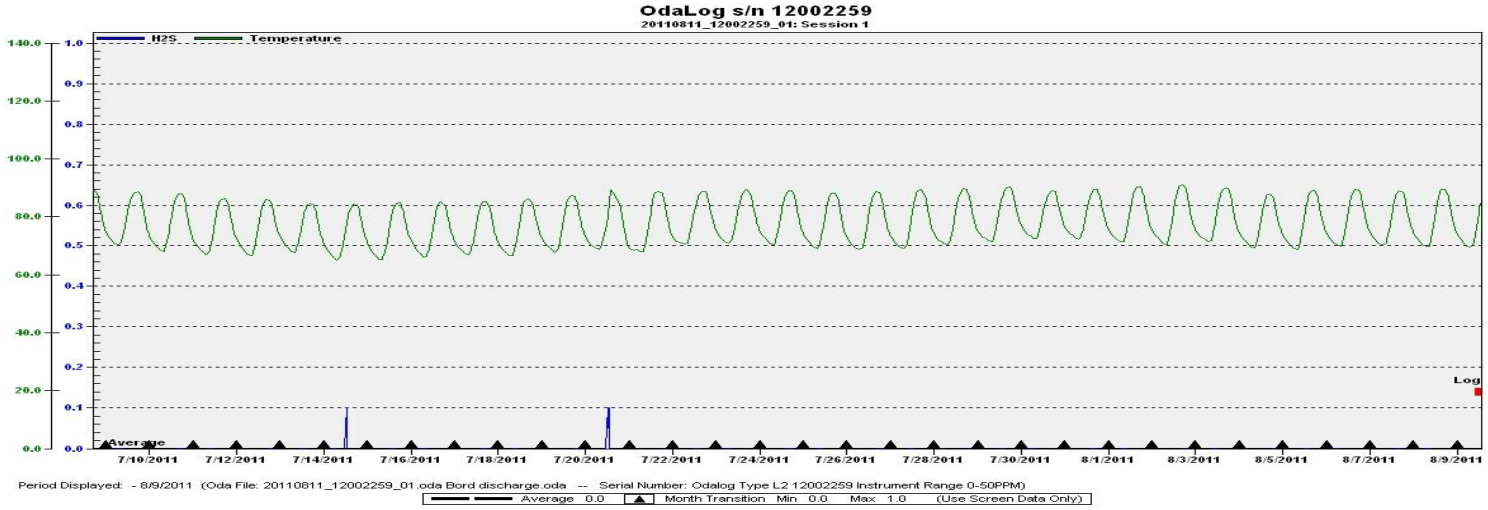
Equalization Tank - CA

Lake Wildwood WWPT – Nevada City, CA

H_2S

- Avg inlet: 16ppm
- Peak Inlet: 44ppm
- Avg % Reduction: >99.5%



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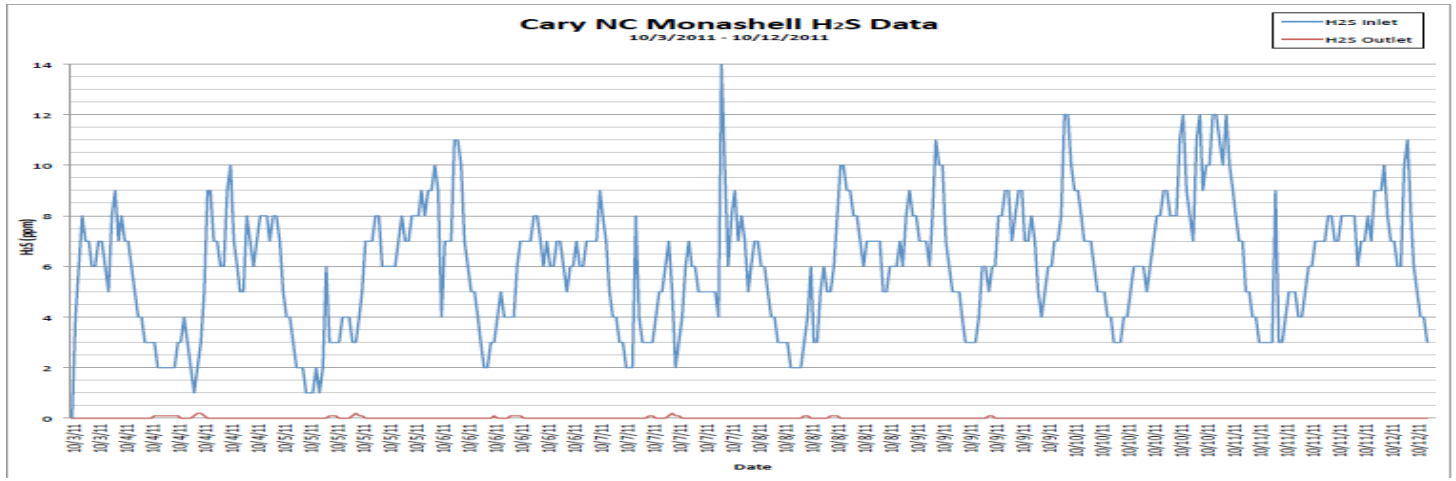
Flow Splitter - NC

Cary NC

H_2S

- Avg inlet: 6ppm
- Peak Inlet: 14ppm
- Avg % Reduction: >99.5%



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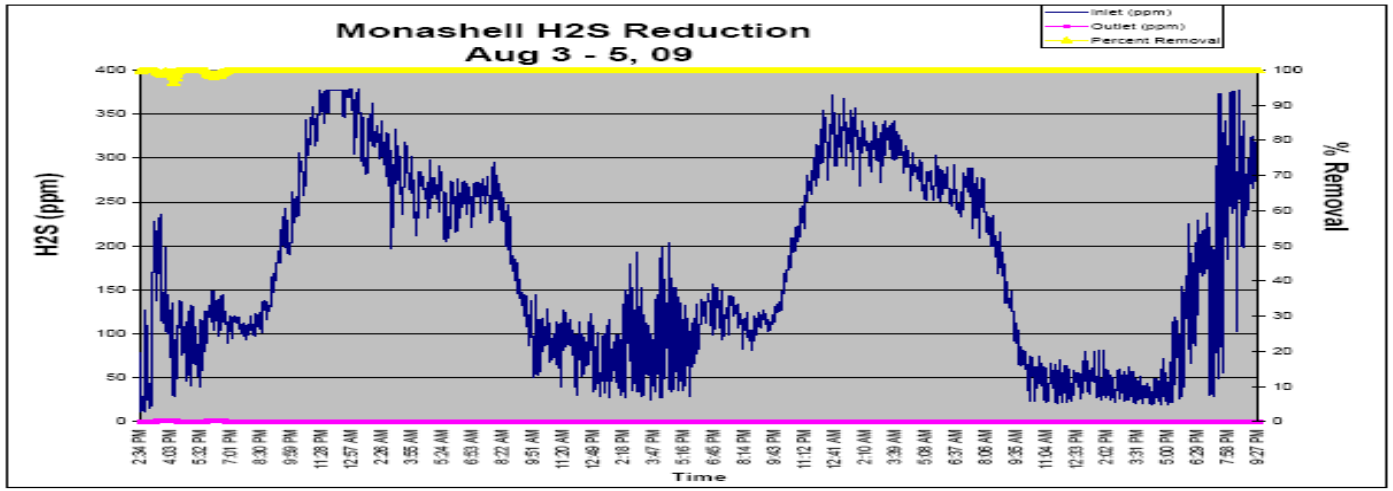
Sludge Treatment - NC

T.Z. Osborne WRF, Greensboro, NC

Emissions from a mixed sludge storage tank – evaluated over 11 months – 3rd party testing by NC State University

- 500cfm H_2S >375 ppm peaks and RSC's
- Avg % Reduction: >99.5% H_2S, 96% Odor as dt



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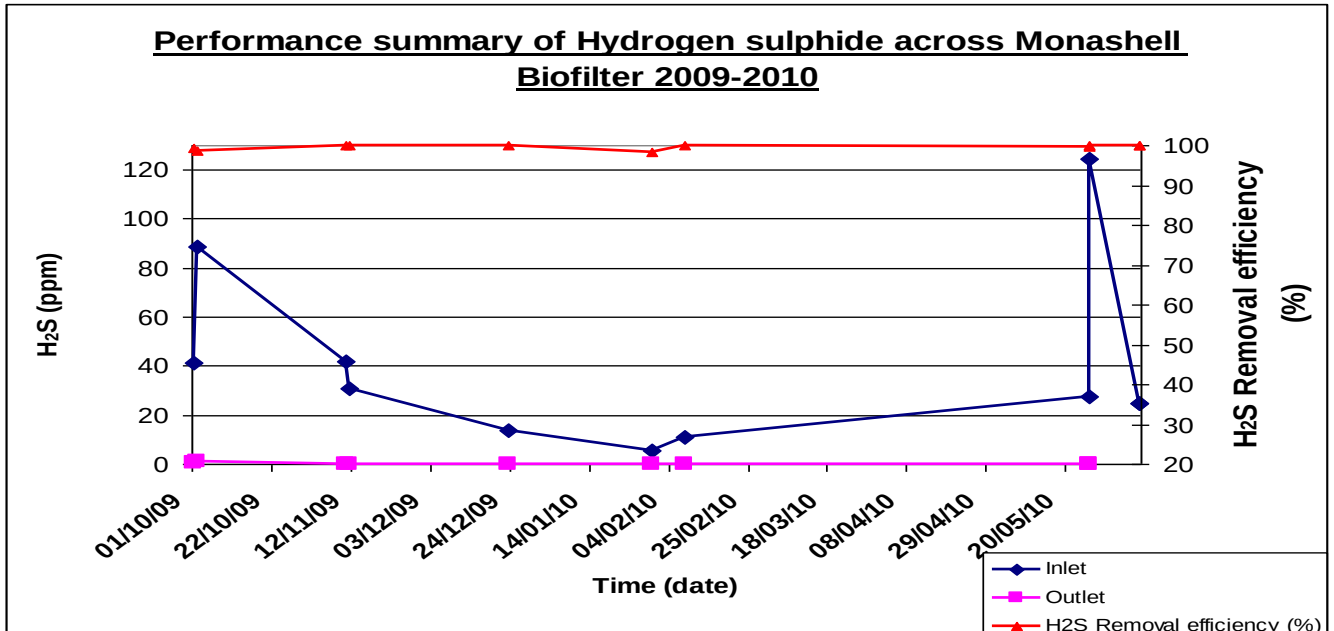
Master Lift Station - FL

Lake Wildwood WWPT – Nevada City, CA

H_2S

- Avg inlet: 41ppm
- Peak Inlet: 125ppm
- Avg % Reduction: >99.5%



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FIND AIR-CLEAN AGENT IN CANADA

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