Navigating the Complex Landscape of Biological Odour Control Solutions for Wastewater Applications

9th IWA Odour & VOC/Air Emission Conference

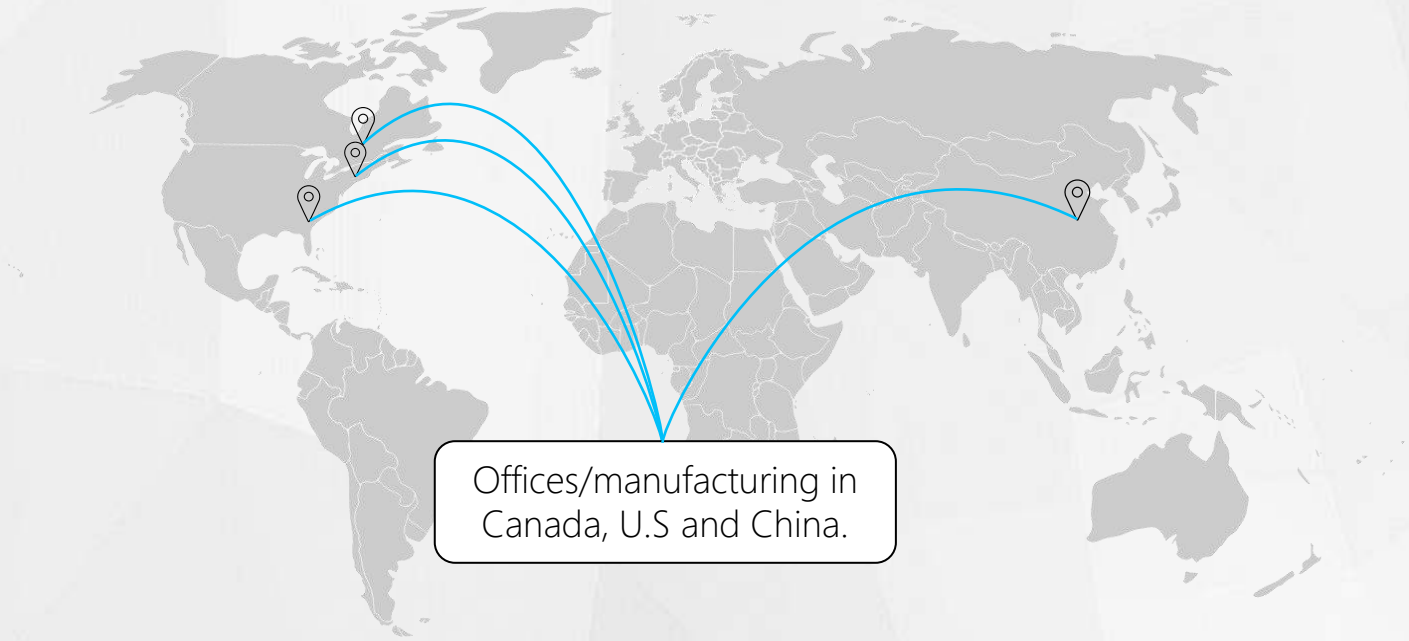
October 26th-27 2021
Bilbao, Spain

Authors:
Derek S. Webb, P. Eng
Caleb Olesen, P. Eng

CORPORATE PROFILE

A History of Odour Control Innovation

BIOREM is the worlds oldest and most experienced biological odour control company. Our objective is to engineer, design, manufacture and distribute the most innovative and effective air emissions abatement technologies in the world. Preferred by utilities that require proven, long-term, reliable performance and a company that will be available in 10 -20 years.



OPTIMAL ODOUR CONTROL SOLUTIONS REQUIRE STRONG CONSIDERATION OF THE APPLICATION

Engineered Systems Must Address Complex Factors Affecting Biological Treatment

THE APPLICATION

- Upstream physical processes
- Emission sources
- Airstream characterization and quantification

THE FACILITY LOCATIONS

- Proximity of sensitive receptors
- Footprint allocations
- Quality of life
- Aesthetics
- Logistics
- Utilities

THE ECONOMICS

- Initial capital expenditure
- Life cycle cost
- Technology comparison

THE OPTIMUM SOLUTION

- Selected technology for each application
- Commercial
- Technical
- Low environmental impact

NOT ALL BIOLOGICAL SYSTEMS ARE CREATED EQUAL

Configuration, Gas/Liquid Interface, and Media Provide Necessary Variation

Systems	Biotrickling Filter	Biofilter	Bioscrubber
Bioreactor Types	Fixed-Film	Fixed-Film	Suspended Growth
Configuration	Counter-current, co-current, Horizonal Flow	Upflow, Downflow, Horizonal Flow	Counter-current
Gas/Liquid Interface	Once-through, Recirculation	"Dry"	Recirculation
Media	Plastic, Ceramic, Mineral. ___ Random or structural	Bark, Compost, Rubber, Mineral, Engineered.	Plastic, Ceramic.
Compounds Treated	H_2S, MM, VOCs,	H_2S, OSCs, VOCs, Nitrogen Bearing	VOCs

Single Stage Bio-trickling Filter

MANY FACTORS IMPACT THE COMPOSITION AND CONCENTRATION OF GASES EMITTED FROM A WWTP

Turbulence and the Absence of Oxygen are Two Main Contributors

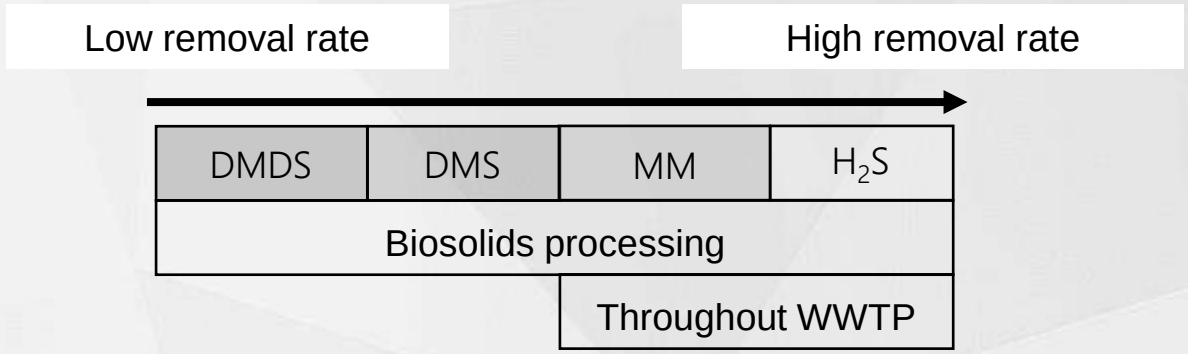
Classification	Sources	Odour Composition
Collection System & Headworks	Pump stations; diversion structures Coarse/fine screens; influent channels	Primary: H_2S Secondary: OSCs/VOCs
Liquid Phase Treatment	Clarifiers; biological	Primary: H_2S Secondary: OSCs/VOCs
Solid Phase Treatment	Dewatering; digestion; thermal drying composting	Primary: OSCs, Nitrogen-bearing compounds Secondary: H_2S, VOCs

REMOVAL RATES OF SUPHIDE COMPOUNDS ARE AFFECTED BY METABOLIC PATHWAYS

OSC Removal Favoured by pH Neutrality and Longer Residence Times

Relative removal rates of sulphide compounds by biofiltration

H_2S bio-oxidation causes accumulation of H_2SO_4 which inhibits organic sulphur specie removal (especially DMS). OSCs can be removed more efficiently by maintaining a relatively neutral pH.



Key design considerations: biological odour control systems

Optimal H_2S Removal	pH 1.5-2.0	Low pH favours acidophiles
Critical Compounds	H_2S, NH_3	Metabolites can impact biology
Low Water Solubility	DMS, DMDS	Recalcitrant to degradation
Diurnal Variation	Fluctuating [ ]	Impacts performance; requires certain configurations
Fouling	VOCs, H_2S	Elevated levels cause biomass accumulation

UNIQUE CHARACTERIZATION DRIVES TECHNOLOGY SELECTION

Matching Airstream Characterization with Technology is Fundamental but not a Binary Solution

Application	Typical Foul Air	Optimal Biological Treatment Process
Collection systems, headworks and primary treatment	20 - 600 ppm H_2S 1 ppm OSCs	• H_2S>100 ppm: Biotrickling filter only • 30<H_2S<100 ppm: Biotrickling filter followed by biofilter • H_2S<30 ppm: Biofilter only
Biological treatment	1 ppm H_2S 1 ppm OSCs	• Odour levels are often low enough that treatment is not required • If biological treatment is being designed, a biofilter only is recommended
Biosolids handling	5 - 200 ppm H_2S 5 ppm OSCs	• H_2S>30 ppm: Biotrickling filter followed by biofilter • H_2S<30 ppm: Biofilter only • Recommended long EBRT
Biosolids dryer	5 ppm H_2S 5 ppm OSCs 2 ppm VFAs	Biofilter only. Long EBRT required for high OSC and VOC concentrations.
Septage receiving	10-200 ppm H_2S 5 ppm OSCs VOCs (solvents) variable loading	Biotrickling filter followed by long retention time biofilter often required to handle the variations in loading and complex composition
Sludge fermenter	2 ppm VFAs VOCs (alcohols)	Biofilter only. Downflow recommended for media maintenance

CASE STUDIES DEMONSTATE THE COMPLEXITY OF TECHNOLOGY SELECTION

Application, Technology, Budget and Location All Factor into a Robust System Offering

Facility Name	A. City of Oviedo WWRF		B. Rocky River Regional WWTP		C. Little Patuxent WRP	
Application	Headworks surge tank		Dewatered biosolids bunkers		Belt dryer exhaust for biosolids drying	
Air flowrate	8,500 m^3/h		5,100 m^3/h		12,240 m^3/h	
Odour control system	Biotrickling filter followed by biofilter		Biotrickling filter		Biofilter	
Testing Date	July 29, 2015		June 27, 2013		February 21, 2021	
Performance[1]	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Odour (OU/m^3)	>60,000	230	N/A	N/A	19,000	1,900
H_2S (ppb)	6 942	<5	56,650	120	<5	<5
MM (ppb)	158	<3	1,299	323	<3	<3
DMS (ppb)	13	<3	177	123	17	3.2
DMDS (ppb)	4.1	<3	340	180	115	8.0

[1]*Performance data obtained by sampling with Tedlar bags and a vacuum chamber. Odour analysis performed by St. Croix Sensory Inc. following ASTM E679. Reduced sulphur analysis performed by Mayfly Odor Laboratory by GC-FPD*

A.

B.

C.

QUESTIONS?

Derek S. Webb, P. Eng – President & CEO, BIOREM

Email: dwebb@biorem.biz

Caleb Olesen, P. Eng – Process Engineering, BIOREM

Email: colesen@biorem.biz