Odour control at WWTP's- Theory and Practice

By

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Introduction

- Odour (Current situation)
- Causes of odours at WWTP's
- Odour contributing processes
- Legal framework for odour impact
- Odour measurement
- Odour dispersion modelling
- General contract specifications for DBO projects
- Odour impact assessment on a WWTP
- General odour abatement techniques
- Experiences of Odour Monitoring Ireland
- Conclusions

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Odour (Current situation and WWTP context)

- Odour generates 50 to 90% of all environmental complaints from various facilities around the country.
- General upward trend in capital and operational investment of overall environmental budget on preventing odours.
- Many compounds responsible for odours in WWTP's-Generally act in antagonism and synergism.
  - Protieneous material in waste
  - Sulphates and sulphonates in waste water (detergents etc.)
  - Trace effluent
- Process specific odour emissions-Inlet works, Primary treatment, Sludge treatment, Anaerobic digestion, Aeration tanks, etc.
- Process specific compound emission-Important when utilising mitigation technologies.

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- What is an odour nuisance ? (characterised through intensity, frequency, duration and hedonic tone to a lesser extent).
  - Ascertain the degree of annoyance in accordance with regulatory used methods.

- Legislation pertaining to odours in Ireland,
  - Public Health Act (1878)
  - Air pollution act (1987)-Section 26
  - EPA Act (1992) Section 4(2)
  - SI787 of 2005
  - When all aspects exhausted-Civil action commences

- Guidance documents
  - IPPC (H guidance notes Part 1 & 2)
  - EPA (Odour impacts and odour emissions from Intensive agricultural facilities)
  - Network experiences from other sites through conferences

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Odour Measurement

- Sampling
  - Point sampling
  - Area sampling
  - Displacement chamber
  - High temperature point source sampling
- 60 litre bags (representative)
  - "How often do you water sample"?
- Olfactometry standards
  - What is olfactometry
  - (EN13725:2003, VDI and Dutch Guidelines for hedonic tone, AUS standard and US ASTM standard)

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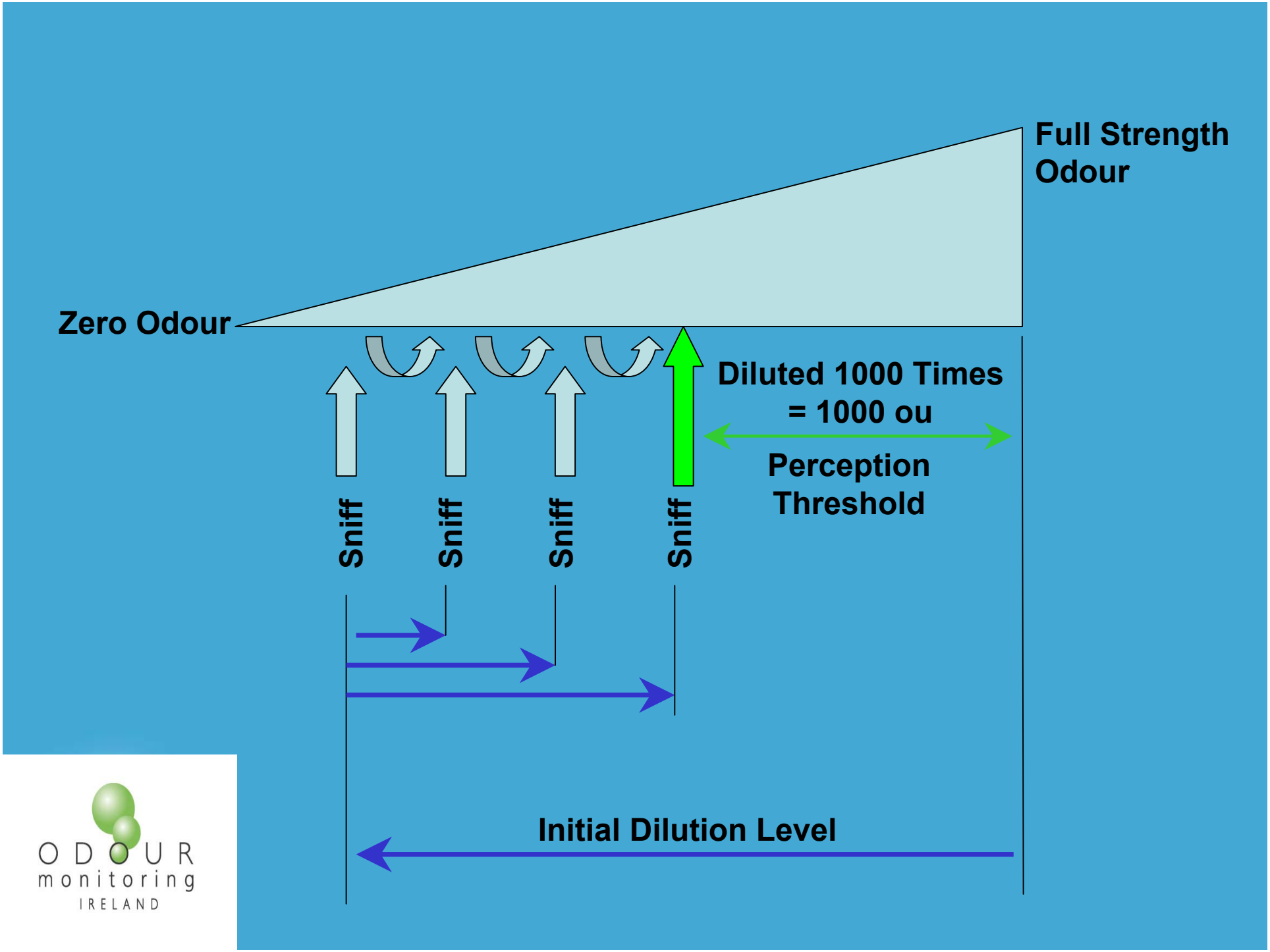

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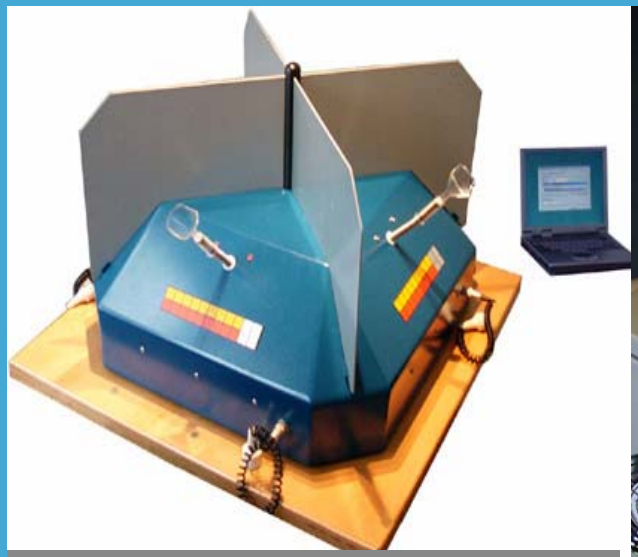

Ecoma T08 olfactometer

Nalophan sampling bag

Ascent olfactometer

Point vacuum sampling device

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Other methods

- Sniff assessments for boundary monitoring
  - Training essential
  - Medical technique now available to test sense of smell in the field (robust and easy to use).
  - Use established methodologies such as VDI, and GOAA-used for regulatory purposes.
- Indicative measurement techniques for performance using H_2S and VOC's
  - Jerome analyser
  - FID analyser
  - PID analyser
  - Super fast GC and odour profiling (2D polar plot)

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Odour dispersion modelling

- "A model is only as good as the information you input"
  - Terrain
  - Met data (macro and micro met) 5 yrs minimum
  - Odour emission rates from site measurements
  - Source charactertics
  - Experience in operating such models for WWTP's
- ISCST3, ISC Prime, Aermod Prime, ADMS, Calpuff
- Model output and risk assessment
    - Different facilities have different odour impact criteria

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Odour impact criterion-important facts

- Establish dispersion model type and input information for standardisation of assessment.
- Odour impact criteria for WWTP commonly refer to
  - Long term impact-1.5 Ou/m^3 contour at the 98^{th} percentile for 5 years of met data.
  - Short term impact in urban areas, Assess 1.5 and 3.0 Ou/m^3 contour at the 99.5^{th} percentile for 5 years.
  - Assess the source that contributes to odour plume-is it a very hedonically offensive source and hence assess risk.
  - Risk assessment approach using scientific techniques

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General DBO contract specifications used in Ireland

- Boundary odour sampling.
- Boundary gas compounds sampling
- Sniff assessments
- Application and enforcement of specification
- Sometimes no sampling

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What's wrong with this approach?

- Boundary odour sampling fundamentally flawed technique.
- Individual gas compound sampling not performed in accordance with standards
- Sampling and analysis can be over specified which results in incomplete process verification.
- Type of technique used has no relation to actual specifications.
- No sampling of actual odour control system.
- Engineering design and actual type of odour control system installed should be accessed on merit.

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How do we resolve this issue?

- Specifications on odour within contract document should be process specific and all sampling should be directly from emission points.
- Odour emission guarantees should be provided for each emission point by contractor whether stack or area source,
- Odour emission limits for entire WWTP design should be in accordance with odour impact criterion should be established and proposed design should demonstrate adherence before build that WWTP will achieve such limits.
- During design client should specify met data, terrain, dispersion model, and odour emission rates that contractor should used for their tender submission so each tender proposal from each contractor can be compared with each other.
- Contractor should be held to emission limit values and odour impact criteria during design and contract.
- Process proving should include a full odour audit to demonstrate this.
- Frequent unannounced audits ensures efficient operation of process and technology.
- Document management system for odour alone in WWTP's
- Approach provides protection to both the client and contractor.

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Odour minimisation and abatement design

Dosing

- Ferric/ferrous,
- Calcium Ammonium Nitrate (CAN),
- Hypochlorite on sludge stream, etc.

These are used to control and/or oxidise sulphide to minimise H_2S formation.

CAN replaces sulphate/sulphide as an electron donator- bacteria in sewer prefer to utilise it.

Chlorite is H_2S scavenging agent

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Containment

- **Covers**
  - GRP covers (heavy and expensive and require significant structural supporting-Cost from 120 to 180 € /m^2).
  - Aluminium powder coated (light weight and requires less structural supporting-Costs from 90 to 140 €/m^2)
  - Flexible covers from PVC/PE/PP polyester weave and other man made fibres. Becoming more popular, light weight and easy to remove and install-Costs from 65 to 110 €/m^2)
  - Larger the span the more expensive the covering of a process tank.
  - Tanks could be designed with this in mind
  - Access hatched should be fit for duty and self sealing.
  - Fresh air intake should have leaf damper which will only open when sufficient pressure created across the leaf.
  - Covers should be tested during contract for integrity (smoke generation machines)

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Ducting

- Manufactured generally from PVC, GRP, PP, and in some cases SS.
- PVC is not preferred material due to cracking and brittleness in cold weather.
- GRP and PP would be preferred materials for routine ductwork,
- GRP is hard and heavy, generally of continuous design.
- PP is lightweight, flexible and more times flanged.

Ductwork should be designed with the following in mind:

- Drain points,
- Face velocity,
- Corrosion resistant,
- Ability to amend

Overall design should minimise number of bends, and all volume control dampers should be in corrosion resistant material of construction

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Odour abatement technologies

- Chemical scrubbers
- Biofilters and biotrickling filters
- Dry chemical scrubbing
- Carbon filtration
- Thermal oxidation

Life cycle costs should be considered,

Previous verified record-not subjective performance,

Maintenance requirements and expertise required to operate.

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Key mechanisms for odour control

- Overall design of plant and location of processes.
- Minimise the source generation of the odour through engineering design (weir overflow, etc.)
- Containment of the odour locally and prevent contamination of large headspace volume of air of a building through design (need to consider access for maintenance).
- Take account of cyclic nature of odour emissions
- Localise all similar odour to same WWTP (i.e. inlet works and primary tank odour to same OCU, Sludge processes to same OCU
- Extract odour to suitable treatment technology
- Ensure adequate dispersion achieved.

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Conclusions

- Reduce problem at design stage
    - Set odour specifications properly
- Common sense required during design
- Document controlled odour management plan available for inspection.
- Public relations programme.
- Specifications most important element.
- Regular monitoring essential
    - Ensure correct sampling
    - Olfactometry using the standard
    - Dispersion modelling verification
    - Sniff assessments
    - Accurate site specific data collection
        - Weather data, complaints records, etc
- Budget for odour
    - "Don't build an extension build the house properly"
    - "prevention is better than cure"

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