

Identification of Organic Compounds in Sewers

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Background & Current Practice

1. Presence of Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) in wastewater

- Affects health and safety of maintenance workers
- Affects downstream treatment processes of downstream used water plants
- Source of VOCs / SVOCs often traces back to wastewater from industrial premises.



Sewer Condition

2. Detection and Source tracing of VOCs

- Photoionisation Detectors (PID) sensors are installed to detect based on total VOC gas concentration measurement.
- Unable to rapidly detect, identify and quantify individual or functional groups of VOCs/SVOCs for timely intervention.



Photoionisation Detector (PID) sensor

Areas of Opportunity

To develop sensors/ measuring devices that can identify individual and/or functional groups of VOCs/ SVOCs

- a. To be deployed in sewers and industrial premises.
- b. To be able to detect, identify, and quantify individual and/or functional groups of the following:
 - i. the entire range of 30 prohibited organic compounds stipulated in the [First Schedule of the Sewerage and Drainage \(Trade Effluent\) Regulation \[SD\(TE\)R\]](#).
 - ii. 6 other VOC/SVOCs: Acetone, N-cyclohexyl-pyrrolidone, N,N-Dimethylacetamide (DMAc), Cyclopentanone, Dibutyl Phthalate and Octadecenenamide / Oleamide

Commonly faced problems

- Fouling/choking of the sensor by particulates/solids
- Short lifespan of the sensor due to harsh environment
- Presence of other compounds, leads to interference in the reading
- Many commercial solutions are not viable for large scale deployment



Sensors choked

Key Considerations & Challenges

1. Sensor Specifications

- Detect compounds in liquid phase of wastewater
- Pre-treatment to be part of the provided system if required
- Lower Detection Limit: ≤ 1 ppm
- Sampling interval ≤ 5 minutes (ideally continuous detection), with no delay from analytical time to result
- Accuracy: 85%

Key Considerations & Challenges

2. Sampling Design Considerations

- Sample extraction process, especially if the sample is analysed outside the sewer
- Sewer Conditions
 - Mixture of compounds present, either as liquid or gaseous state
 - High levels of total suspended solids
 - Presence of Hydrogen Sulfide (H₂S)
 - Poor sanitation issues, e.g. smell



Autosampler unit

Key Considerations & Challenges

3. Installation Conditions

- Power requirements: up to 500W (ideally low power requirements).
- Installation depth: up to 15m.
- Footprint $\leq 1\text{m}^2$.



PID sensors deployed above ground

4. Maintenance Requirements

- The solution should be automated and unmanned with low maintenance
- Maintenance frequency: once every 3 months
- Replacement frequency: once every 5 years

Key Considerations & Challenges

5. Considerations for full-scale implementation

- Implementation costs
- Considerations for system integration



Monitoring systems deployed

Expected Outcomes

1. Validation of prototype sensor to detect & quantify for a subset or all of the required VOCs/ SVOCs

- Lab Scale: To validate in simulated environments
- Pilot Scale: To validate in test sewer sites under actual operating conditions

2. Full Scale Implementation

- The sensors will be mass deployed and connected to dashboard.
- The sensors will be provided to PUB through a leasing model, inclusive of operation and maintenance services.

Thank You

