Targeting Odorous Compounds in Municipal Solid Waste using Canister Sampling

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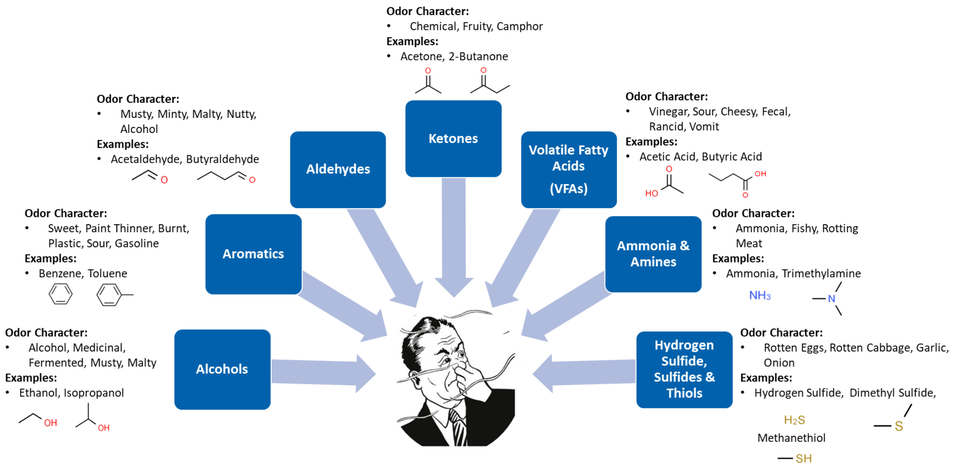
Introduction and Background

Trace gas emissions from landfills containing municipal solid waste (MSW) have become a growing concern for the environment and human health. Trace gases originate from waste degradation, direct volatilization of chemicals, and reactions between compounds, with different groups dominating at various decomposition stages. They are transported during waste handling processes and by the landfill's cover system.

Landfill gases contain several odorous compounds, such as volatile organic compounds (VOCs), sulfur and nitrogen-based compounds, and volatile fatty acids (VFAs). These are found in small amounts in raw landfill gas (LFG).

The methodology used has been developed to identify 43 odorous compounds together, instead of different compound groups. The limit of detection (LOD) has been determined for some of these compounds. It is important for the LOD to be within the odorous threshold range, which can be detected by the human nose. The determination of LOD is important because it evaluates whether the method can detect odors at the same range as the human nose.



Methodology and Results

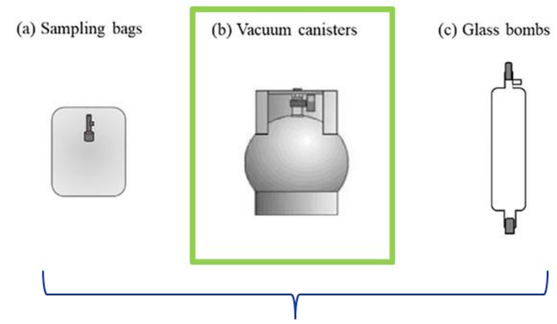
Gas chromatography triple quadrupole mass spectrometry (GCMS-TQ8030) was used to develop analytical testing methods targeting 43 odorous compounds associated with MSW operations using a single air sample.

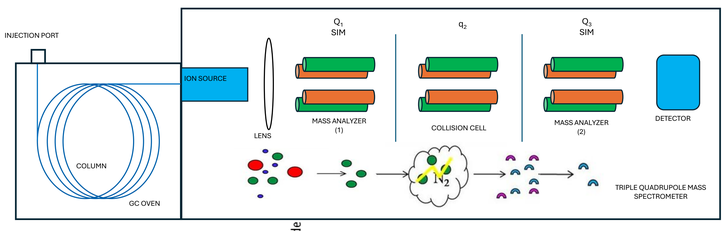
Whole-air sampling with vacuum canisters equipped with Silcotek lining has been used to capture trace gases from MSW landfills. This method involves collecting gaseous samples without losing any original constituents, offering simplicity and quick sampling of large volumes.

Multiple Reaction Monitoring (MRM) mode in TQMS detection targets specific analyte fragmentation transitions, increasing sensitivity by maintaining a structural link between precursor and product ions to eliminate chemical noise.

The EPA TO-15 method is a standard analytical method for measuring VOCs in air samples.

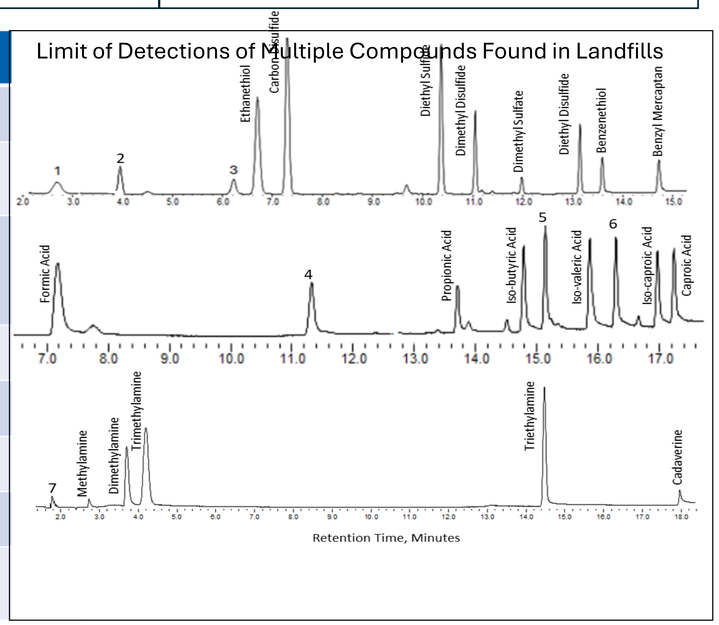
Column	RTX-1: 60.0 m, 0.53 mmID, 7.00 µm
Oven Temp	35 °C (hold for 10 min.) to 240 °C (hold for 5 min.) at 25 °C/min.
Linear Velocity	60.0 cm/sec
Inj Mode	Splitless
Inj Temp	200 °C
Inj Volume	0.5 mL
Ion Source Temp	230 °C
Interface Temp	240 °C





Peak #	Target Compound	Odor Character	Odor Threshold (ppmV)	Amount on Column (pg)	LOD (ppmV)
1	Hydrogen Sulfide	Boiled Eggs, Chokingly, Rotten Eggs, Sulfurous	0.00004 – 1.4	100	0.070
2	Methanethiol	Disagreeable, Egg, Garlic, Rotten Cabbage, Sulfurous	5.1E-13 - 0.56	50	0.025
3	Dimethyl Sulfide	Asparagus, Cabbage, Cooked Corn, Cowy, Disagreeable, Gasoline, Putrid, Radish, Sharp, Sulfurous	0.00012 - 8.11	2.50	0.0009
4	Acetic Acid	Acetic, Acidic, Pungent, Sharp, Sour, Vinegar	0.0004 - 204	375	0.152
5	Butyric Acid	Pungent, Rancid, Sour Milk, Vomit	0.001 - 0.03	375	0.104
6	Valeric Acid	Pungent, Unpleasant, Rancid Cheese, Sour, Acidic	0.03 - 0.3	375	0.089
8	Ammonia	Ammoniacal, Irritating, Pungent	0.043- 60.3	1000	1.4
9	Trimethylamine	Amine, Ammonia, Fishy, Oily, Pungent, Rancid, Sweaty	0.00002 - 1.82	5000	4.1

Limit of Detections of Multiple Compounds Found in Landfills



Conclusion

Landfill gases contain various odorous compounds, such as VOCs, sulfur and nitrogen-based compounds, and VFAs. The new detection method can identify multiple compound types, and verifying the LOD for these compounds is essential to ensure that it can detect odors within the perceivable range of humans.

The GCMS-TQ8030 analytical instrument is utilized, and vacuum canisters with Silcotek lining preserve reactive compounds and maintain sample integrity. Additionally, the MRM method enhances sensitivity by reducing chemical noise.

References

Duan, Z.; Scheutz, C.; Kjeldsen, P. *Waste Management*. **2021**, *119*, 39-62.

Acknowledgements

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