LABORATORY AND FIELD STUDY ON THE ANALYSES OF SILOXANES IN BIOGAS BY TD-GC-MS

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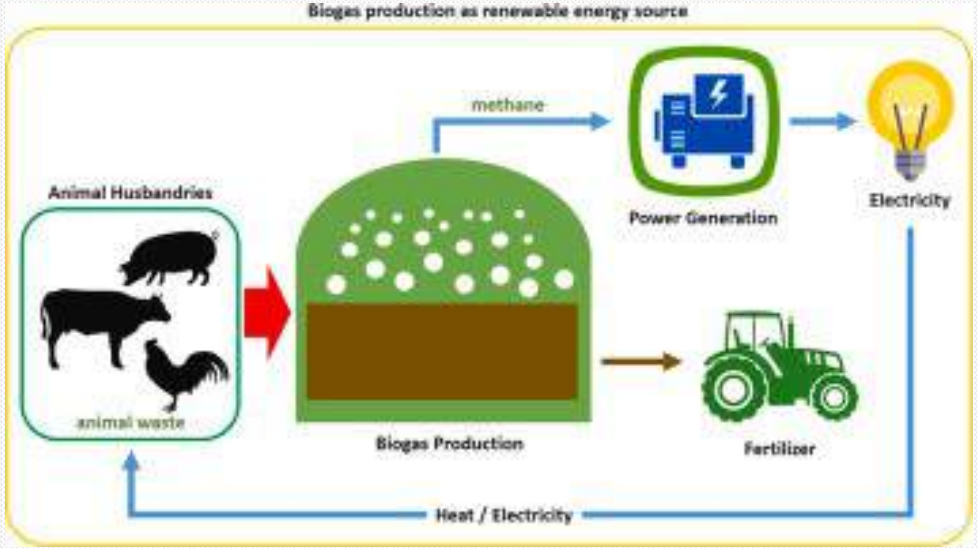
Biogas

Renewable and clean resource

Production of biogas:

- Spontaneous in landfills
- Controlles conditions in digestion reactors



Mixture of

- 50-75% methane (CH_4)
- 20-40% carbon dioxide (CO_2)
- <2% hydrogen (H_2), oxygen (O_2), nitrogen (N_2), ammonia (NH_3)
- Harmfull trace elements: hydrogen sulphide (H_2S) and **siloxanes**

Volatile Methyl Siloxanes (VMS)

1

Siloxanes in man-made products:

- Detergents
- Cosmetics
- Paints
- Medical products

2

Discarded in:

- Wastewaters
- Landfills

3

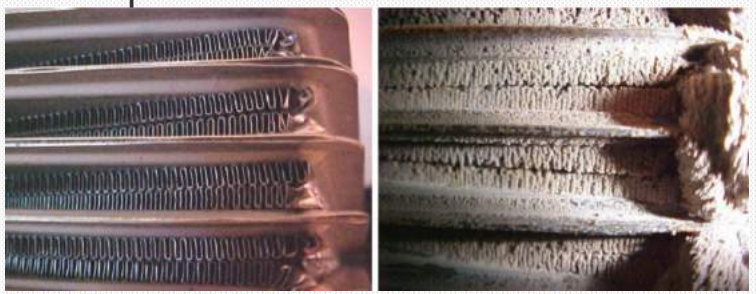
Production of biogas used for:

- Combustion engines
- Turbines

4

Combustion to silicone dioxide (SiO_2) particals causing:

- Build-up in engines
- Overheating
- Lower generation capacity
- Frequent maintenance



Determination of siloxanes in biogas

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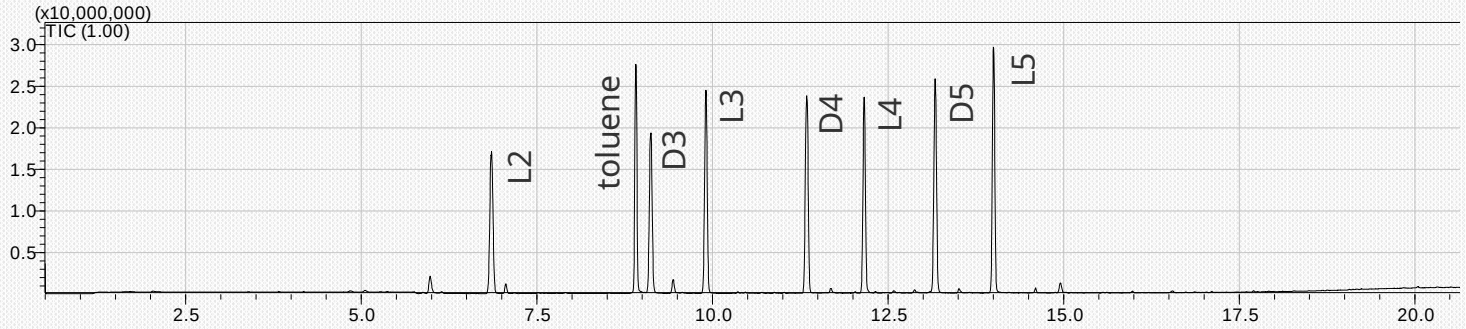
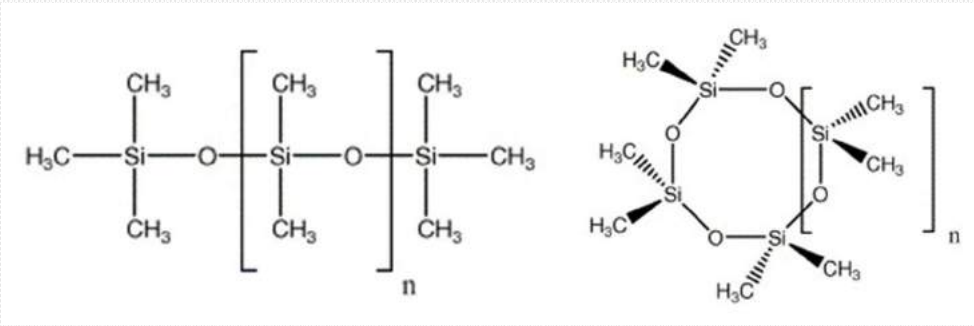
European Biomethane Standards for the concentration of siloxane in biogas (EN 16726):

- < 0.3 – 1 mg/m³ for grid injection
- < 0.5 mg/m³ for traffic use

Studied volatile methyl siloxanes (VMS) with TD-GC-MS:





How to sample biogas?

<u>Sorbent tube:</u>
Immediate sampling of biogas with pump

<u>Sampling bag:</u>
Collecting biogas in a nalophane bag

<u>Canister:</u>
Collecting biogas in a Silonite coated canister

<u>TD-GC-MS:</u>
Analysis of collected siloxanes on tube

Results of landfill biogas

Underpressure at sampling point

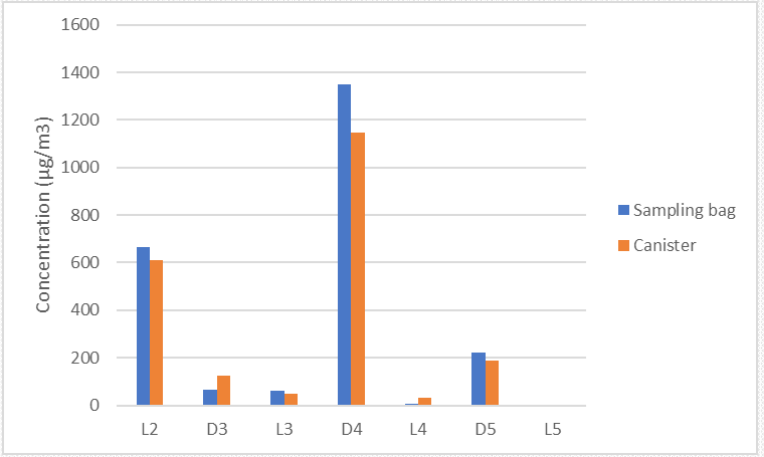
- Immediat sampling on sorbent tube not possible
- RSD < 10% between sampling bag and canister

Landfill closed since 2000:

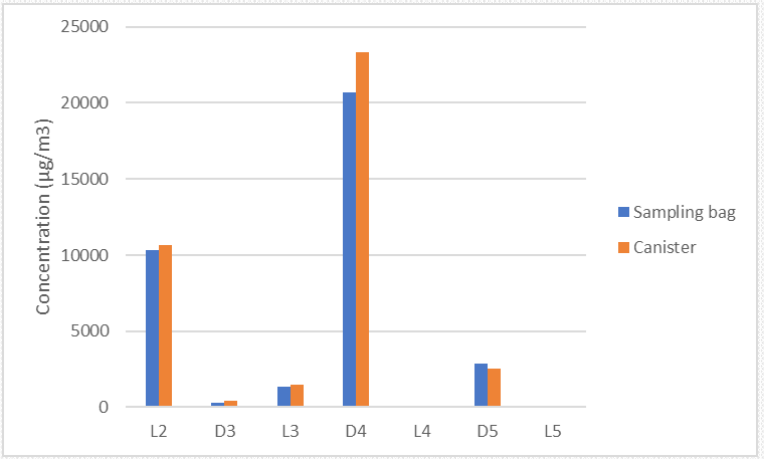
- D4 < L2 < D5 < D3
- Other siloxanes measured under average LOD of 75 µg/m³
- D3 unstable (RSD > 10%)
- **761 µg Si/m³**

Active landfill:

- D4 < L2 < D5 < L3 < D3
- Other siloxanes measured under average LOD of 80 µg/m³
- D3 unstable (RSD > 10%)
- **13 009 µg Si/m³**



Biogas from landfill closed since 2000



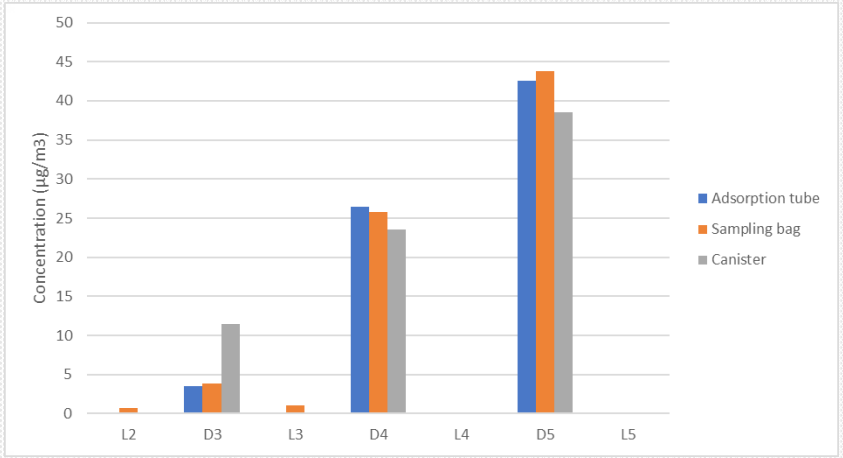
Biogas from an active landfill

Results of digestion reactor biogas

Overpressure at sampling point

Raw biogas from digester:

- RSD < 10% between methodes
- D5 < D4
- Other siloxanes measured under average LOD of 8 µg/m³
- **16 µg Si/m³**



Biogas from digestion reactor

Conclusion

Determination of siloxanes with TD-GC-MS

European Biomethane Standards for the concentration of siloxane in biogas (EN 16726):

- < 0.3 – 1 mg/m^3 for grid injection
- < 0.5 mg/m^3 for traffic use

Sampling methode:

- Ease of sampling
- Representative sample
- Pressure of sampling point
- Recovery of the siloxanes

Landfill biogas vs digestion reactor biogas:

- Landfill biogas: D4, L2, D5
- Digestion biogas: D5, D4
- Totale siloxane concentration landfill biogas > digestion biogas

Questions?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