9th IWA ODOURS & VOC/AIR EMISSIONS CONFERENCE

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DETECTION OF GAS LEAKAGE FROM LANDFILLS USING OPTICAL GAS IMAGING COUPLED WITH FENCE MONITORING SYSTEM OF ODOUR BY IOMS: A CASE STUDY

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TECNOLOGIA & AMBIENTE

PRESENTATION OUTLINE

- Site description
- Odour Management Plan (OMP)
  - ❑Source monitoring
  - ❑Fence Monitoring
  - ❑Analysis of complaints
- Odour reduction program (ORP):
  - ❑Characterizing the source(s)
  - ❑Implementing reduction measures
  - ❑Measuring the effectivness of ORP

SITE DESCRIPTION 1/2

Non hazardous waste landfill; mostly sewage sludge and wastes deriving from mechanical-biological treatment of urban wastes.

Overall Capacity 6.2 Mm^3

Residual Volume (31/12/20): 0.35 Mm^3

Overall surface: 213.000 m^2

Distance to the first receptors (scattered house): 1000 m

Area emission source (*waste coverd by virgine excavated natural material*) = 127.000 m^2

SOER: 0.02 – 0.1 ou/m^2s

Tipping area *(fresh wastes daily delivered)* **=** 2000 m^2

SOER: 0.7 - 9 ou/m^2s (depending on wastes)

SITE DESCRIPTION 2/2

Landfill biogas (LFG) management system

LFG management **before** the Odour Reduction Program (ORP):

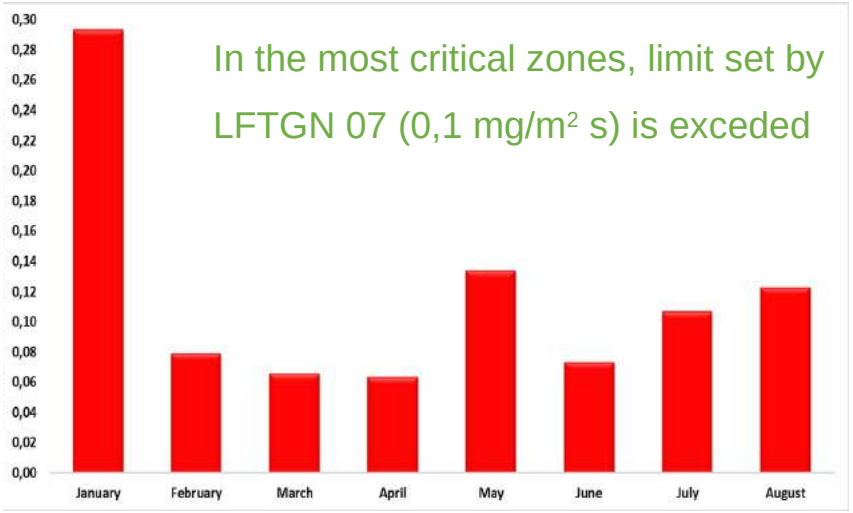
- **301** vertical wells;
- Two energy recovery engines: 1.065 MW and 0.995 MW;
- Three blower-flare facilities (2000, 1000 and 500 Nm^3/h)

ODOUR MANAGEMENT PLAN 1/2

Source Monitoring

Campaigns of biogas from the landfill surface are carried out *monthly* according to the UK Environment Agency "*Guide to monitoring surface gas emissions in landfills*" over 160 points for each campaign (prescription)

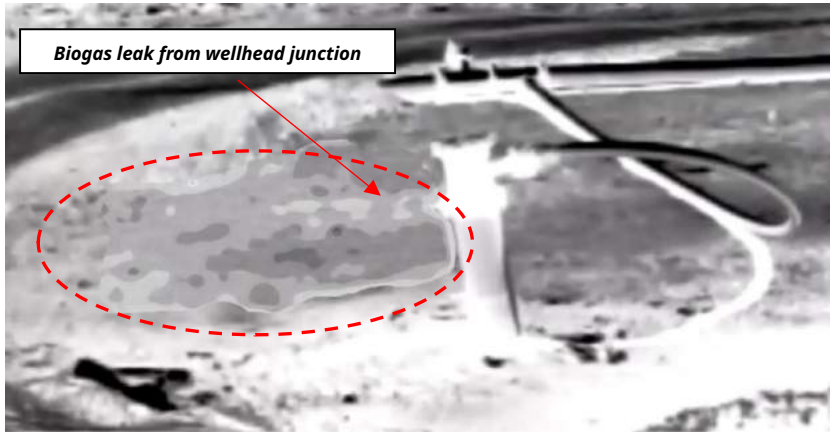
Before Odour Reduction Program



Detailed investigation (voluntary)

OGI (Optical Gas Imaging) technology was employed to detect the presence of methane in biogas: an IR EyeCgas model was used with a cooled optical sensor and with a differential thermal sensitivity <12mK at 25C°.

Preliminary LDAR screening (August)



High spatial resolution LDAR campaign (September)

In "*Odour Reduction Program*" Section

ODOUR MANAGEMENT PLAN 2/2

Fenceline and Complaints Monitoring

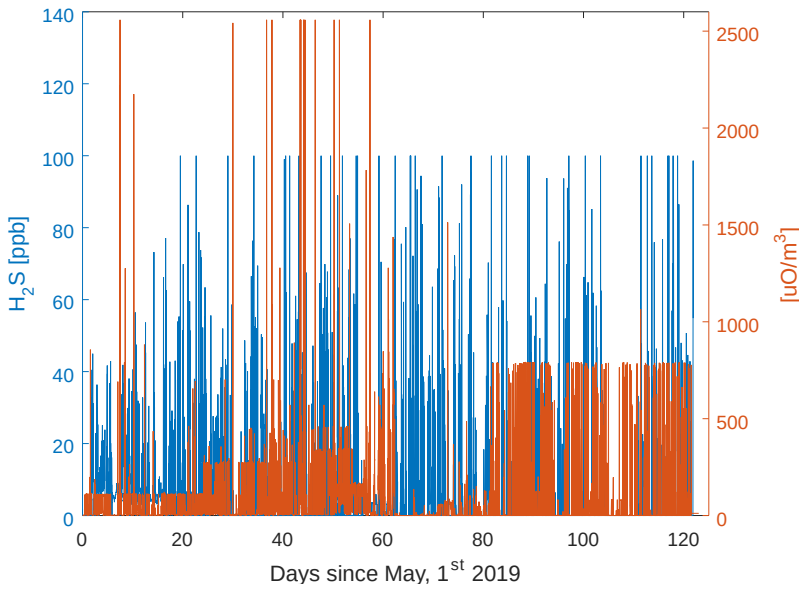
Fenceline monitoring (prescription)

- N. 2 IOMS: MSEM 3200 (Sensigent)
- N. 2 H_2S Analyser: Jerome® J605 (Arizona Instr)
- N. 2 OdorPrep® V3, on-demand air sampling system

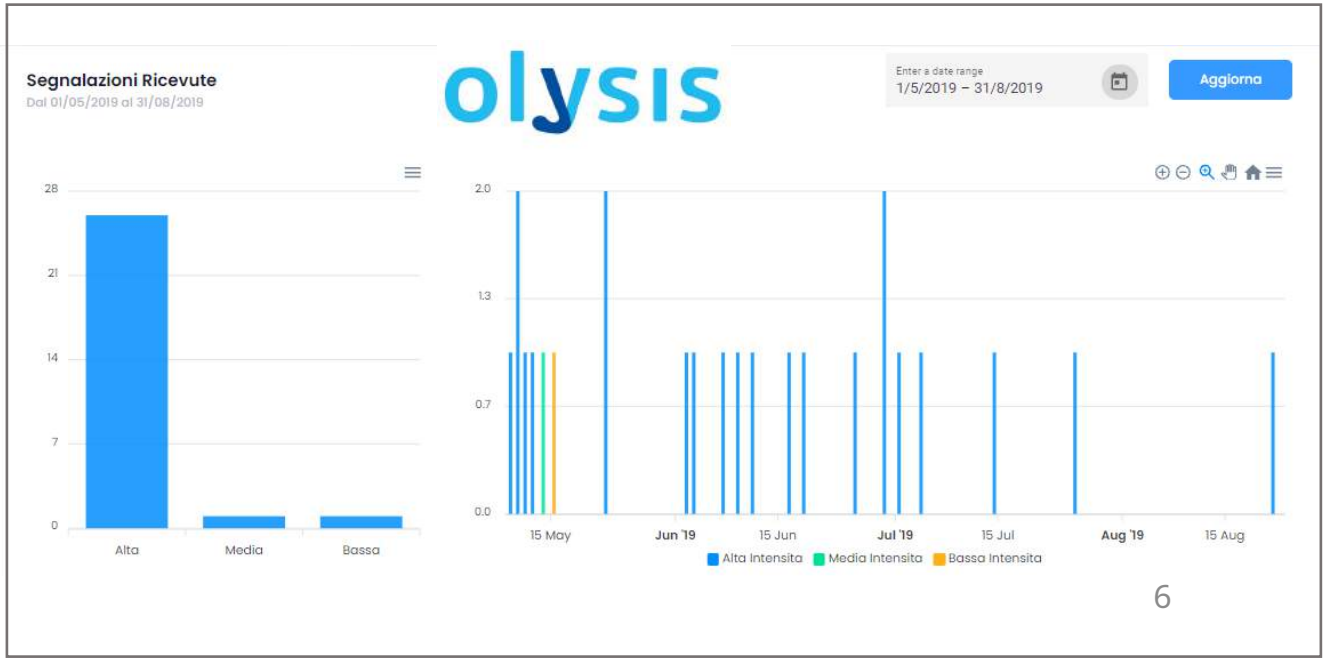
Complaints monitoring (voluntary)

- App Nosy (WPS) provided by the plant management to the citizens for *odour complaints registration* (geo-localization + odour Intensity)
- Olysis (T&A) data acquisition, processing and management system

Before Odour Reduction Program



In the period May-August, 117 exceedances of the set values for H_2S or odour units were recorded, with an average of 30 per month.



ODOUR REDUCTION PROGRAM 1/3

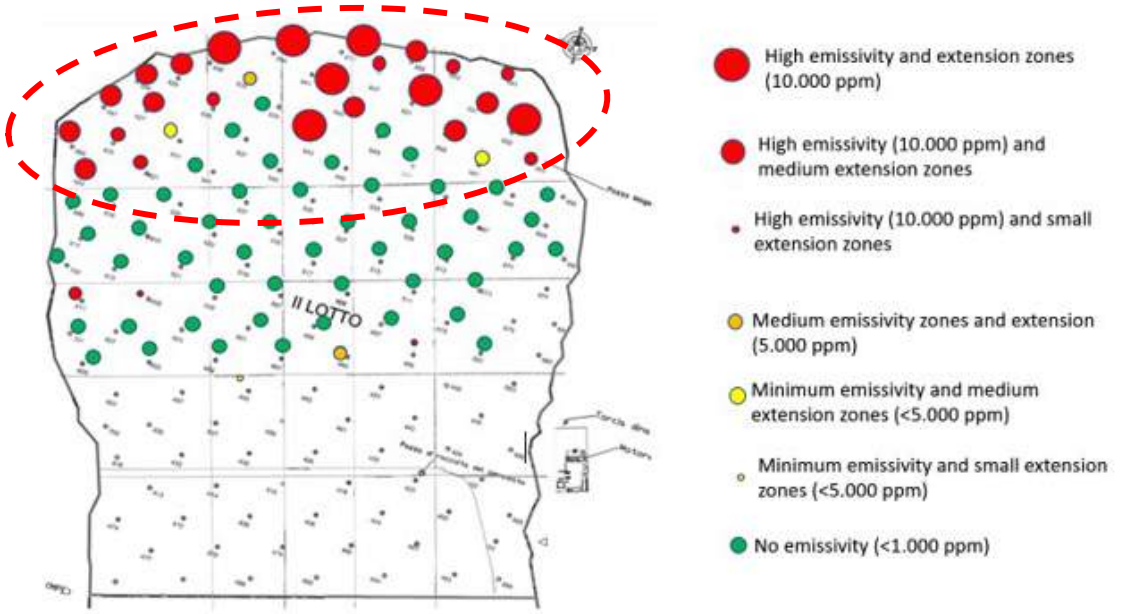
Characterizing the sources

Two hypothesis:

a) Fugitive emissions (Leaks from single wells)

b) Poor biogas capture in specific zones

Specific campaign (September) : 85 wells were characterized for pressure, composition, leaks (OGI)



CH_4 [%]	CO_2 [%]	O_2 [%]	Temperatura [°C]	Pressione relativa [mb]	CO [ppm]	H_2S [ppm]	IR OGI
58,4	39,8	0,0	42,2	1,22	468	152	
58,3	39,5	0,0	33,7	1,58	246	126	
58,9	39,6	0,0	37,8	-0,27	>>>>	178	
57,9	39,6	0,0	36	1,49	>>>>	215	
57,7	39,6	0,0	33,1	1,37	>>>>	262	
57,7	40,0	0,0	39,1	1,75	>>>>	113	
58,6	39,2	0,0	39,1	1,58	467	175	
59,1	38,9	0,0	36,6	1,44	231	139	
57,9	39,9	0,0	39,7	0,35	>>>>	123	
58,4	39,4	0,0	43,2	1,2	296	118	
58,5	39,3	0,0	35,1	1,52	270	202	
57,4	40,3	0,0	38,2	1,53	>>>>	66	
58,9	39,1	0,0	33,7	3,32	287	116	
58,4	39,2	0,0	28,9	0,61	144	71	
56,7	38,9	3,9	37,5	0,56	>>>>	80	
58,4	39,7	0,0	29,3	0,51	69	46	
57,6	39,3	0,0	36,2	-0,12	332	59	
57,7	39,6	0,2	36,8	-0,03	121	63	

Optimal relative pressure for biogas capture is around -0.1 mbar: Positive values are related to pressure unbalance in the suction network in specific zones

ODOUR REDUCTION PROGRAM 2/3

Implementing reduction measures

Actions undertaken in order to improve the LFG pipe network and balance the suction pressures from the critical zones of the landfill:

1) Drilling new uptake wells: form 301 wells to **364** wells

2) Modifying the position of LFG blower-flares in order to optimize the distances between low-efficiency capture zones and blowers: *trial-and-error procedure* in order to achieve negative pressure in each well

3) Checking and repairing the valves and connections of wellfield system, particularly in the northern landfill sector: OGI was employed for quality control after repairing

Reduction measures were carried out in 15 days (September/October) after the problem was identified

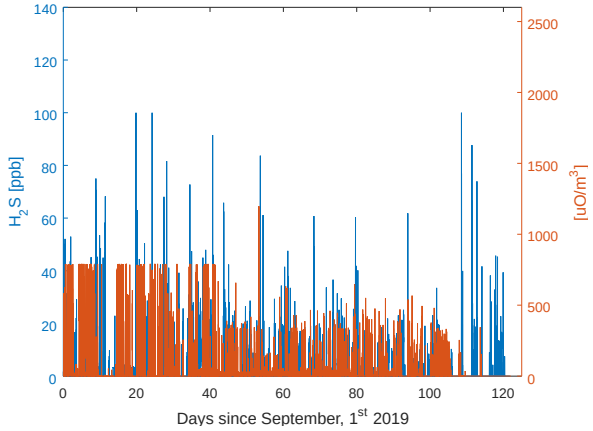
ODOUR REDUCTION PROGRAM 3/3

Results of ORP

Quarter-over-Quarter comparison (Sept-Dec to May-Aug)

Source: 75th percentiles of methane Flux
August: 0.12 – December: 0.04

Fenceline: exceedances of the set values for H2S or uoE/m3:
30/month May-August – 5/month Sept-Dec



Receptors: complaints:
#28 complaints May-August – #1 complaint Sept-Dec

Year-over-Year comparison (May-Aug 2019 to May-Aug 2020)

Comparison between ***homogeneous periods***:

The 98th percentile of **odor concentration** measured by IOMS in May-Aug 2019 was **100 uoE/m3** against **440 uoE/m3** (May-Aug 2020), with a reduction effectiveness of over 75%.

The 98th percentile of **H_2S** in May-Aug 2019 was **9 ppb** against **34 ppb** (May-Aug 2020), with a reduction effectiveness of over 70%.

Conclusions

Example of a complex integrated Odour Management Plan (Source, Fenceline, Receptors) and Odour Reduction Program

Different technologies for different purposes:

- Flux emissions and LDAR at the source
- IOMS + specific sensors at the fenceline
- Citizens complaints registration (by App) for the receptors

Complemantary technologies identified the specific problem (poor biogas suctions in specific zones vs. fugitive emissions from single wellhead)

Measurable performances (biogas flux, #wells with low suction, odour units, H2S concentrations, #complaints): quantifying the effectivness of an *Odour Reduction Program*

- QoQ comparison: significative reduction, even though it may be related to seasonal effects

- YoY comparison: 75% reduction of *98° pecentile* of odour concentrations at the fenceline monitored by IOMS; over 90% reduction for citizens complaints (2 complaints vs 28)

Thank you for your attention!

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