Analysis of landfill gas migration using autonomous gas monitoring platforms

Fiachra Collins, Dylan Orpen, Cormac Fay, Dermot Diamond

CLARITY: Centre for Sensor Web Technologies
National Centre for Sensor Research
Dublin City University
Dublin 9, Ireland

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Adaptive Sensors Group
Motivations

1. Reduction in greenhouse gas pollution\(^1, 2\)

2. Optimised management /utilisation of gas-generative sources

3. Eliminate hazardous, costly and controversial social risks
   - €33M landfill fire clean-up in Irish midlands \(^3\)

\(^2\) Kyoto Protocol, Information Unit on Climate Change, U.N.,1998
Landfilling in Ireland

The numbers:
National rate: 2 million tonnes per annum (2008) = ~1.2 kg/person/day

48 open facilities

Maximum landfill capacity will be reached in 2020

Odorous landfill gas accounted for ~71% of all complaints in relation to licensed facilities (2009)

Source: Focus on landfilling in Ireland. The Environmental Protection Agency. 2010

Methane emissions from landfill 1990-2008

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Landfill gas generation

Magnitude dependent on numerous factors: age, waste type, environmental conditions...

Generated gas is extracted for flaring or power generation (if CH$_4 > 50\%$ vol.)

Gas migration measured in perimeter borehole wells:
→ threshold limits of 1.0% /1.5% vol. for CH$_4$ / CO$_2$
Platform technology

Components:
1. Microcontroller circuitry
2. Gas extraction
3. Infrared CH$_4$ and CO$_2$ gas sensors
4. GSM communication
5. 12V 5Ah lead acid battery (10 weeks @ four samples/day)
6. IP68-rated weatherproof casing
Data access

Physical world

Analyte source

Gateway

Internet

Digital world

CLARITY portal

Fusion tables

in-situ measurement

wireless telemetry

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Landfill gas monitoring

Duration

- 253 days/6072 hrs
- 890 measurements

Validation checks with GA2000 on 20/04/11, 16/08/11, 16/10/11
> 98 % accuracy for all checks
Data analysis

- Borehole avg CO2
- Borehole avg CH4
- SCADA flowrate
- SCADA CH4
- Barometric pressure
- Rainfall

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Data conclusions

- Overall reduction in gas levels over the monitoring period
- Gas levels ↓ with increased extraction
- Gas levels ↑ when barometric pressure ↓ and rainfall ↑
- Positive feedback from regulators and operators in terms of data accessibility and usefulness
On-going work...

- Distributed network of multiple platforms
- GEN3 development (cost reduction, power longevity, modularity in sensors and comms)
- Commercialisation
Thank you for your attention.

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