Autonomous remote gas sensor network platforms with applications in landfill, wastewater treatment and ambient air quality measurement

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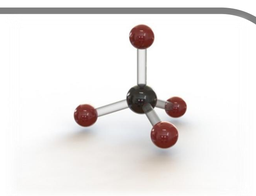
Introduction



•Carbon dioxide (CO_2) and methane (CH_4) are produced by anaerobes on decaying matter. This gas production is present in landfill sites and in anaerobic lagoons in waste water treatment plants (WWTP). Monitoring gas production is important as CO_2 can collect in low lying areas and asphyxiates, CH_4 is flammable in the 5%-15% v/v gas/air region

•Both CO_2 and CH_4 are greenhouse gases, CH_4 having 25 times the global warming potential of CO_2. At landfill site perimeters, CO_2 and CH_4 must not exceed the EPA thresholds of 1.5% and 1.0% respectively. Gas production is infrequently measured on individual wells due to expense and labour-intensity.

•In WWTPs, the monitoring of gas emissions from anaerobic lagoons can enable the bio-digestion process to be optimised and ensure they remain in safe levels. Gas levels can be reduced by modifying the chemistry of the process and by water agitation.

•Typically measuring gas emissions requires a handheld device to be brought on site and connected to the gas source at each point of interest. This is expensive, time consuming and results in infrequent data, sometimes as long as one month between samples.

Systems Development

Need for near real time gas monitoring → **Development of GEN3 gas monitoring platform**

•To address the issue of infrequent sampling rates and to provide the plant managers with near real time data from multiple points on site autonomous wireless gas sensing platforms have been developed, multiples of which can be deployed across a landfill/WWTP to sample gas and pressure up to 12 times per day. Data is sent via GSM to the cloud and can be accessed via an online portal.

Above: data from system being accessed online.
Right: GEN3 gas monitoring platform without case.

Above: GEN3 system during deployment setup to Kinsale road landfill perimeter well, Cork, Ireland.

✓30% lower cost than previous generation

✓Commercially viable

✓More compact

✓Integrated gas and pressure sensing

✓Improved environmental sealing

✓Future-proofed: updated circuitry and expanded functionality

✓More user friendly installation

System Deployments

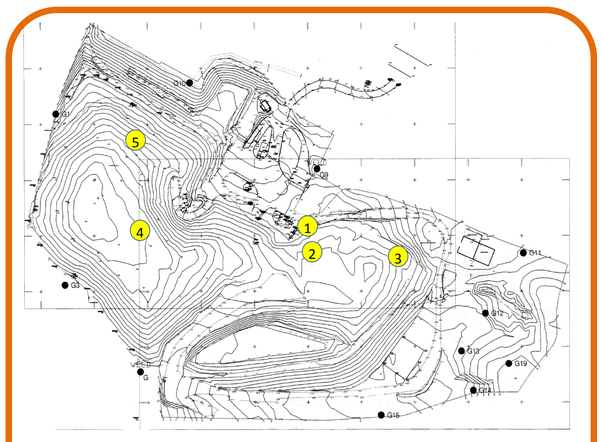
Test deployment to USP swine effluent lagoon, Pirassununga, São Paulo, Brazil

A base station to receive GSM data from system was installed in USP, Pirassununga and a test deployment made to ensure data was received correctly. The deployment was made to a swine effluent lagoon on the USP campus. The image above shows this test deployment where; 1. Gas monitoring platform, 2. Accumulator bag from which the system samples, and 3. Checking system signal strength and function on personal mobile phone. 29/8/2013 – 9/9/2013.

Deployment to SEAN lagoon, Artur Nogueira, São Paulo, Brazil

Once the test deployment showed the system and base station were functioning correctly the gas monitoring system was deployed to an anaerobic lagoon in Artur Nogueira, São Paulo, Brazil.
13/9/2013 – ongoing deployment.

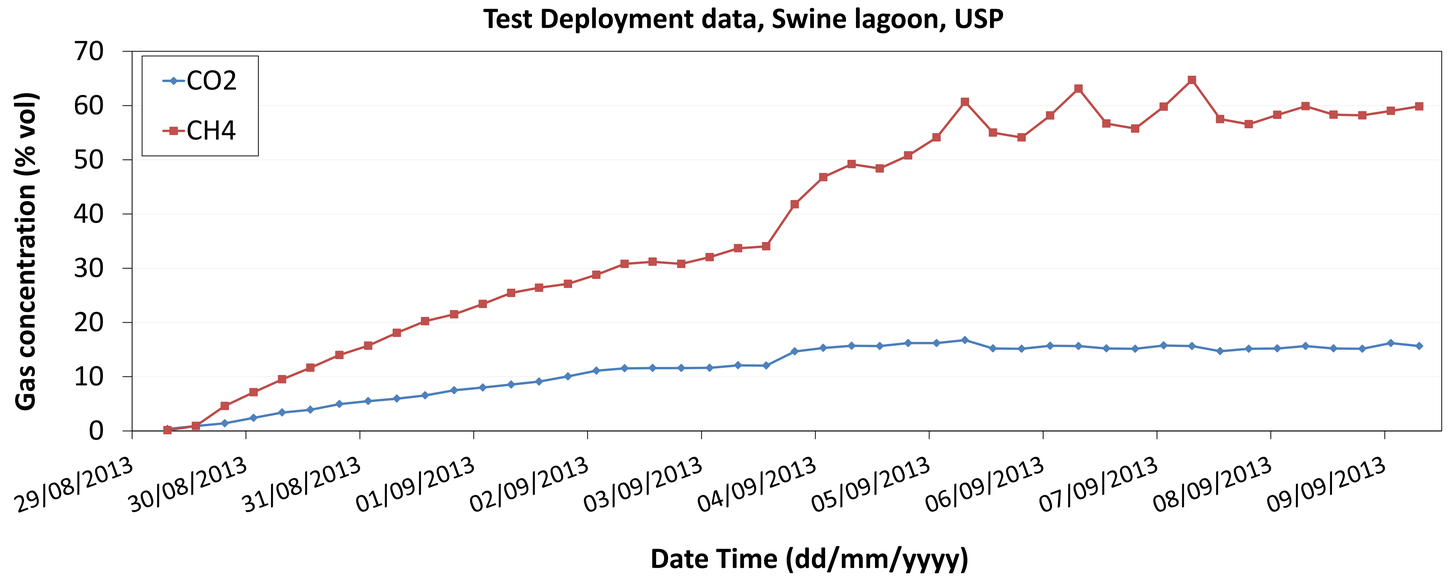
Deployment to Ballydonagh landfill, Athlone, and Kinsale road, Cork, Ireland



A previous deployment site in Ireland is the Ballydonagh landfill where five systems were deployed in a network on extraction pipe manifolds. This allowed the gas levels from individual site areas to be measured as opposed to the net total. A current deployment is the Kinsale road landfill, Cork, where two systems are installed.

Deployment Data

Test Deployment data, Swine lagoon, USP



Deployment to the swine effluent lagoon on the USP campus was intended to show that the system was transmitting and the base station was receiving correctly. However it also showed the high levels of CO_2 and CH_4 collected in the accumulator bag. The rate at which the atmosphere in the bag was replaced by CO_2 and CH_4 is very high, given that the bag dimensions are 1 m x 1.5 m x 1.5 m.

Future Work

•Future work will see further deployments both in Ireland and Brazil, with the intention of multiple systems on one site to provide a sensor network.

•Further system development is currently underway to fit the Gen3 gas sensing platform with photovoltaic cells, increasing its battery life indefinitely.

•The Gen3 gas sensing platform may be fitted with alternate sensors to allow monitoring of other gasses, including SOx and NOx. Ambient air quality monitoring in urban areas and car parks are planned for the future.

•Further collaboration between USP and DCU on system deployments.

We acknowledge support for this research from Enterprise Ireland (CF2012-2328) and from SFI for the opportunity to present this work through the ISCA-Brazil program.