
This item was submitted to [Loughborough's Research Repository](#) by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Real-time autonomous remote monitoring of AD

PLEASE CITE THE PUBLISHED VERSION

VERSION

AM (Accepted Manuscript)

PUBLISHER STATEMENT

This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: <https://creativecommons.org/licenses/by-nc-nd/4.0/>

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Radu, Tanja, Richard E. Blanchard, Andrew D. Wheatley, and James Taylor. 2019. "Real-time Autonomous Remote Monitoring of AD". figshare. <https://hdl.handle.net/2134/19751>.

Real-time autonomous remote monitoring of AD

Tanja Radu¹, Richard Blanchard² and Andrew Wheatley¹

James Taylor³

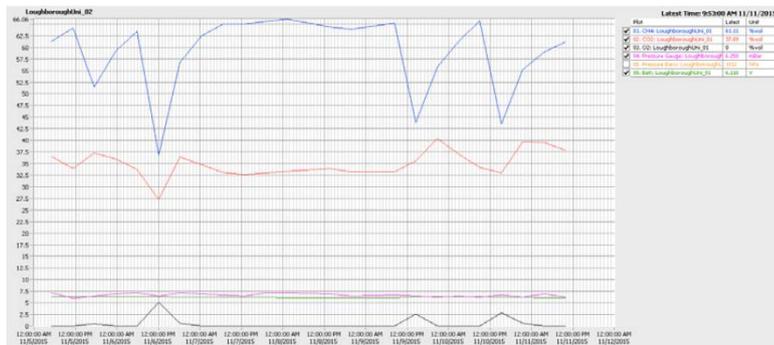
¹School of Civil and Building Engineering, ²School of Electronic, Electrical and Systems Engineering, Loughborough University, Loughborough, UK

³Ambisense Limited, Institute of Research & Development, Birmingham Research Park, B15 2SQ

Monitoring and optimisation of small and medium size, remote anaerobic digesters is an outstanding issue. Continuous on-line monitoring of biogas quality and quantity, along with reactor pressure and oxygen levels (potential indicators of leaks) would enable control and management of decentralized digesters. Current monitoring systems at large digesters are bespoke and expensive precluding their use for smaller reactors.

We have identified a novel remote monitoring platform developed by Dublin City University (commercialised by Ambisense Ireland) for the on line measurement of methane, carbon dioxide and pressure currently under test by the landfill industry. The instrument is autonomous (solar powered) and can be controlled remotely. The data is sent to the cloud via GSM transmissions, and accessible via an online portal. CO₂ and CH₄ are measured by modified infrared and pressure by piezoelectric sensors embedded in a chip.

Here, we are examining instrument's suitability for application in AD market by testing its performance at various biogas compositions, pressures and temperatures typical of the AD process range. Success in this proof of concept would lead to a further development of an expert machine control system, based on the monitor, to allow autonomous control and optimise performance of several digesters remotely.



Screen shot of online software for real-time remote monitoring



Loughborough University
ambisense
AUTONOMOUS GAS MONITORING

Labscale AD 02		
CH ₄	43.82	%vol
CO ₂	35.64	%vol
O ₂	2.67	%vol
Pressure	6.49	mBar
PressureAtm	1010.84	hPa
Battery	6.28	V
Mon 9/11/2015 14:28		

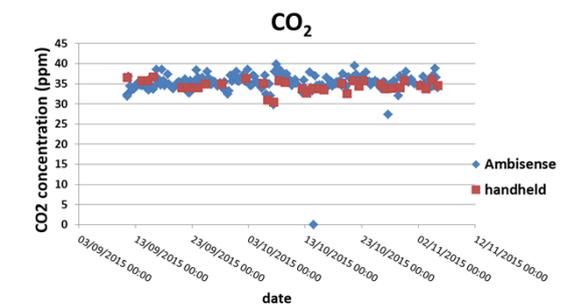
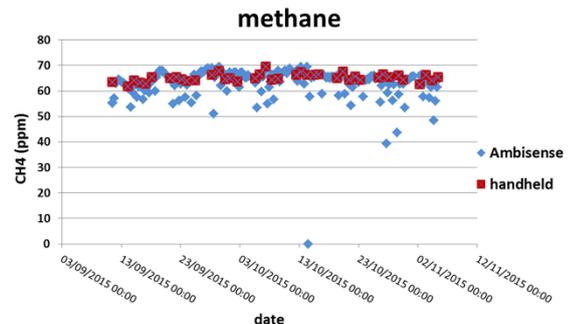


Autonomous landfill gas monitoring platform developed by Ambisense Limited:

- a) Deployed in field
- b) In Loughborough University labs

Autonomous remote monitoring of: CH₄, CO₂, O₂, pressure

- Using autonomous wireless gas sensing platforms- reliable long term performance and reduction in component cost
- The data sent to the cloud via GSM transmissions, and is accessible via an online portal for remote monitoring by the facility management
- CO₂ and CH₄ sensing: high-accuracy infrared absorbance sensors
- Pressure sensing: piezoelectric sensors (critical for understanding gas flows)
- Oxygen sensor is an electrochemical cell
- The integrity of the sensors' measurements are protected by use of pre-conditioning filters to remove water vapour, particulates and condensate
- Autonomous operation is achieved by custom-programmed microcontroller circuitry, which also manages data logging and remote transmission (GSM communications)
- Ambisense data shows good agreement with the hand held instrument for CH₄ and CO₂



Monitoring quality: comparison with hand-held device

ACKNOWLEDGEMENT: This research is funded by SUPERGEN Bioenergy Hub's Small Grant Scheme and Engineering and Physical Sciences Research Council (EPSRC) grant EP/J000361
For further details please contact Tanja Radu at T.Radu@lboro.ac.uk or +44 (0)1509 23808