

Project Number & Title: 4C-122

Installation of instrumentation for remote monitoring of biogas composition and operational data at commercial piggeries.

Project Leader: Alan Skerman

Principal Environmental Engineer, Department of Agriculture and Fisheries, Toowoomba.

Project Participants: Dr Stephan Tait

Formerly Research Fellow, Advanced Water Management Centre, University of Qld.

Aims and Objectives: To facilitate and provide incentives for producers to install instrumentation to enable Pork CRC Bioenergy Support Program (BSP) officers and piggery managers to remotely monitor biogas composition and other operational data at up to three existing on-farm biogas systems operating at commercial piggeries.

Key Findings: New instrumentation was installed to closely monitor the operation of an existing hybrid covered anaerobic pond (hybrid CAP) at Piggery A, from April to June 2018. Over this period, the average biogas production from the hybrid CAP was 5,601 m³/d and the resulting biogas and methane yields were 523 m³ biogas and 287 m³ CH₄, respectively, per tonne of volatile solids (VS) discharged into the hybrid CAP. The recorded methane yield indicated that the hybrid CAP was achieving a high methane recovery of 88% of the biochemical methane potential (BMP). Approximately two-thirds of the biogas produced by the hybrid CAP was used to run two 250 kWe combined heat and power (CHP) generator units, while the remaining third was burnt in a shrouded flare. The two CHP units generated an average of 6,490 kWh/d over the monitoring period (average output 270 kWe). Thirty-six percent (36%) of the electrical power generated by the CHP units was used in the pig sheds, predominantly running cooling fans, lights and heat lamps, 26% of the power was used to operate the on-site feed mill, and 26% was exported to the electricity grid. The remaining 12% (34 kWe) was used to run the hybrid CAP and onsite biogas production and use infrastructure. Piggery shed power consumption decreased and grid exports increased from April to June, reflecting the lower usage of the evaporative cooling fans as the weather became cooler. Based on the average power generation of 1.73 kWh/m³ biogas and the average biogas methane content of 55%, the average electrical efficiency of the generator engines was 34%, which is typical for reciprocating biogas engines.

The average hydrogen sulphide (H₂S) concentration in the biogas extracted from the hybrid CAP (223 ppm H₂S) was much lower than levels typically observed in raw piggery biogas and only marginally higher than the recommended maximum of 200 ppm for many generator engines. However, this reduction in H₂S concentration, which was achieved by biological oxidation inside the hybrid CAP headspace, was not sufficiently consistent for safe operation of the generator engines. Further biogas treatment in the external biological scrubber reduced the H₂S concentrations to very low levels (average 18 ppm) which rarely exceeded 200 ppm. Occasional spikes in the H₂S concentration generally coincided with generator stoppages which resulted in stoppages of the biological scrubber, biogas blower and air dosing pump. In general, the combined biological oxidation in the hybrid CAP and external biological scrubber was effective at removing H₂S from the biogas.

Application to Industry: Installation of monitoring instrumentation, similar to that installed at Piggery A, has considerable potential for improving the management of on-farm biogas systems. More specifically, the high quality, real-time data provided by such installations assists piggery managers to promptly diagnose operational irregularities and system faults, and thereby avoid costly damage to system components, such as generator engines. The output data can also be used in evaluating a range of operating strategies and biogas treatment methods to maximise economic benefit. The installation of the monitoring instrumentation at Piggery A provides a model for the further development and more widespread deployment of similar systems across the industry.