

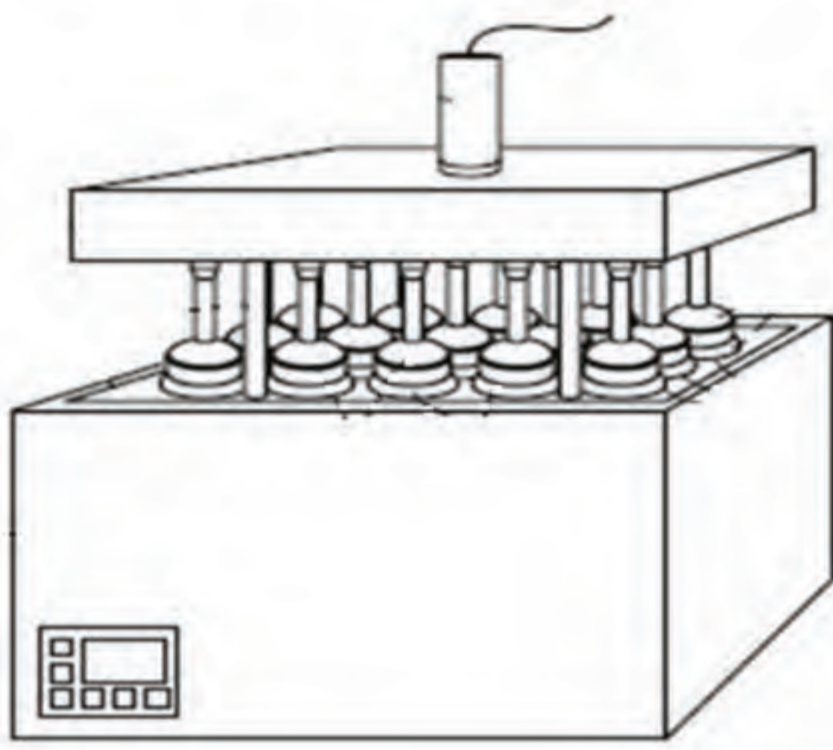
Lab fermenters that narrow the gap with full-scale operation - automatic feeding and batch sets

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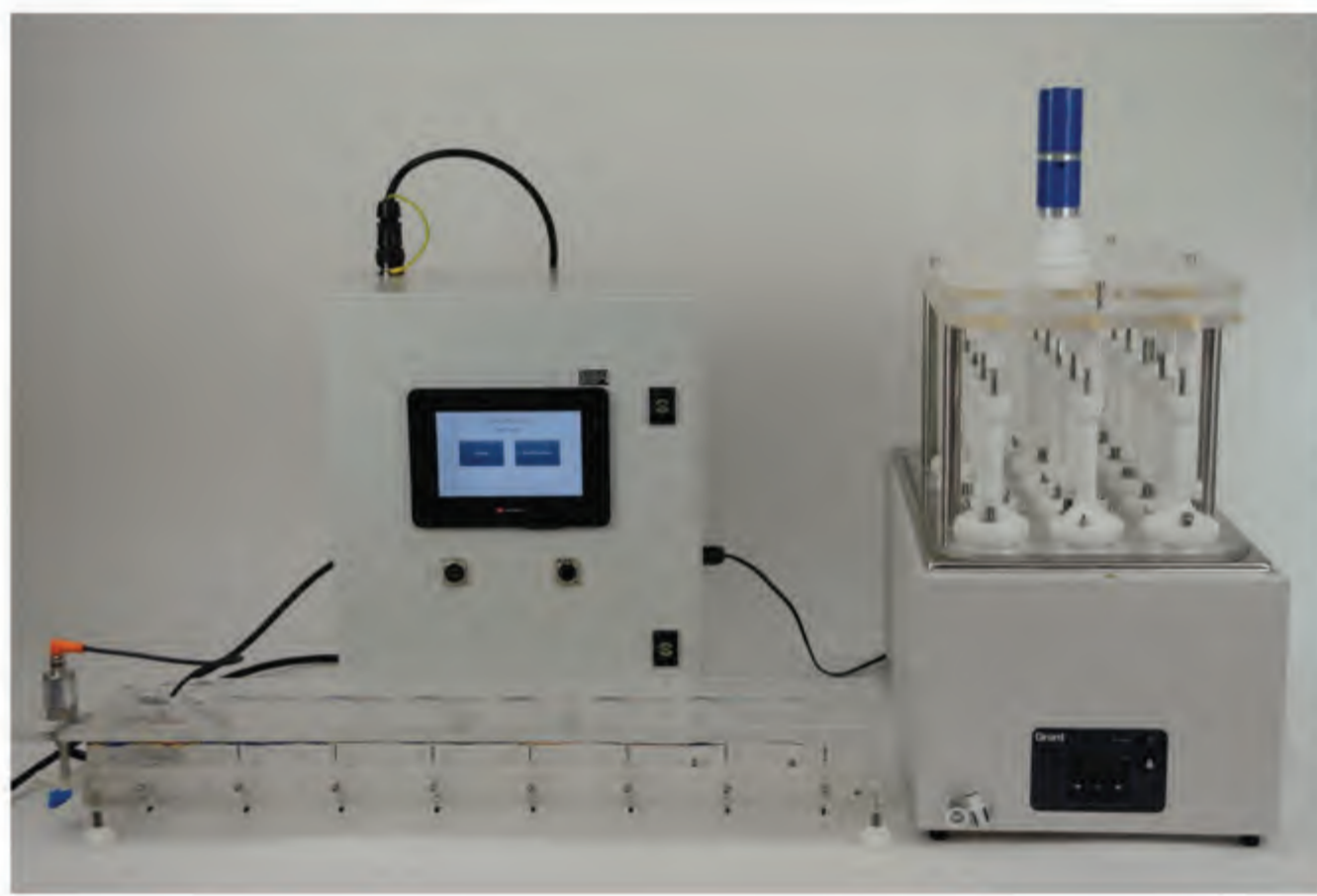
Background

The quality of fermentation research has been affected in batch experiments by laborious setting-up of tests due to equipment limitations, and by inconsistency in the mixing regime. For example, mixing failure in a control reactor will affect how the results from other reactors are interpreted. Most available batch test equipment offers low flexibility for biogas collection and monitoring, and no access to the reactor during testing, for example to monitor pH or to dose additives while tests are running. Most "semi-continuous" fermentation to date has been of limited quality due to the inability to apply the same feed regime as used in full-scale plants; for example feeding several times a day with heterogeneous feedstock. Most research has used single daily feed regimes, causing transient shock loads, not found in industrial operation. Manual feeding produces lower quality results and is labour intensive (e.g., weekend feeding rotas!)

Batch fermentation (BMP) sets



- Sets of 15 fermenters in water bath
- All vessels mixed at the same speed by a single motor improves test consistency
- Fast and simple assembly and re-start of new tests
- Wide mouth bottles facilitate sample handling
- Added monitoring capability with access to fermenter contents without opening gas headspace
- pH monitoring or supplementation while test is under way are possible
- Single, compact, gas flow meter automatically corrects to STP
- Monitoring of biogas, or methane is possible
- Simple, low cost, gas flow meter calibration kit available
- Mesophilic or thermophilic with low bath water evaporation loss

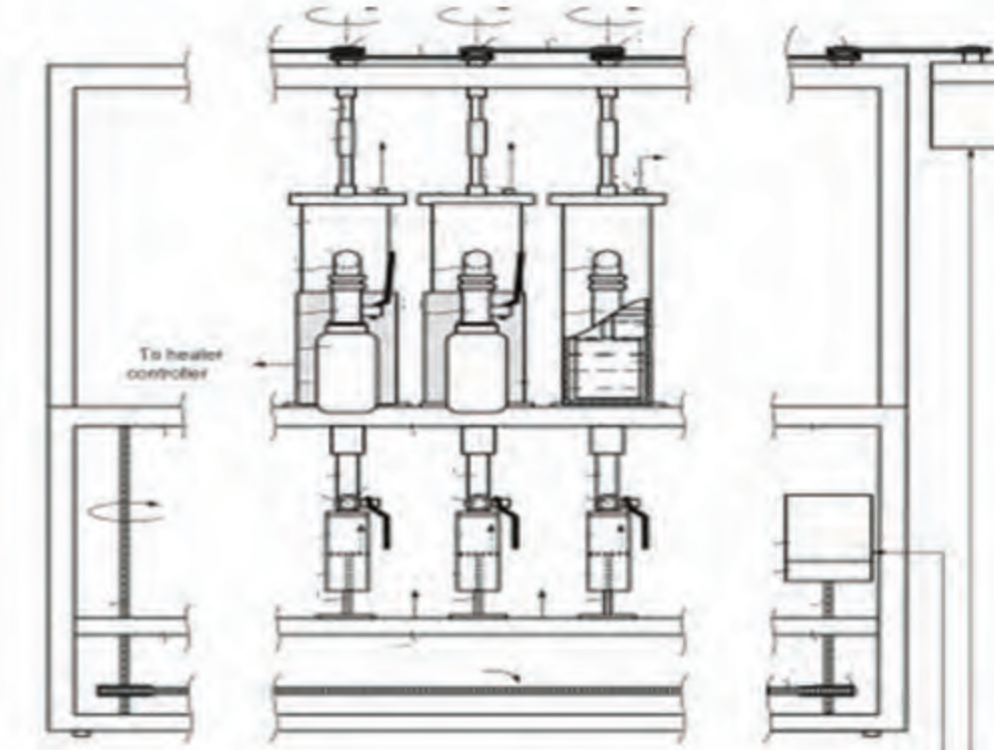


*Patent pending

Anaero Technology Solutions

- **Batch fermentation rig (BMP)** . Equipment that delivers the same mixing speed to all reactors in the set - a key parameter in the kinetics of fermentation. Easily assembled sets speed test preparation, and wide mouth plastic bottles are drop-proof, and simplify filling of vessels.
- **Semi-continuous fermentation rig.** Full-automatic feeding of fermentation sets with reactor volumes from 1 to 50 litres,. Accurate delivery of feed with dry solids content up to 37%. Up to 999 feeding events per day in a gas-tight system. PLC control and monitoring of biogas production with automatic conversion to STP. Upgrade of existing equipment may be possible. Our gas flow meter calibration rig maintains data quality

Semi-continuous auto-feed (CSTR) sets

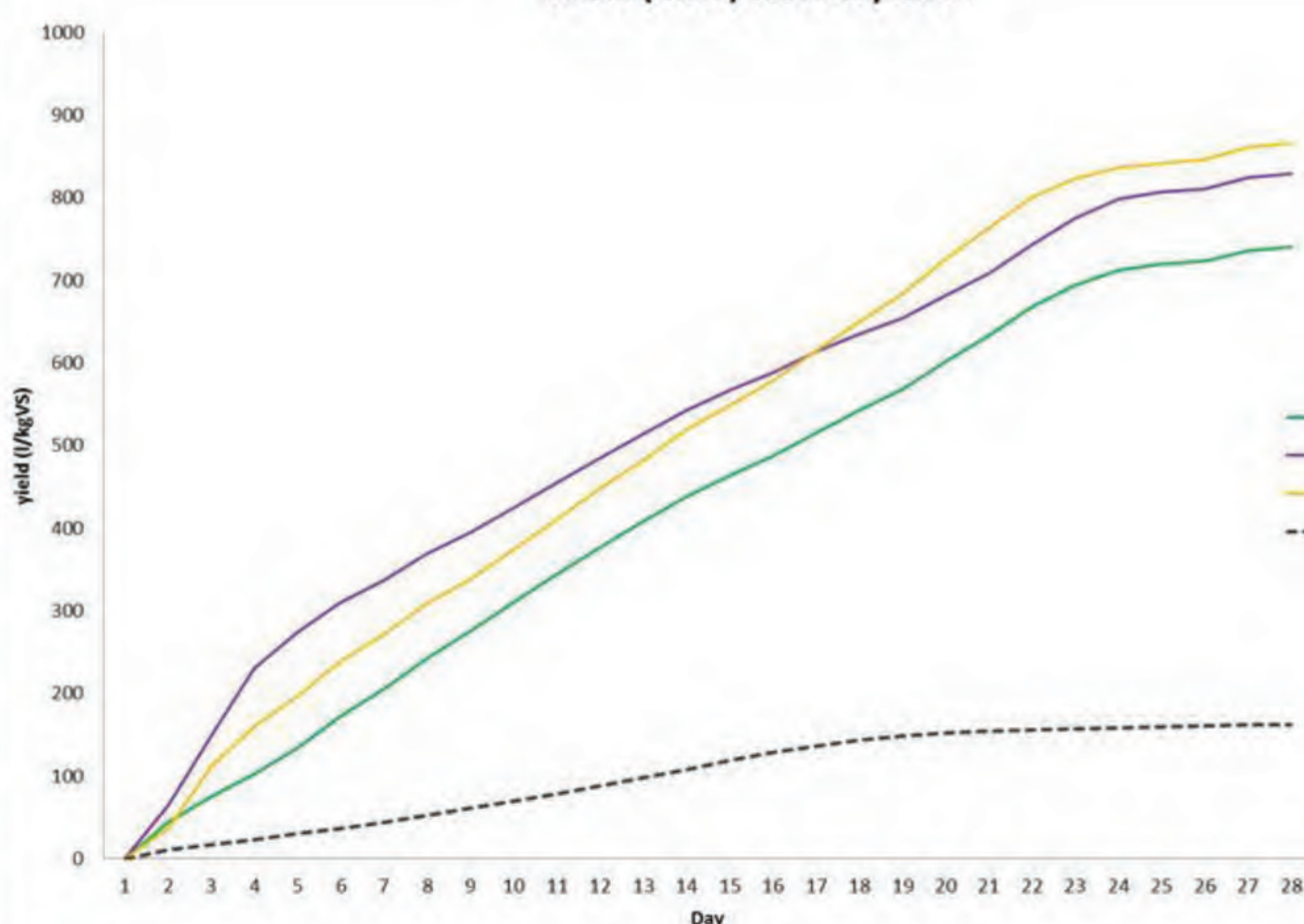


- Sets from 1 to 30 digesters using same automatic feeder (configuration as required)
- Stainless steel reactors from 1 to 50 litres
- All reactors can be mixed with one easy assembly motor
- Individual heater jackets allow different operation temperatures in same set (ambient to 100°C)
- Feed in as many batches per day as required (graph below 10/d)
- Feeding of dry solids up to 36% successfully tested
- 5 sizes of feeder available (0.6 to 10 litres) increase flexibility of rigs and give extended time between top-ups
- Access tube to digester contents without opening gas headspace. Single compact gas flow meter automatically corrects to STP
- Simple, low cost gas flow meter calibration kit

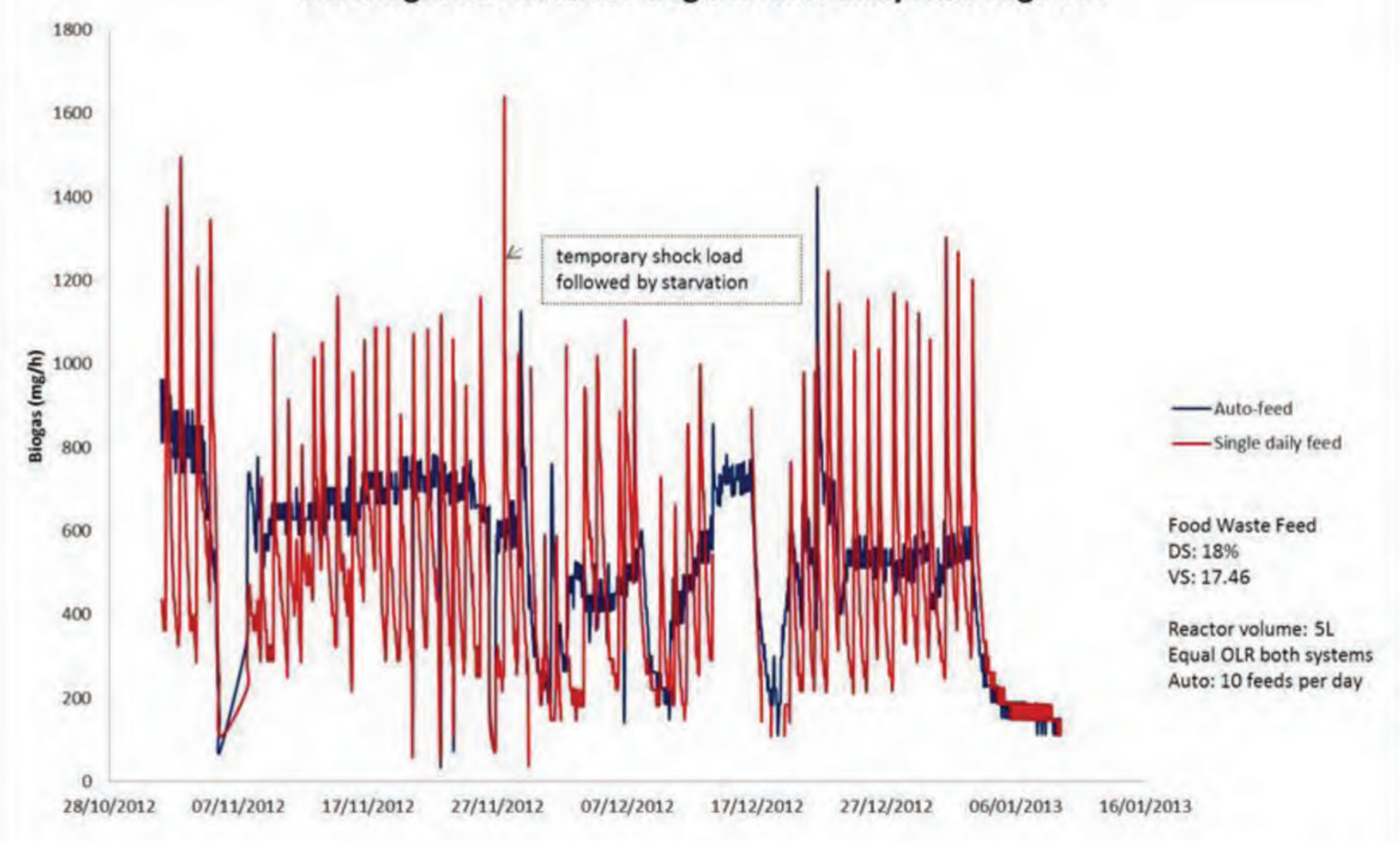


*Patent pending

Batch (BMP) test May 2014



CSTR digestion tests for single and 10 daily feed regimes



Final remarks

- Batch fermentation tests gain consistency by ensuring all vessels have similar operating conditions, such as mixing intensity and temperature. Anaero Technology addresses this by introducing a mechanism that mixes all reactors in a set at exactly the same speed by using a single mixer for all 15 digesters
- Starting batch fermentation test is laborious. Anaero Technology uses larger, plastic bottles (1l), with wide mouth and easily assembled caps that ease test start
- Anaero Technology is bringing fermentation research capability in line with full-scale operation. Feeding non-realistic "semi-continuous" regimes (single feed a day) is laborious and will no longer be acceptable for research once automatic feeding of heterogeneous mixtures becomes established.
- Feeding automatically produces superior and consistent results that are more applicable to full-scale operation. Auto-feeding at lab-scale reduces the logistic problems of operating larger research fermenters, reduces staff-time, (no need for staff to feed during weekends or holidays, the machine does it!)
- Anaero Technology has patent applications on course regarding auto feeding and BMP and is looking for clients in the biotechnological sector, and/or possible partners

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