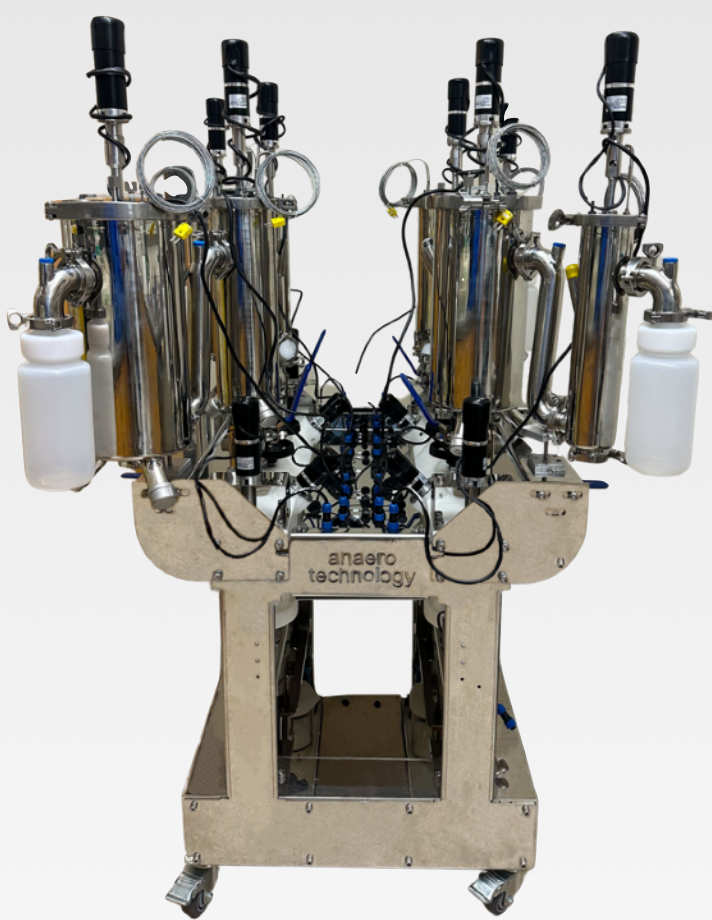
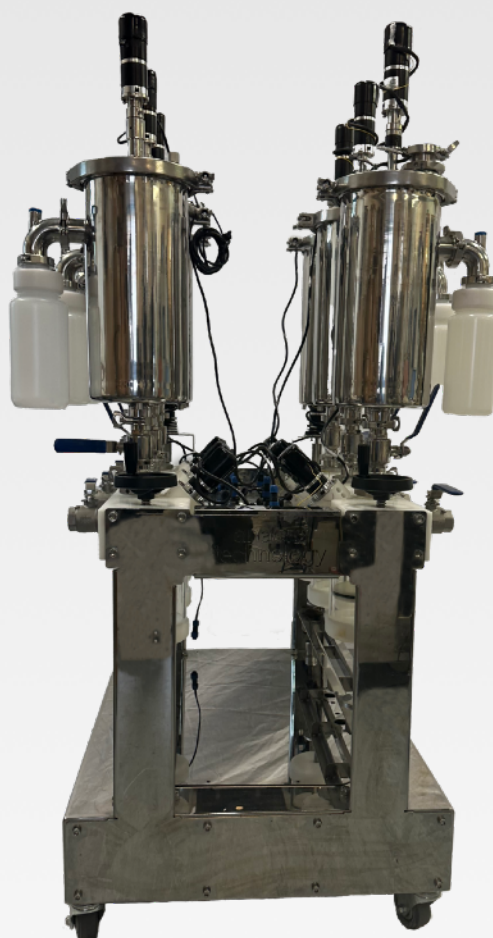


Automatically fed lab-scale Digesters®

A miniaturised, automated AD plant for R&D and to test real operational regimes.



Multi-stage



Single-stage

PATENT 9.850.460, 2017



AUTO-FED DIGESTER RANGE



Solving a problem with traditional digesters

A significant challenge with traditional anaerobic digestion (AD) research systems is that they do not accurately simulate the conditions of full scale operations, such as feeding frequency. This discrepancy between lab and full scale operations can create a serious disconnect between research and the reality in AD plants.

The current discrepancy between lab and industrial operations

Full-scale AD plants usually feed on an hourly or bi-hourly basis, which enables the microbiological system to reach a homeostasis where there is a stable flow of nutrients in and biogas out as output. However, many legacy research systems do not have automatic feeding or are limited to synthetic feed, which means that scientists, with great daily effort Monday to Sunday, can only feed their reactors once a day at an inconsistent interval (and this often excludes weekends). Overall, beside requiring significant manual labour, manual feeding can also increase human error from under or over feeding or discharging.

Automatically fed lab-scale digesters designed and assembled by Anaero Technology significantly increase the capability for accurate and precise analysis of dynamic AD systems. In contrast to traditional systems the automatic feeding coupled with precise, programmable control of the environment (temperature, mixing rate, etc.) enable you to replicate a full-scale AD plant operation in your lab.

1 Year Warranty Included



www.anaerotech.com



contact@anaero.co.uk



Landsite 2, Cowley Road,
Cambridge, CB4 0DL



Replicating True Full-Scale in Your Lab

THE CHALLENGE WITH TRADITIONAL LAB FEEDING

Of the main controls in AD—feeding, temperature, and mixing—the feeding regime is paramount for accurately simulating industrial plant performance. Full-scale AD plants operate on frequent, often hourly or bi-hourly, small feeds. This consistency allows the microbial community to achieve homeostasis, ensuring stable nutrient flow and biogas output, minimising VFA spikes and foaming often seen with large, infrequent lab feeds.

For most AD researchers feeding daily alone is a significant struggle especially on weekends, let alone achieving high feeding frequency of AD plants!

Manually-fed lab reactors, typically dosed once daily, struggle to replicate this dynamic. This "feed shock" can:

- Limit Organic Loading Rates (OLR) to conservative levels (often $<3\text{kgVS}/\text{m}^3\cdot\text{d}$) to avoid instability.
- Induce transient increases in CO_2 and VFA, and pH drops, masking true process potential or causing premature process stress, even failure that may not occur in full-scale plants. This was our experience when we started running manual feeding compared to a full-scale food waste AD plant in 2008.
- Introduce human error and inconsistency, especially when managing multiple reactors or weekend schedules, leading to unreliable and unrepeatable research.
- Fail to accurately deliver heterogeneous, real-world feedstocks like food waste due to limitations of generic lab pumps (e.g., peristaltic, roto) which struggle with consistency, low flow rates, and particle-induced blockages.



OUR AUTO-FED DIGESTER SOLUTION



Automatically fed lab-scale digesters designed and assembled in the UK by Anaero Technology significantly increase the capability for accurate and precise analysis of dynamic AD systems.

Increase Research Reliability and Throughput

Automation removes the variability and time-drain of manual feeding, freeing up researchers and ensuring consistent, repeatable conditions across all reactors, day and night, 7 days a week. This allows for more complex experimental designs, including multi-stage digestion or recirculation studies (Product Features).

Precisely Mimic Industrial Feeding Protocols

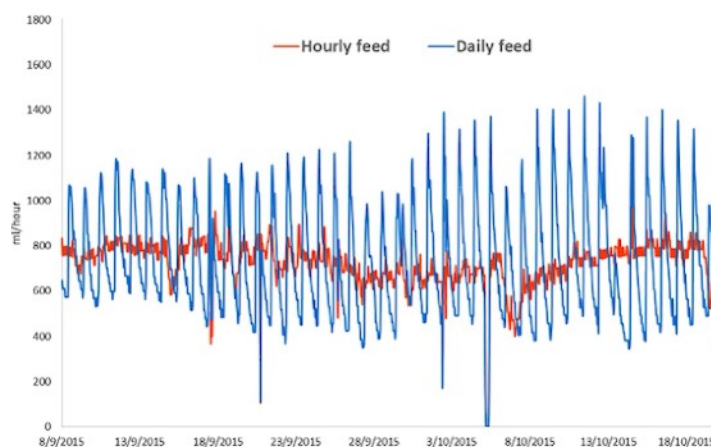
With PLC-controlled, automated feeding, deliver substrate in multiple, small, programmable doses throughout the day (up to 999 feeds/day, as detailed in our System Components). This mirrors the near-continuous feeding of most full-scale plants. This approach facilitates stable operation even at higher OLRs avoiding transient foaming events (e.g., successfully achieving 5.5-6kgVS/m³.d with food waste), a feat often unrealistic in manually fed systems that often foam when loaded above 3.5kgVS/m³.d.

Handle Real-World, Challenging Feedstocks

Our robust feeding mechanism is designed for thick slurries (up to 24% DS) and low-fibre heterogeneous wastes. This allows you to experiment with feedstocks closer to industrial reality, minimising the need for excessive pre-processing that can alter substrate characteristics. Automatic mixing within feeders (Product Features) prevents settling and ensures consistent feed delivery, crucial for non-

Eliminate Feed Shock & Enhance Stability

The frequent, small feeds maintain a stable digester environment, drastically reducing transient VFA accumulation and with stable production of gas akin to stable full-scale AD plants (figure of flow patterns). Research has shown that automated, frequent feeding, coupled with precise control, can lead to dramatic VFA reductions. This stability allows for clearer interpretation of experimental variables without the confounding effects of feed-induced stress.



ANATOMY OF AN AUTO-FED DIGESTER

Bioreactor

- 316 Stainless steel
- 1–10 litre vol
- Multi-stage capable
- Multiple dosing ports
- Gas input points
- Recirculation ports
- 316SS mixing blade

Mixer motors

- Brushless for extended lifetime
- 24vDC
- Select rpm 20,30, 50, 100
- Screw on fitting

Agitator Motor

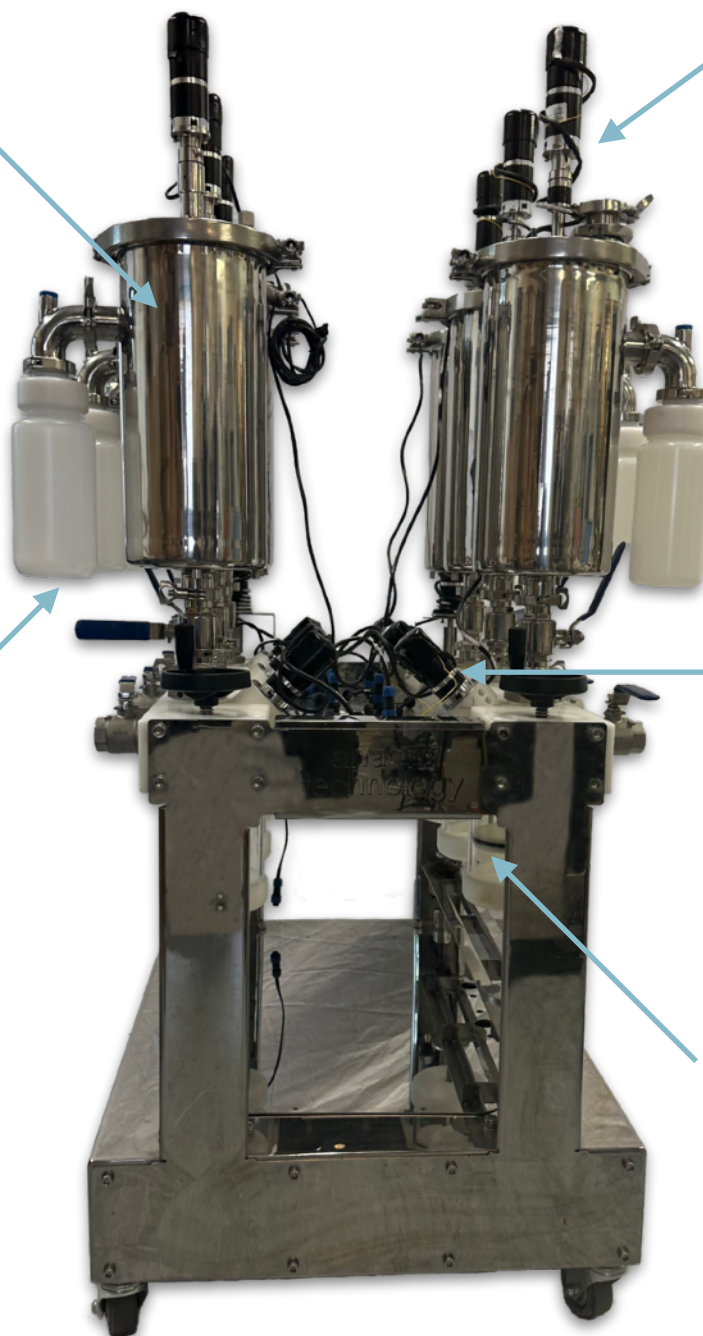
- 900rpm 24vDC
- Screw on fitting top
- mounted

Digestate Tank

- Low density polyethylene 1-litre
- Valve minimises air contamination during emptying

Syringe Feeders

- 0.6 to 5 litres (1.6 litre standard volume)
- 900 rpm top mounted agitator to prevent settling in settable feedstock



AUTO-FED DIGESTER RANGE

BITTERN⁺

Gas flow Analysis Software - Ready to go

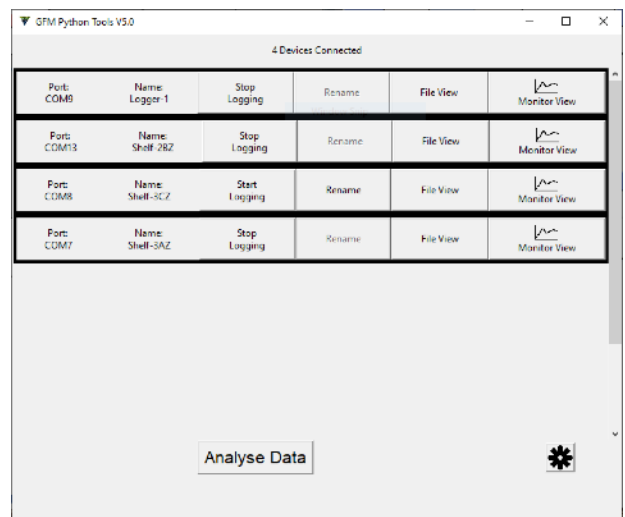
Granular and clean data

Our Arduino-based system is an open source state-of-the-art data logger . When one of the tumblers in the gas flow meter tips, a magnet attached to it causes the reed switch to close and record the volume in real time. Simultaneously a barometric pressure sensor and a thermocouple capture data which enables all gas flow data to be corrected for pressure and temperature (STP).



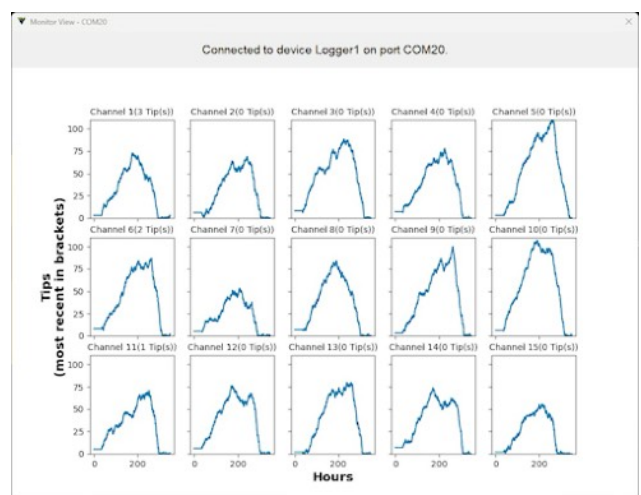
Real-time monitoring

All tumbler events are written to a log file with raw and processed gas flow data. This real-time data can also be displayed live on a PC, using monitor view within the software. With Bitterns' streamlined design it becomes seamless to set up an experiment, monitor it and collect the data. Enabling no hassle analysis.



Designed for security and robustness

Our gas monitor system is secure even in the case of a power outage, where a rechargeable battery pack will provide protection for up to 15 hours. The gas flow data is also stored locally in a secure drive.



AUTO-FED DIGESTER RANGE

PRODUCT FEATURES

Feature	Description
Feeding	<ul style="list-style-type: none">• PLC-controlled, precise feeding of thick (up to 24% DS), low-fibre slurries• Adjustable frequency and volume of automatic feed.• Requires minimal operator input (e.g., bi-weekly top-up)• Optional cooling available• Up to 999 feeds per day
Mixing	<ul style="list-style-type: none">• Automatic mixing with continuous or timed option• Different mixing speeds available (10-100 rpm)
Temperature control	<ul style="list-style-type: none">• Individual reactor temperature control (ambient to 85°C) via electric jackets, allowing simultaneous multi-temperature operation (psychro-, meso-, thermophilic, pasteuriser)
Software	<ul style="list-style-type: none">• Bittern+ gas flow analysis and logger software• Data visualisation features• Python based PLC Control software
Control interface	<ul style="list-style-type: none">• PLC console manages temperature, mixing, feeding regimes, and maintenance functions• Optional remote access set-up
Gas flow measurement	<ul style="list-style-type: none">• Real-time monitoring with automatic conversion to STP and processed gas flow data• Gas flow meter included with each auto-fed instrument
System Compatibility	<ul style="list-style-type: none">• Compatible with Anaero Technology's flow meters• Works with other reactor systems with minimal adaptation
Multi-stage digestion*	<ul style="list-style-type: none">• Reactors can be interconnected in series for multi-stage digestion or recirculation.

Future progress on AD, such as performance optimisation, microbiology, fermentation, metabolomics studies, and developments in bio-refining, requires enhanced research capabilities that better replicate full-scale conditions of operation, such as multi-stage research digesters. Anaero Technology have developed a range of auto-fed continuous digesters capable of multi-stage operation and multiple possibilities for recirculation between phases or in the same reactors.

**For multi-stage capable auto-fed models*



AUTO-FED DIGESTER RANGE

SYSTEM COMPONENTS

Component	Specification
Bioreactor	<ul style="list-style-type: none">• Quantity: 2 to 30 depending on volume and model• Material: 316 stainless steel• Volume: 1 to 10L• Ports: 2 x 1/8", 2 x 1/4", 1 x 1 1/2", 1x gas port
Heater Jackets	<ul style="list-style-type: none">• Electric jacket with internal 85°C cut out• Power: 110VAC, 150W• Quantity: 1 per reactor
Reactor mixer motor	<ul style="list-style-type: none">• 1 extra large paddle mixer per reactor with programmable mixing motor• 24VDC
Syringe feeders	<ul style="list-style-type: none">• Individual auto-fed in i-models,• Alternatively, one beam operates multiple syringe feeders• Volume: 0.6 to 5 litres (1.6 litre standard volume)• 900 rpm top mounted agitator to prevent settling in settlable feedstock
PLC control, monitoring	<ul style="list-style-type: none">• 110VAC touchscreen PLC with software included
Large Top-up syringe	<ul style="list-style-type: none">• Volume: 1.6L• Wide mouth: Yes• Enables top-up without air contamination
Digestate Bottles	<ul style="list-style-type: none">• Volume: 1L• Quantity: 1 per reactor
Access tube	<ul style="list-style-type: none">• Installed on 1/8" BSP port• Enables sampling and manual feeding during operation• Gas tight: Yes• Material: Stainless Steel
Gas flow meter set	<ul style="list-style-type: none">• Channels: 15• Resolution: ~10ml (individually calibrated for precise values)• Gas inlet/outlet port: 15 of each• Drainage outlet: Yes• Logger box: Yes• Hose and luer connectors: Yes
Gas Bags (not included in base package)	<ul style="list-style-type: none">• Valves: 1• Volume: Wide range of volumes available
Manual feeder tube (not included in base package)	<ul style="list-style-type: none">• 1 x 1 1/2" stainless steel gas-tight tube• Used for inoculation or manual feeding



AUTO-FED DIGESTER RANGE

PRODUCT COMPARISON

Feature	Lobster Max	Lobster Max-i	Caterpillar	Hungry Caterpillar	Black Swan	Ray-i	Medusa
Price*	£25000	£26000	£30500	£47000	£31000	£18500	£17100
Primary Focus	Multiple simulations of industrial AD plants	Flexible, independent reactors. Our most popular product	High-volume compact auto-fed research	Combined single and multi-stage digestion lower flows	Configurable multi-stage AD and fermentation experiment platform	Auto-fed, larger reactor volume	Low solids autofed research
Reactors # (1st Stage)	6	4	10	10	4	2	10
Reactors # (2st Stage)	0	0	0	10	4	2	N/A
Auto-feeders	2	4 (one per reactor)	2	2	4	1 or 2	2
Feeds/day	0-999	0-999	0-999	0-999	0-999	0-999	0-999
Reactor Vol [L]	1, 2, 5	1, 2, 5	1	1, 2	1, 2, 5	1, 2, 5 , 10, 20	1
Temp [°C]	Ambient to 85	Ambient to 85	Ambient to 85	Ambient to 85	Ambient to 85	Ambient to 85	Ambient to 85
Key Differentiators	Mixed fluid feedstocks, 6 reactors	Each reactor with own feeder, 4 independent test regimes	10 reactors, individual for multiple experiments	10x 1st & 10x 2nd stage reactors for deep analysis	Highly configurable multi-stage	Capable of larger digester volumes	Combines batch and auto-fed reactors
Multi-stage Capability	Can be converted	Can be converted	4 corner reactors can be converted	Yes	Yes (highly configurable)	Yes	No
Warranty	1 Year	1 Year	1 Year	1 Year	1 Year	1 Year	1 Year
Software	Bittern+ & PLC control	Bittern+ & PLC control	Bittern+ & PLC control	Bittern+ & PLC control	Bittern+ & PLC control	Bittern+ & PLC control	Bittern+ & PLC control
Data Storage	Local SD Card	Local SD card	Local SD Card	Local SD Card	Local SD Card	Local SD Card	Local SD Card
Gas Flowmeter Included	6-cell	6-cell	15-cell	15-cell	15-cell	6-cell	15-cell

As valued customers, you will be provided with technical support, regardless of whether your warranty has expired. We want your instruments constantly running and collecting data.

**Base models*



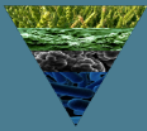
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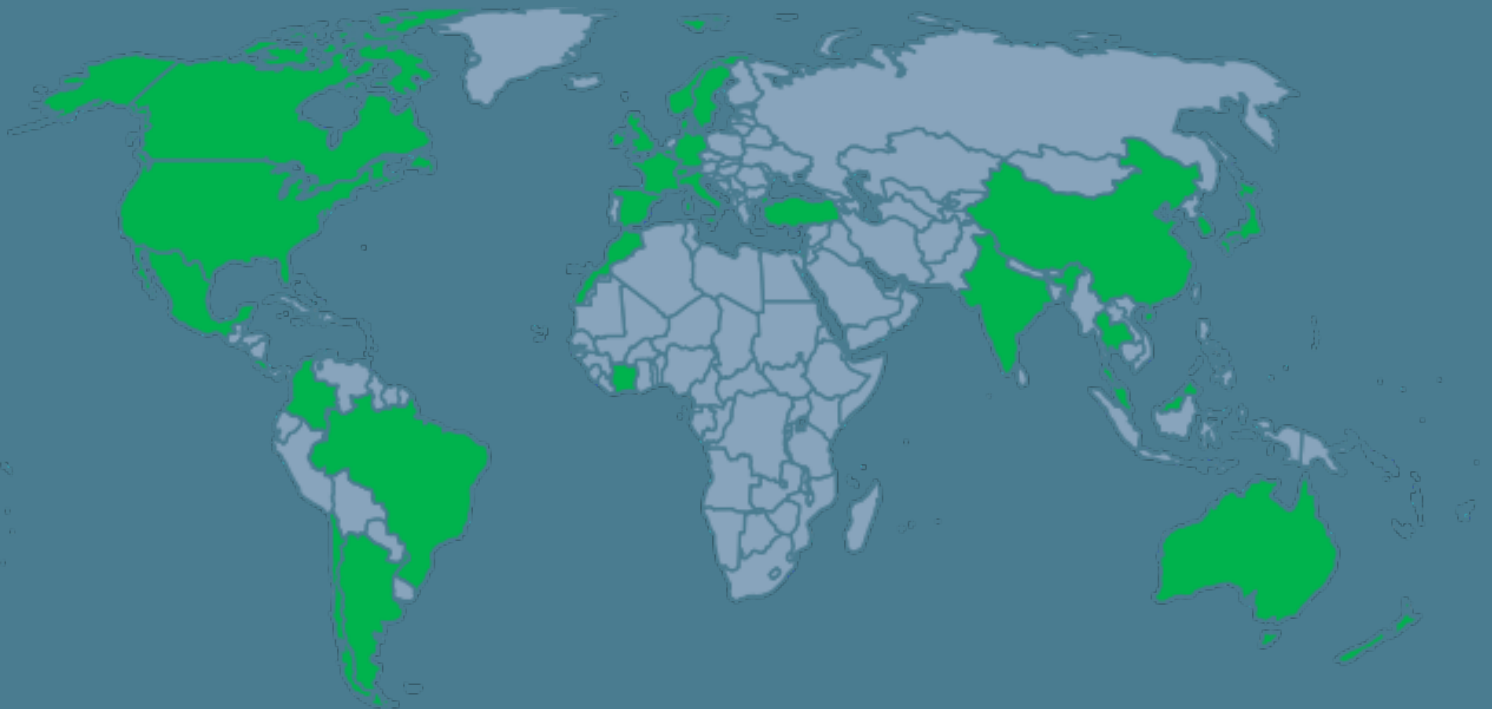
Built And Designed by Researchers

Founded in 2013 from our need for equipment capable of accurately evaluating the biogas processed in full-scale AD plants. With environmental sustainability and scientific advancement always in mind, improvements were (and are) constantly being innovated, meaning our machines benefit from a forward thinking and evolving attitude. Holding **3 patents** and clients from 32 countries globally. Our instruments are used in:

100+ publications

50+ academic institutions

20+ commercial labs





Our Mission

Anaero technology is built on decades of experience in the wastewater and AD Industry. The founder Edgar Blanco has almost 3 decades experience working with academic institutions in the UK and the EU on anaerobic digestion and sludge treatment, translating academic research into industrial practice for maximum economic and environmental benefit, from work on anaerobic biofilm reactors for abattoir wastewater treatment to activated sludge optimisation, odour control, agricultural use of biosolids to collaborating on UK standards development for industrial food waste AD (PAS110). We are determined to help promote the link between academia and industry.

It's our privilege to work alongside brilliant people and scientists from around the world. We will maintain confidentiality of our customers and share our experience freely as we are committed to spreading our knowledge and ensuring you have the best data available.



Anaero Technology sponsors several PhD and Masters



3 Patents have been granted with more in the pipeline



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