AD-WISE: a new tool to optimise the operation of Anaerobic Digestion plants

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> Contents

- MAC - who we are
- AD-WISE system
- AD-WISE EU Project

The National Microelectronics Applications Centre Ltd

- **MAC founded in 1981, Limerick, Ireland**
  - **GreenTech monitoring & control**
    - **Electric SmartGrid**
    - **Smart Irrigation & Water Quality**
- **Electronic product design & Software development**
  - **30 year Track Record developing distributed systems solutions,**
    e.g. Tyco Electronics, ESB, Suparule Systems, Irish Marine Institute
- **MAC has delivered:**
  - **225 leading edge product developments + 40 Web/online services**
  - **30 EU ICT R&D projects + 3,000 new ideas evaluation**
- **Partner in many EU research projects ➔ Products**
  - **WaterBee Demonstration Action & WATER-BEE ➔ WaterWatch products**
  - **CALIBRE, OKKAM & SmartOpenData ➔ GridWatch products**
  - **AD-WISE ➔ new family of Greentech products**

> Biogas Plants & Anaerobic Digestion (AD)

- **Anaerobic Digestion (AD)**
  - Biological process degrading organic matter to form biogas & a digestate
- **Total biogas primary energy in the EU was 10.9 Mtoe in 2010**
  - Rising to 39.5 Mtoe by 2020 & 10% of EU's natural gas consumption.
  - Ever **growing potential** & **huge amount of organic waste**.
- **Control & Optimisation of AD plants is critical.**
  - **AD plant operators currently** drive their plant with just measurements of pH & biogas composition, leading to
    - **Underuse** of the plant,
      - if the operator drives the plant in a conservative way, or
    - Process **malfunction**,
      - if the operator drives the plant near the load limit.

> Solution –> AD-WISE real-time system

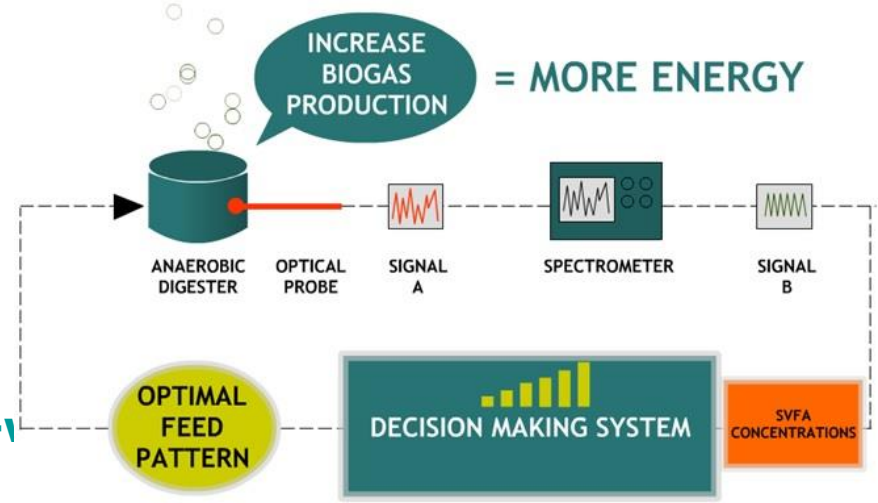
- **Best parameter to control the AD process - Volatile Fatty Acids (VFA)**
  - Consisting of single **VFA** concentration (acetate, propionate, butyrate, etc.)
  - Allows checking of the **AD process state** plus predicting & avoiding process malfunction (due to acidification)
    - Not possible with other parameters (pH, biogas composition, etc.)

- **Currently VFA is measured offline using Gas Chromatography (GC)**
  - An off-line measurement using specific equipment & trained specialists
  - Takes 1-2 weeks between the sampling & the results,
  - Not useful for process optimisation.

- **AD-WISE automatically measures VFA in real-time**
  - For **process automation** & **optimisation**

> The AD-WISE System

- AD-WISE is an **on-line system for Biogas Plants** to
  - **Increase revenues by 10% to 20%**
    - By making AD plants more efficient
  - **Maximise biogas production & waste processing**
    - By optimizing the AD process
  - **Maintain process stability**
    - By **eliminating process stops** – that take weeks/months to restart
    - Particularly good for plants operating with co-digestion of waste, where the feeding mixture is changing & the risk of acidification is higher.
    - Reduces the need for external analysis of VFA
- **By:**
  - Real time VFA measurements using optical techniques
  - Integrating these measurements in the control system of the AD plant to optimise the process



> Benefits of the AD-WISE system

New on-line VFA measurement techniques for optimisation of the AD process.

Parameter	External lab (current system)	AD-WISE
Response time	1-2 weeks	**30 minutes**
Cost	€6,000 /year in chemical analysis	**€20,000**
Accuracy	Very good	**Good**
Risk of system overload	High	**Very low**
Commercial losses due to system stops	€57,000 /year	**€0 /year**
Possibility of automation of feed	No	**Yes**

> Additional Benefits of AD-WISE

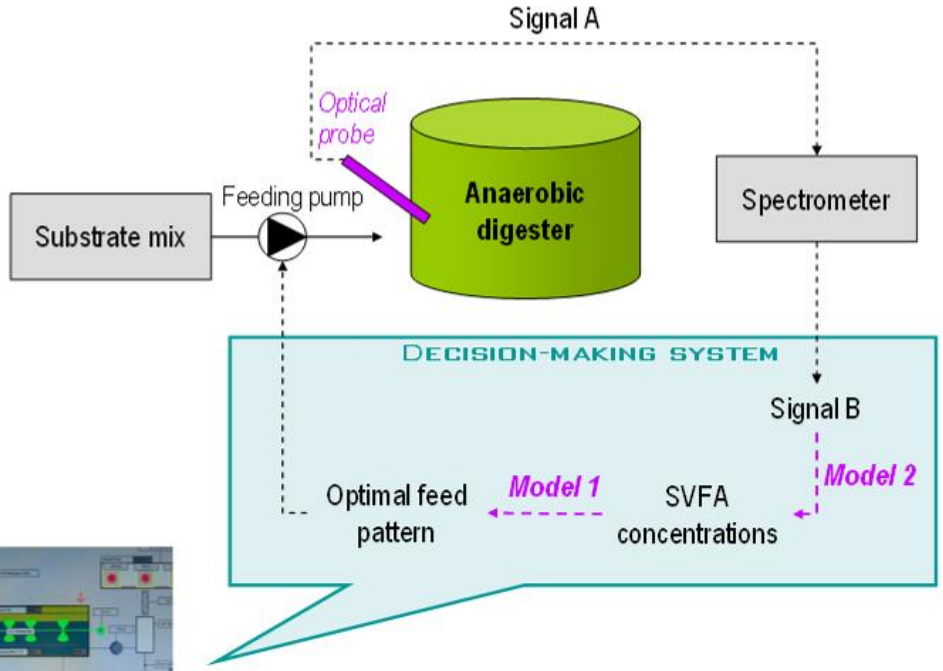
- Ensures that **Biogas plants** are **Highly Efficient**
  - As per the European High Efficiency CHP Directive (2004/8/EC)

- **REFIT3** Support Scheme specifies that Biomass plants **must** be certified as **High Efficiency (HE)** plants**.**
  - Irish Government's 'Renewable Energy Feed in Tariff', support for electricity from renewable sources in Ireland
  - Loss of this status results in **loss of REFIT benefit** for the period during which the plant is deemed not to be meeting the HE criteria.

- **AD-WISE** system & real-time monitoring **mitigates these revenue risks**
  - by ensuring that an AD plant can **verify its High Efficiency at all times**.
  - Helping to ensure **long term revenue stability**
    - Critical in the financing of most renewable energy projects.

> AD-WISE project - *an European FP7 Research for SMEs Programme**

AD-WISE
Automated system based on on-line VFA sensors for an optimised control of anaerobic digestion plants



SCADA

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> Expected Project Results

1. Optical probe for measurement of VFA
2. Software for transformation of optical spectra to VFA concentration
3. Software to predict process malfunction based on the feed composition and operating conditions of the plant
4. Integrated system for biogas production plant control

> AD-WISE Team

Estonia, Germany, Ireland & Spain

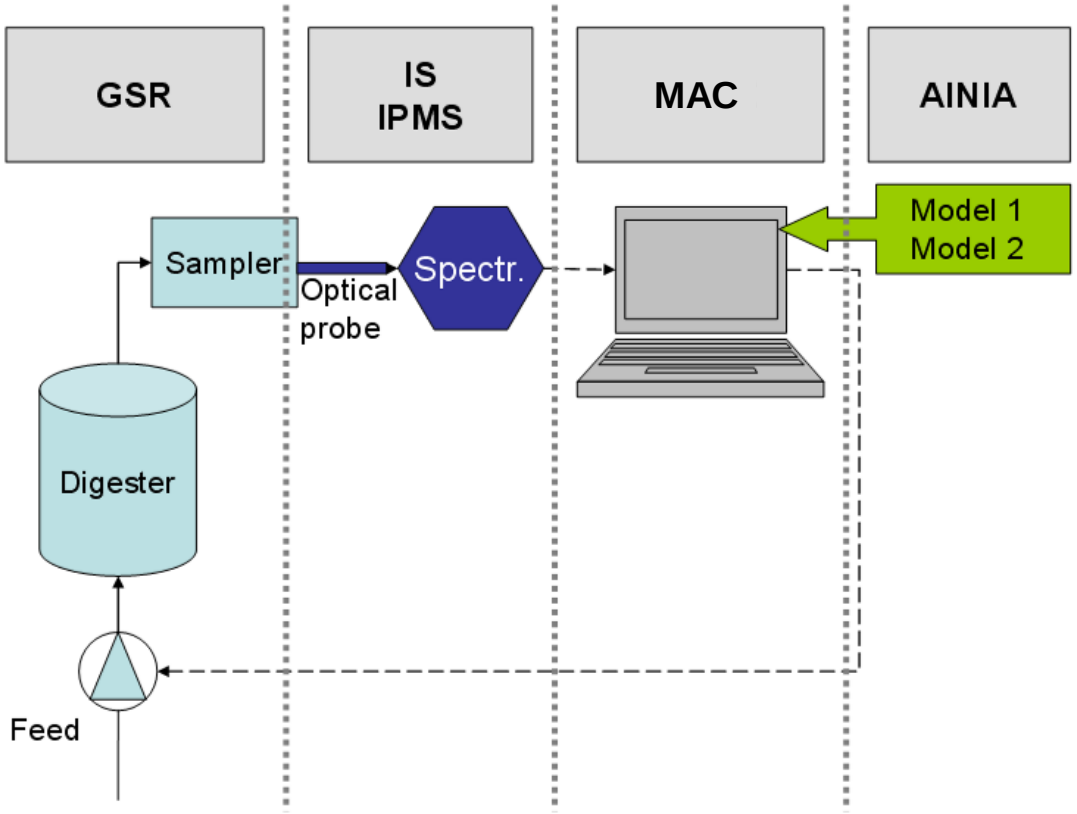
ainia

San Ramón

MAC

Fraunhofer IPMS

INTERSPECTRUM®



> Achievements

1 **Study of VFA evolution depending on feed characteristics and operating conditions** (literature review + experimental tests)

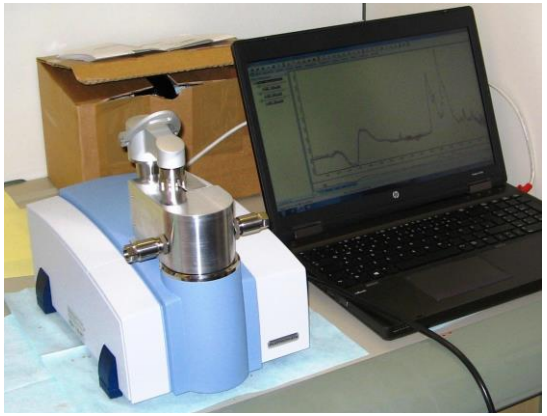
AD pilot plants at AINIA

Results:

- Modelling of prediction of process malfunction depending on feed characteristics and operating conditions
- Set of values for process control depending on VFA evolution.

> Achievements

2 Pilot prototype of optical device for VFA measurement



Prototype for VFA measurement

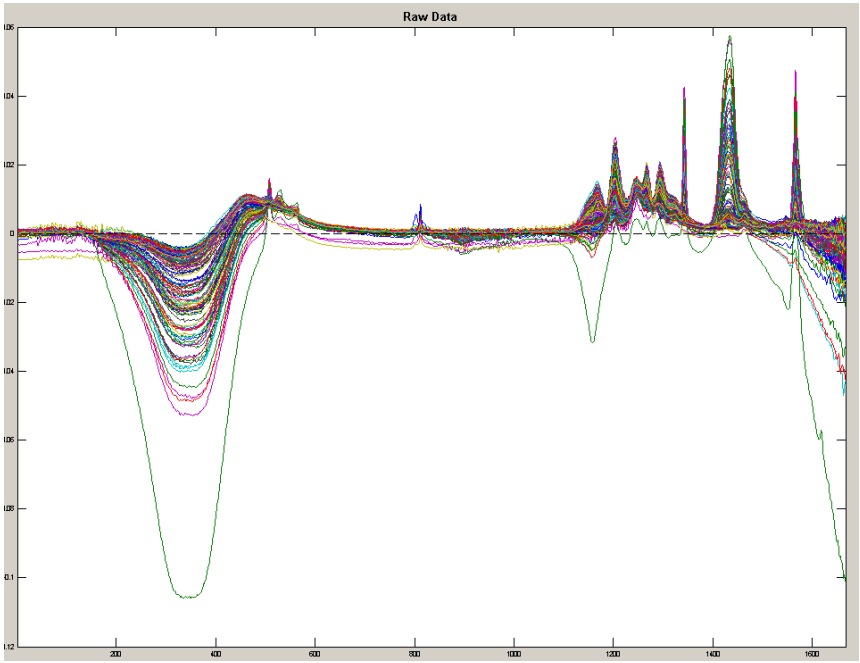
Results:

- Prototype of optical measurement of VFA with special flow chamber for digestates
- Finalising the calibration (spectra vs VFA concentration) in the pilot plant validation

> Achievements

3 Pilot scale validation (in progress)

AD pilot plant at AINIA where the pilot scale validation is being carried out



> Achievements

4 Full scale validation (starting in March 2014)

Full scale biogas plant of GSR where the industrial validation will be carried out

Thank you for your attention

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