SABIA
SOUTHERN AFRICAN BIOGAS INDUSTRY ASSOCIATION

DBFZ

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Development of a standardized protocol for biogas testing

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Development of a standardized protocol for biogas testing

Cowork of:

- South African German Energy Programme (SAGEN)
- Deutsche Gesellschaft für international Zusammenarbeit (GIZ) GmbH
- SABIA – Southern African Biogas Industry Association
- DBFZ – German Biomass Research Centre
- University of Johannesburg, PEETS
- Tshwane University of Technology, Engineering and the Built Environment
- University of Stellenbosch, Process Engineering
- North-West University, Potchefstroom Campus, Unit for Environmental Science and Management
- University of Free State, Faculty of Natural and Agricultural Sciences
- University of Kwazulu-Natali, School of Engineering

Purpose & aim of protocol development

Aim

- Improve testing/ usage of organic substrates/ feedstocks
- Enhance approvement of biogas yields published in international literature under South Africa's conditions
- Exchange of academia and practice → Practical relevance of standardized biogas testing protocol
- Successful implementation in practice

Main questions

- Which data and tests are required by industry?
- What is the purpose of standardization?
- How to achieve reproducible and transferable testing results even in different laboratories?

Workshop and discussion on method standardization

Protocol is based on…

- Several norms aimed to standardization of biogas potential tests:

"Fermentation of organic materials. Characterization of the substrate, sampling, collection of material data, fermentation tests" VDI GUIDELINE 4630, 2006; VDLUFA Book of Methods VII, Environmental Analysis and Gas Yield Measurement 4.1.1

- Recent international efforts by „Task group for the anarobic biodegradation, activity and inhibition – ABAI-Group" (IWA)
- International guidlines: Guwy et al., 2004; Angelidaki et al, 2009; Holliger et al., 2016
- Workshop: South African universities
- Requirements from industry → practical application

Biogas potential analysis

- Essential for dimensioning/ design of biogas plants
- Suitability of potential substrates

→ What are suitable lab methods?

Pictures: DBFZ

Substrate characterization

Several substrates are suitable for anaerobic digestion:

- Agricultural residues
- Crops
- Residues from industries, food waste, waste water

Relevant parameters:

- Biogas/ methane potential
- Dry matter/ water content
- Organic content
- Composition: protein, lipid, carbohydrate, fiber content
- Macronutrients and micronutrients
- Toxic components or inhibitors

Substrate characterization

Several substrates are suitable for anaerobic digestion:

- Agricultural residues
- Crops
- Residues from industries, food waste, waste water

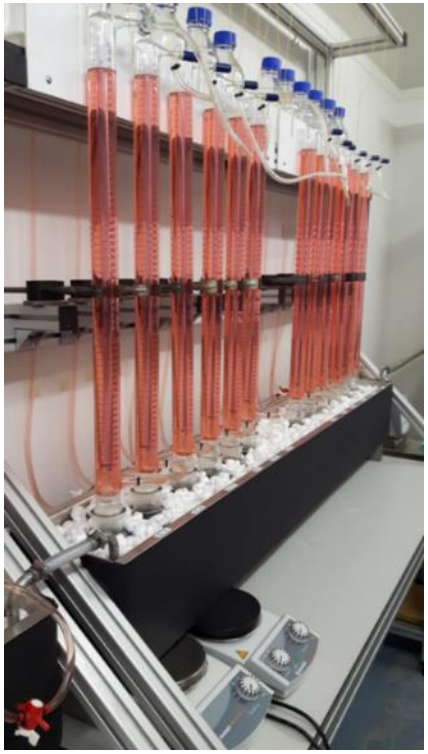
Relevant parameters:

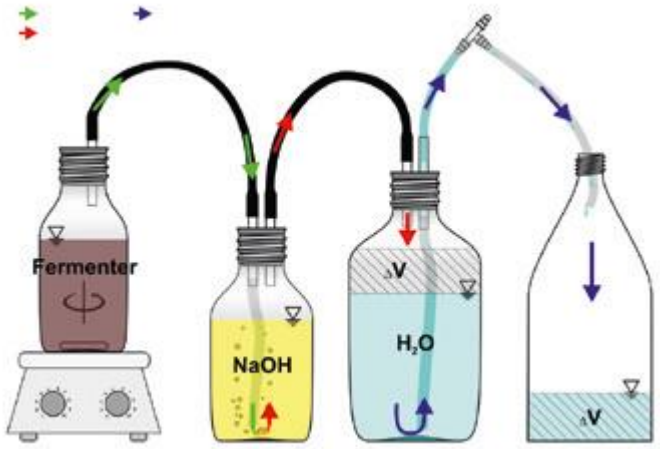
→ Biomethane potential analysis

Pictures: © Martin Dotzauer, Britt Schumacher (DBFZ)

Biomethane potential (BMP) testing

- To determine the biogas/methane production of substrates or digestates
- Focus on batch fermentation → different equipment available
- Method harmonization is necessary

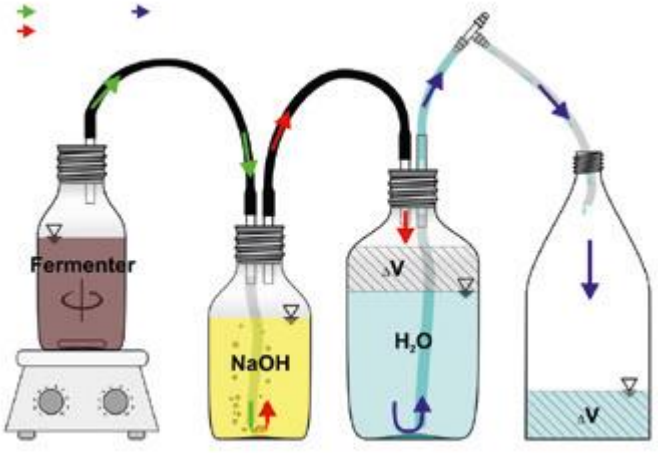




Pictures: DBFZ

Equipment

AMPTSII (Bioprocess Control Sweden)
(1 unit = 15 samples → 402,900 ZAR)



Set-up of a simplified test equipment (BMP)

Eudiometer
(60,000 ZAR per 15 samples)

Milli Gas Counter (Ritter)
(241,050 ZAR per 15 samples)

Method protocol: VDI 4630, Picture : DBFZ

Standardized BMP test

Recommendations to obtain validated BMP test results

- Inoculum (origin, quality criteria, preparation and storage)
- Substrate (preparation and storage, characterization, inoculum-substrate-ratio)
- Test setup (reactor vessels, preparation, incubation conditions, gas measurement)
- Evaluation (reference and blank, data analysis and reporting, inter-laboratory comparison)

Summary of method discussion

Which factors influence the comparability of testing results?

- Method selection
  - → substrate characterization (✓)
  - → Batch tests (AMPTS, Eudiometer,…) ✓
  - → substrate sampling, storage & pretreatment !
- Inoculum
  - → Source !
  - → Storage/ pretreatment !
  - → Inoculum substrate ratio !
- Calculation formula → ✓

Outcome & outlook

Improvement of the comparability of testing results

- Inter-laboratory standardization of BMP tests

Standard implementation

Scientific area

- Hosting of guest scientists/ students at DBFZ
- Method harmonization
- Round robin tests in South Africa

Picture: © Angela Gröber (DBFZ)

Thank you!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