In-situ biological methanation (IBM)

MHP “Ukraine”, **DBFZ** & **EE** “Germany”

Barcelona, 29.11.24

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innovations in the BIOMETHANE uniVERSE

Objectives

Demonstration of an innovative in-situ biological methanation pathway using a gas recirculation system, as well as the construction and implementation of a similar system and technology at a biogas plant in Ladyzhyn, Ukraine

- Increase the overall methane content from ~55 % to ~85 % in the produced biogas

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Activities

A.1. Demonstration of an innovative IBM pathway in 50 L lab-scale reactors

A.2. Construction and installation of IBM demo reactor (10 m^3) at a biogas plant in Ukraine

A.3. Demonstration of IBM in the 10 m^3 demo reactor

A.4. Providing a concept for the implementation of IBM at biogas plants.

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A.1. Demonstration of IBM in 50 L lab-scale reactors

➢ Laboratory setup

1: AD reactor
2: Mass flow controller
3: H_2 tank
4: Gas meter
5: Gas pump
6: Stirrer
7: Monitor
8: Water trap

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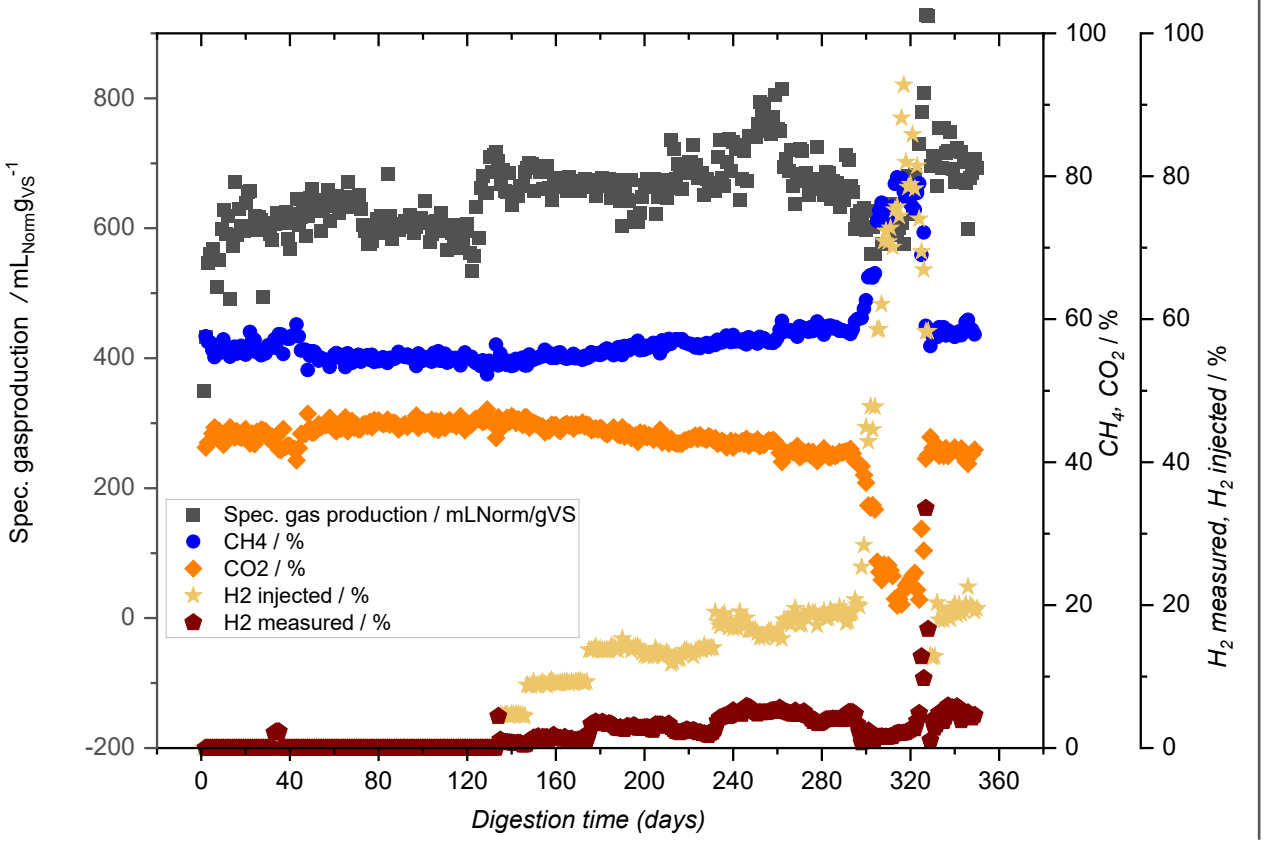
A.1. Demonstration of IBM in 50 L lab-scale reactors

Result to date: Specific biogas production, H_2 (injected & measured), CO_2 and CH_4 content in biogas

R1.19



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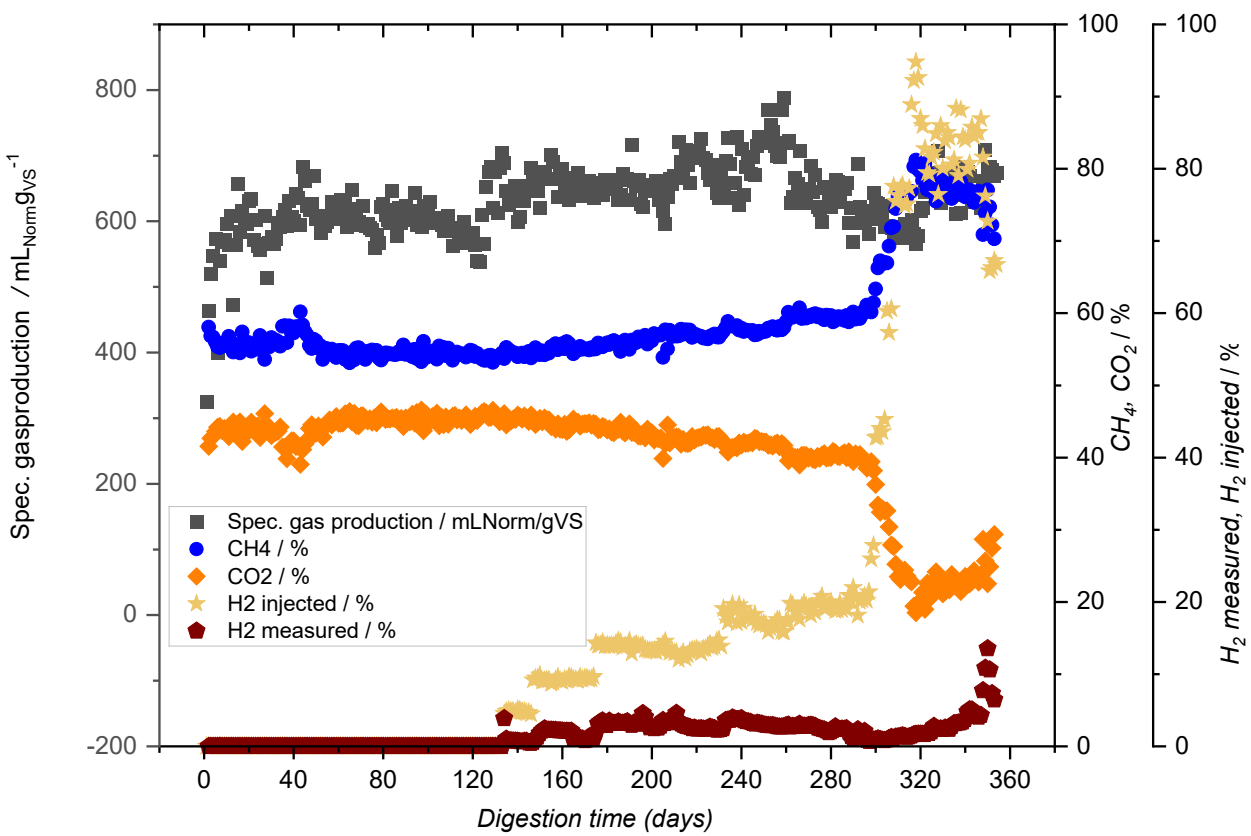

DBFZ reactors

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A.2. Construction of an IBM demo reactor 10 m^3

Ellmann Engineering
process solutions

MHP Demo – Tasks

- Task 2.1 Definition of the Technical Task ✓
- Task 2.2 Concept design ✓
- Task 2.3 Detailed technical Design ✓
- Task 2.4 Design of Controls and Instruments ✓
- Task 2.5 Equipment List ✓
- HAZOP ✓
- Task 2.6 Installation of the Demo Plant
- Task 2.7 Commissioning of the Demo Plant

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A.2. Construction of an IBM demo reactor 10 m³

Pilot Plant concept

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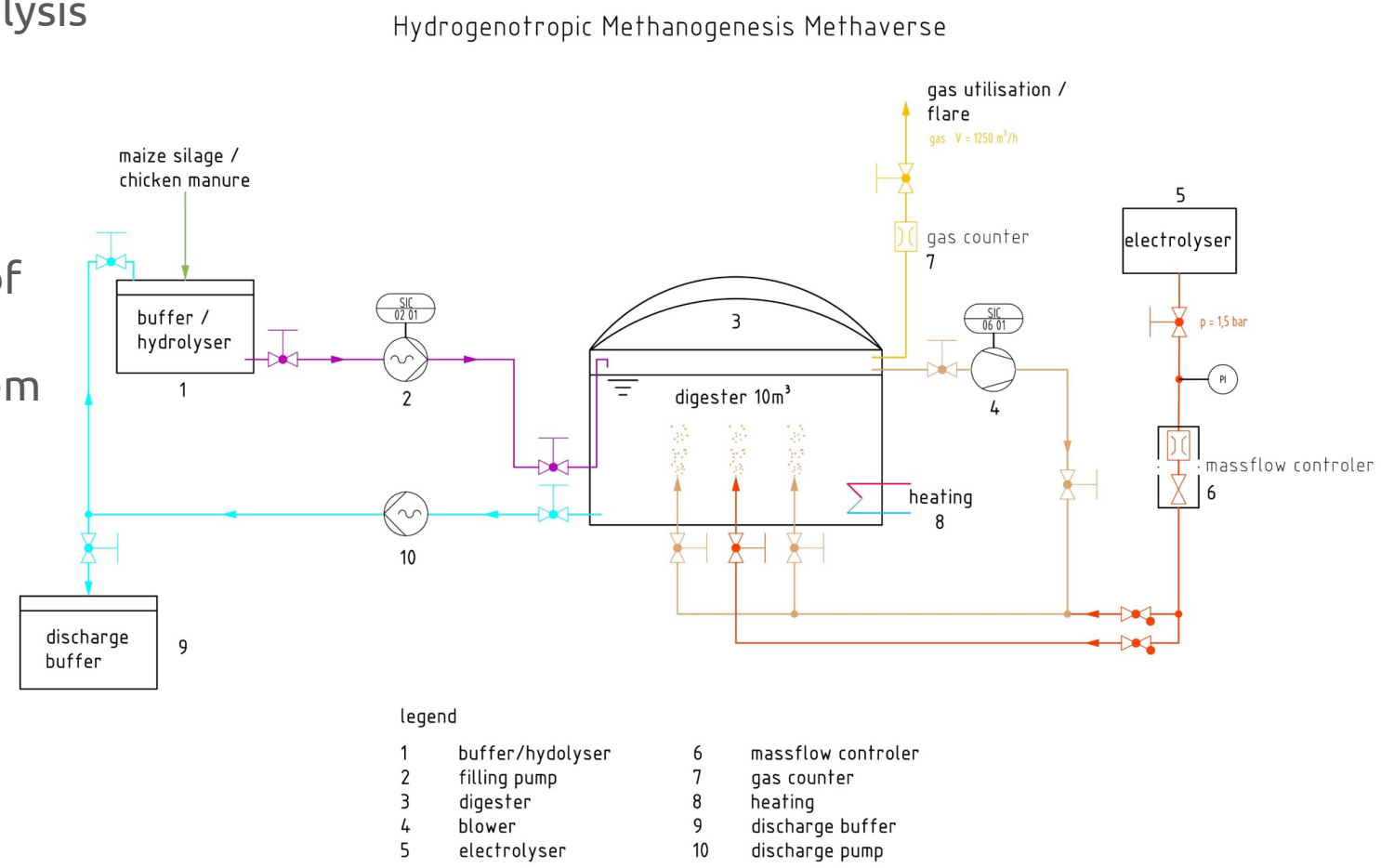
- Two-stage concept with separate hydrolysis
- Mesophilic main digester
- Fermenter circulation by gas injection
- Hydrogen dosing either simultaneously with gas circulation or independently
- Hydrogen dosing in a range of 2 - 40% of biogas production
- Automatic operation of the entire system
- Autonomous operation of the system without operating personnel possible for 1-2 days

Flow Chart Pilot Plant Ukraine



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A.2. Construction of an IBM demo reactor 10 m³

▪ Technical Detailed Design

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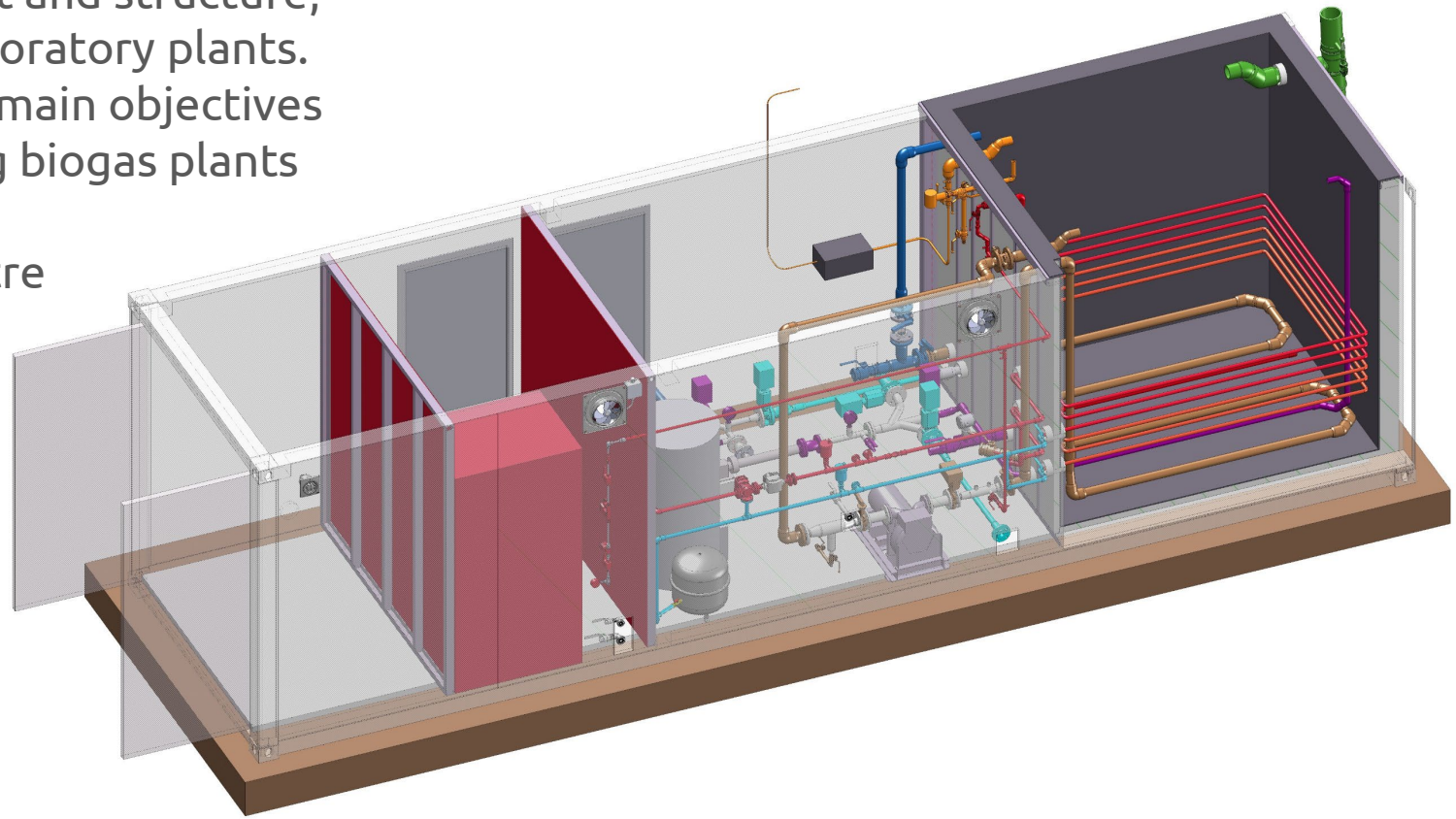
Containerized In situ Demo Plant Ukraine

The pilot plant must have the essential characteristics of a conventional biogas plant in its equipment and structure, as well as mirroring the processes in the laboratory plants. This is all the more important as one of the main objectives of the research project is to retrofit existing biogas plants with IBM technology.
The following priorities therefore took centre stage in the design:

- Mesophilic process with temperatures between 37 - 45°C
- Gas circulation system in the fermenter, which corresponds to that of a large scale plant
- Integration of hydrogen distribution and injection into the gas circulation system.



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Demonstration of the electrolyser

Electrolyser purchased
Commissioning works have been completed
First green hydrogen produced
Use of hydrogen for laboratory research

1: Hydrogen sensor
2: Water filter
3: Electrolyser
4: Mass flow controller
5: Hydrogen tank

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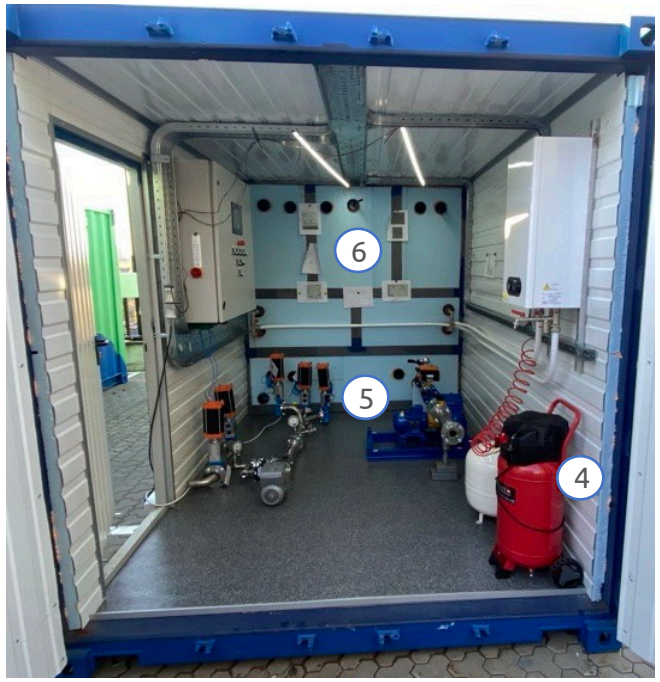
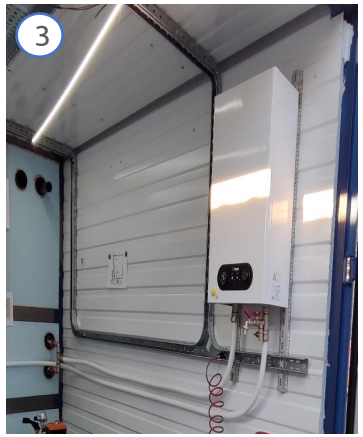
A.2. Construction of a 10 m³ IBM demo reactor





All equipment purchased
A 10 m³ reactor was manufactured
The reactor heating system was tested
Connection of technical equipment
Electrical connection of technical equipment
Commissioning and start-up (end of 2024)

1: Control system
2: Substrate feeding system
3: Heating system
4: Compressor
5: Gas pump
6: Reactor / reactor inside
7: Gas meter

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