SynFerm – efficient syngas fermentation of gasified woody biomass

Jörgen Held[1], Anni Alitalo[2], Jörgen Ejlertsson[3], Staffan Hellsén[4], Ludvig Landen[5] and Niclas Svensson[6]

[1] Baltic Energy innovation Centre, Skarpskyttev. 10D, SE-22642 Lund, SWEDEN
[2] Q Power Oy, FINLAND
[3] Scandinavian Biogas Fuels AB, SWEDEN
[4] Cortus Energy AB, SWEDEN
[5] NSR AB, SWEDEN
[6] Linköping University, SWEDEN

1. Introduction

The European Union has adopted a target of 35 bcm renewable methane by 2030 as part of the REPowerEU plan. Renewable methane will play an important role to achieve the REPowerEU objectives of diversified gas supplies and reduce the EU´s dependence on Russian natural gas.
There are several conversion routes to produce renewable methane of natural gas quality, e.g., biomethane through anaerobic digestion followed by gas cleaning and upgrading, bioSNG through biomass gasification followed by extensive gas cleaning, methanation and upgrading, and electro-methane through combining green hydrogen, produced from excessive electricity, and carbon dioxide.

So far bioSNG through gasification and catalytic methanation has been hampered by the need of extensive and costly gas cleaning prior to the methanation to avoid catalyst poisoning and deactivation. The state-of-the-art is the GoBiGas I project in Gothenburg which was a technical demonstration in the 32 MW_{th} scale [1]. The next step, GoBiGas II, would have been a commercial bioSNG plant in the 150-200 MW_{th} scale. However, the GoBiGas I was mothballed in 2018 and the next step was never realised.

One way to circumvent the need for extensive gas cleaning associated with catalytic methanation, and to improve the economic feasibility, also in the smaller scale, is to opt for biological methanation of the syngas, also referred to as syngas fermentation. A high methane formation rate, expressed as litre CH_4 per litre reactor volume and day, is essential for the economic feasibility of the technology.

Thermal gasification of forest residues, demolition timber, park and garden waste, etc. makes the carbon and hydrogen content of the ligno-cellulosic material available to the microbes and thus biological conversion to methane. The Swedish potential for these materials has been estimated to 59 TWh/a [2].

Syngas fermentation enables production on a smaller scale, <20 MW, which entails several advantages in terms of feedstock supply, lower financial risk and that it is easier to match the excess heat with local heat and steam demand [3].

2. The SynFerm project

The two-year project started 1 January 2023 and involves the WoodRoll® gasification technology developed by Cortus (SE) and the solid-state biological

methanation system developed by Q Power Oy (FI). The other project partners are NSR AB, Scandinavian Biogas Fuels AB, Linköping University, and Baltic Energy Innovation Centre (coordinator). The project has received public funding by the Swedish Energy Agency.

Figure 1. The 6 MW syngas WoodRoll® installation in Höganäs.

Figure 2. Q Power Oy's mobile biological methanation pilot plant.

3. Project targets

The mobile biological methanation pilot plant will be installed at the WoodRoll® site in Höganäs. A partial syngas flow will be diverted to the pilot plant. The aim is to show:

- A methane formation rate of 10 litre CH_4/litre reactor volume and day
- An electric consumption less than 0.02 kWh/kWh CH_4 for the syngas fermentation
- Complete conversion of CO (below detection limit)
- Residual H_2 in the final product less than 2%.

4. Objectives

- Enable commercialization of syn-gas fermentation by 2030 based on the WoodRoll® gasifier and Q Power's solid-state reactor for biological methanation.
- Double the Swedish production of renewable methane within a time span of 15 years and contribute to an increased self-sufficiency.
- Develop business models that, in addition to implementation in Sweden, provide the opportunity to export technology and know-how.

5. References

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