Newsletter IEA Bioenergy Task 37: 02/2024

New developments in biogas production and application

Topics

GEO-Methanization in large seasonal storages

Is geo-methanization suitable as a solution for seasonal storage in a renewable energy system? This question was the focus of the binational research project "Underground Sun Conversion - Flexible Storage" by Energie 360°, RAG Austria AG and several research partners. The final report now shows: The storage process works. RAG Austria AG discovered the associated biological process when they stored hydrogen in depleted natural gas reservoirs. During the storage at a depth of 1000 meters, the experts observed partial methanation of the hydrogen. They succeeded in reproducing the process. First, surplus renewable energy (solar or wind) is converted into green hydrogen via electrolysis. For the methanation the hydrogen is injected into a natural gas underground storage facility together with CO2, which comes e.g. from biogas plants. In a microbiological process, renewable methane is formed which is stored underground. In winter, when demand for electricity and heat is high, the renewable gas is used. Researchers at BOKU Vienna conducted extensive laboratory and field tests in a geo-methanization storage facility in Pilsbach, Austria. They concluded: natural methanation underground works. Recently the newest results were presented during a R2Gas Workshop.

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Italy moves forward with biogas-to-biomethanol production

In Italy, the Milano Post reports an innovative industrial plant capable of producing biomethanol from biogas, the result of a five-year effort by the Politecnico di Milano and Fattoria Autonoma Tabacchi SC, is now a reality, thanks to BIGSQUID (Biogas-to-liquid) technology. The project was presented in Rome during the Confagricoltura annual meeting. The plant, operating in the Giove district of Città di Castello, in the province of Perugia, is capable of producing up to 4,500 tons of biomethanol per year which can be used as an advanced fuel for the decarbonisation of agricultural and industrial transport, as well as biochemical carbon negative (-88%) to trap CO2 and in all methanol derivatives such as chipboard panels, polymers, paints and glues. Furthermore, biomethanol is much greener than fossil methanol

and at the same cost it is a good investment. In fact, assuming to sell bioethanol at the same market price as fossil methanol, which fluctuates between €450 and €550 per metric ton, each biomethanol plant from biogas would be in economic profit for the first time without incentives.
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Manchester's sewage biogas to be used for hydrogen production

Sewage biogas produced in Manchester is set to become a sustainable feed source for graphene and hydrogen production, due to a pioneering partnership between Levidian and United Utilities. As well as producing hydrogen, Levidian's technology will also produce graphene, a highly useful material which was first discovered in Manchester which is stronger than steel and thinner than paper.
The LOOP100 system will be installed at United Utilities' Manchester Bioresources Centre at Davyhulme and used to decarbonise biogas produced at the facility. This trial follows a successful feasibility study and will serve as the first demonstration of a LOOP100. The project has been awarded £3m (€3.4m) of funding from the Department of Energy Security and Net Zero Hydrogen BECCS Innovation Competition and will deliver more than 1,000 hours of in-situ testing. The demonstrator LOOP100 will be capable of processing around 15m3 of biogas per hour.
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High-load fermenters at biogas plants increase economic efficiency

Researchers at Münster University of Applied Sciences (FH Münster), together with the company PlanET, have developed a process for the efficient fermentation of liquid residual and waste materials from agriculture and industry. It was shown that an additionally installed high-load fermenter at agricultural biogas plants can supplement the conventional stirred tank fermenter and thus tap previously unused biomass potential. In high-load fermentation, the microorganisms required for biogas production are retained and enriched in the fermenter system. In contrast to conventional biogas fermenters, higher throughputs, shorter retention times and thus smaller tank volumes can be realized. An EGSB reactor (Expanded Granular Sludge Bed) proven in biological wastewater treatment proved to be the most suitable reactor system. Among the substrate mixtures, the mix of pig and cattle manure and a high-calorific residual showed the highest biogas potential. The retention time in the high-load reactor could be reduced to up to one day, with optimal retention times ranging from four to twelve days depending on the substrate combination selected.
More (in German)

CO2 liquefaction as an optimal complement

Recycling Energie AG celebrated the official start of operations of the CO_2 liquefaction plant in Nesselnbach (Switzerland). Hitachi Zosen Inova developed and delivered the turnkey project on behalf of the operating company CO_2 Energie AG. It is a significant milestone on the way to decarbonizing the Swiss energy system. The project is a best-practice example of optimized recycling management and maximized resource utilization: carbon dioxide (CO_2) previously released into the environment from the processing of biogas is now used in industrial applications, for example in processes in the pharmaceutical, medical or food industries. For this purpose, the biogas plant of Recycling Energie AG, which has already been feeding biogas into the grid since 2018, was supplemented by a CO_2 liquefaction plant implemented by Hitachi Zosen Inova.
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Cow waste for space rocket fuel

A Japanese chemical manufacturing company has been working on creating liquid biomethane from cow waste to be used as rocket fuel. Air Water has been manufacturing liquid biomethane in Hokkaido since 2021. It ferments cattle manure in a plant constructed on a dairy farm in the town of Taiki and

convert it into high-grade biomethane. While high-purity methane is usually manufactured using liquid natural gas, the company has been working on creating methane of a similar quality through waste-sourced biogas. The first test of Interstellar Technologies involved a 10-second blast of a blue-and-orange flame confirming that the fuel created from cow waste can be utilized to to operate a “Zero emission” rocket with a small satellite payload.
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Mobile biogas pilot plant with pre-treatment options

The MOSTCH4 research project of Swiss Applied Research Schools aims to develop an affordable and efficient anaerobic digestion plant that is especially suitable for small farms. Built into a 20-foot container, this 500-liter pilot plant houses three test lines, including two pretreatment processes. Based on the characterization of the potential substrates, the article focuses on three pre-treatment processes. The pretreatment of the biomass should increase the specific biomethane yield. The two most promising pretreatment processes i.e., physical cavitation and microaeration were used to operate the pilot plant with three 500-liter digesters. Enzymatic treatment did not show a better result than the control. With a cavitation time of two minutes, the maximum biogas production was 518.5 Nl/kg organic dry matter (TOC), which corresponds to a production rate of 1.31 Nl/h. Uncavitated substrate resulted in a significantly lower yield of 347.1 Nl/kg TOC. The micro-aerobically pretreated substrate showed the biomethane potential (BMP) of the reference 127 h earlier or 70% of the time. The increased yield of +33% through cavitation and the faster conversion of the biomass through microaerobic pretreatment led to the decision to use these two methods in a pilot plant.
More (in German)

Innovative high-temperature electrolysis at the heart of Power-to-X systems

The new high-temperature solid oxide cell electrolyzers (SOEC) are based on ceramic solid electrolytes. They operate at temperatures of over 600 °C and can be ideally combined with Power-to-X systems. The cells can be operated bidirectionally (reversible operation). At the high operating temperature, water is present in vapor form so that it is broken down directly into oxygen and hydrogen during the electrolysis reaction. Due to the thermodynamics, this reaction consumes significantly less electricity than the electrolysis of water in liquid form, and this is precisely the great advantage of SOE. The idea of combining high-temperature electrolysis with synthesis processes was demonstrated experimentally at the Eastern Switzerland University of Applied Sciences (OST). A pilot plant demonstrated the feasibility of the entire system, from the generation of renewable electricity to the production of synthetic methane and its final use in a compressed natural gas (CNG) vehicle, supplemented by the capture of carbon dioxide from the atmosphere.
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Innovative technology using solar energy to convert 100% renewable biogas to hydrogen

Southern California Gas Company (SoCalGas) announced that an innovative technology developed by UCLA researchers with potential project support from SoCalGas, was on display at COP 28. The goal of the technology is to use renewable solar energy and biogas to produce hydrogen and high-quality cylindrical graphite through an environmentally sustainable process. If developed at scale, this technology has the potential to be applicable to fuel cells, microgrids, and utility-scale hydrogen production. Over the past two years, the technology was successfully developed and demonstrated in a laboratory setting and is now advancing from the laboratory to a real-world demonstration.
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Japan: Meat, dung and hydrogen

Hokkaido, in the very north of Japan has frosty temperatures during the long winters. Despite this, a

large part of the food produced in the country is grown on Hokkaido such as corn, potatoes, onions, beets or cabbage. Huge farms produce meat and dairy products. It is therefore not surprising that most of Japan's biogas plants are located here. Of the country's 220 or so plants, one hundred are working with substrates from agriculture. Seventy of them are located on Hokkaido. in Shikaoi, for example, live 5500 people and 20,000 cows. So, with the support of the Japanese government, the community invested in an environmental center. The centerpiece is a biogas plant that went into operation in October 2007. Every day, trucks fill its digesters with more than 130 tons of slurry as well as small amounts of organic municipal waste. The 3,900 cubic meters of biogas produced daily are used by two CHP units generating 6 MWh of electricity, enough for 600 households. Above all, the odor nuisance in the village has been massively reduced. Recently, the center has been operating the first hydrogen filling station powered by biogas. A Toyota Mirai, the first mass-produced hydrogen car, fully fueled drives 500 km. This requires 60 cubic meters of hydrogen produced from 25 cubic meters of methane.
More (in German)

At GRDF gas pipes become bio-sourced

GRDF, the largest gas distributor in France, is testing a new kind of gas pipe for the first time. Certified bio-sourced and made from plant waste, it could soon be deployed on a large scale. Green pipes to transport green gas: Particularly committed to the promotion and development of biomethane and bioGNV, GRDF is going one step further in the greening of its networks. In September, the company inaugurated the laying of a new generation of "bio-sourced" gas pipes. With an appearance similar to that of existing polyethylene pipes, this new type of pipe is made from wood processing residues, notably from Finnish paper mills. Once transformed into bio-naphtha and then bio-ethylene, this plant waste offers properties identical to those of traditional pipes, particularly in terms of safety. Clermont Auvergne Métropole, the first local authority in the world to use the system, will have one kilometer of green pipes at its disposal.
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