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Anoxic Biowash for Biogas Desulfurization as a Contribution to the Climate Future

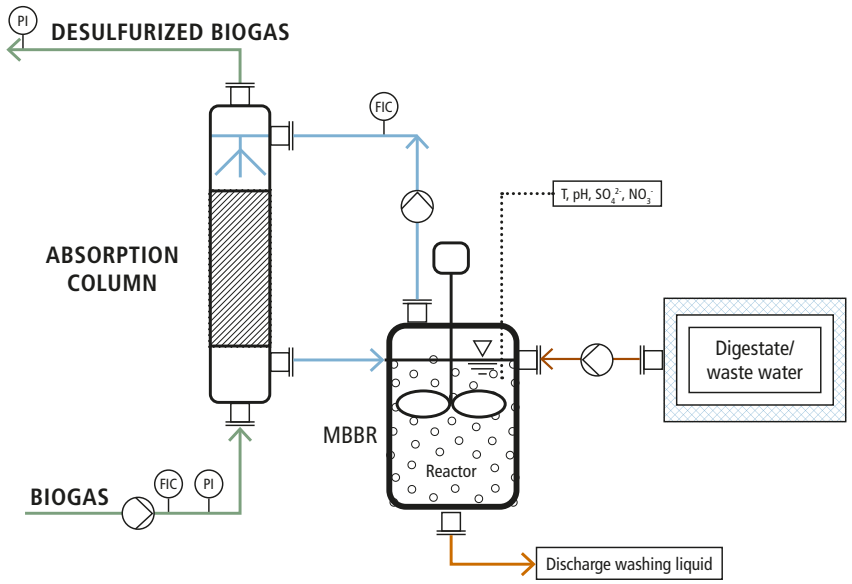
Development of a method to convert ammonium from digestate into nitrate and its reuse as an oxygen donor for biological oxidative biogas desulfurization

In the face of ambitious national and European efforts to reduce anthropogenically induced climate change by at least 55 % compared to 1990 emissions and achieve national climate neutrality by 2045, renewable (RE) and biogenic energy sources have gained significant importance. In this context, biogas, as a continuously producible fuel, plays a crucial role. The NitroSX process aims to enable the utilization of available streams in the biogas plant. In this way, the process is expected to contribute to the sustainability and economic viability of biogas plant operation.

Biogas is formed through the anaerobic microbiological degradation of organic material (fermentation). The main component of biogas is the energetically usable methane (CH_4). However, biogas also contains significant amounts of carbon dioxide (CO_2) and other accompanying gases, including hydrogen sulfide (H_2S). H_2S poses a problem for the energetic use of biogas. Combusting H_2S generates environmentally harmful sulfur dioxide (SO_2). Simultaneously, H_2S, through corrosion and lubricant acidification, causes severe damage to gas engines. Furthermore, even in very small doses, H_2S has a highly toxic effect on many organisms.

To economically utilize the methane content of biogas for energy generation, biogas must first be desulfurized. Physical, chemical, and biological processes are employed in biogas desulfurization. The first two methods involve the use of, among other things, precipitation and adsorbents, which significantly increase operational costs.

In contrast, biological processes are based on microbiological aerobic respiration processes, which are usually carried out by introducing air into the biogas stream. The introduced air must then be removed through energy-intensive processes for the upgrading



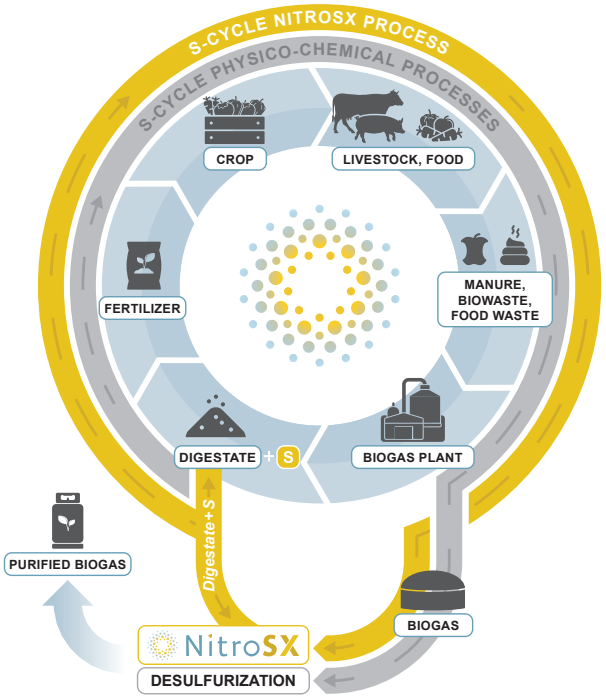
Pilot plant at the Simmerath site on a farm with a biogas production plant. (above)

Process diagram of the NitroSX pilot plant. (left)

of biogas to natural gas quality. To avoid this, nitrate can be used as an oxidation source instead of oxygen. Nitrate can be produced from the ammonium contained in the digestate. Since nitrate is used as an oxygen donor in microbiological biogas desulfurization and can be produced in the digestate, the innovative Nitro-SX process is being investigated as part of the BioSulfOx project, which runs from January 2023 to December 2024. This process aims to remove H_2S from biogas cost-effectively and environmentally friendly using nitrified digestate.

Consequently, this process can also contribute to reducing nitrate leakage into the soil. The products of the process include desulfurized biogas and low-nitrate digestate, which can still be used in agriculture as a fertilizer.

The objectives of this project include the investigation of the process engineering and microbiological biogas desulfurization, as well as the development and integration of a separate digestate nitrification stage into the existing pilot plant. Subsequently, the implementation



S-Cycles in Comparison: The NitroSX process contributes to closing the sulfur cycle in agriculture and thus supports the path towards more sustainable agriculture.

of the existing process into a large-scale operation, in collaboration with the project partner, SH Sulphtec GmbH, is to be prepared. The challenge in developing and implementing the process lies in determining a stable operating condition for all process stages and subsequently maintaining the entire pilot plant in a steady-state condition.

Project overview

PROJECT TITLE

RAIN – Sustainable technologies and services for climate change adaptation in flood and drought-prone settlements in Ghana

PROJECT PERIOD

NitroSX: 10/2018 – 12/2020
SulfNitrOx: 02/2021 – 12/2022
BioSulfOx: 01/2023 – 12/2024

PROJECT PARTNERS

NitroSX: aquatec-Reuter GmbH;
EVU Innovative Umwelttechnik GmbH
SulfNitrOx: –
BioSulfOx: SH Sulphtec GmbH

FUNDING

2018 – 2020
GEFÖRDERT VOM
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2021 – 2022
GEFÖRDERT VOM
Bundesministerium für Wirtschaft und Klimaschutz

2023 – 2024
GEFÖRDERT VOM
Bundesministerium für Ernährung und Landwirtschaft

SUPERVISED BY

2018 – 2020: Arbeitsgemeinschaft industrieller Forschungs-vereinigungen (AiF)
2021 – 2022: EURONORM GmbH
2023 – 2024: Fachagentur für Nachwachsende Rohstoffe e. V. (FNR)

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