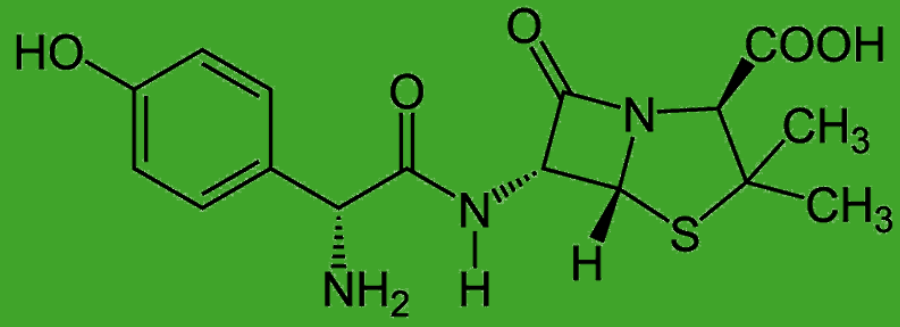




Valorizing Penicillium Production Residues towards bio-methane.

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Introduction

With rising energy costs and economic pressure, industry is searching for applications to valorize their waste streams and establish a circular economy.

In this study the biogas production potential of pharmaceutical production residues were investigated with focus on achieving a robust process despite high SO_4^{2-} (~12 g/kg) and nitrogen (TKN ~ 18 g/kg) concentrations in the solid waste fraction.

Experimental set-up:

A 6-L CSTR (continuously stirred tank reactor) (see Fig. 1) was operated at 37 °C and fed daily (excluding weekends). The produced biogas was quantified by a gas clock and the composition determined with an infra-red / electro-chemical gas analyzer.

The biogas trials were accompanied with standard biogas analysis: $\text{NH}_4\text{-N}$, TKN, TS, VS, pH, VFA to ensure stable process conditions.

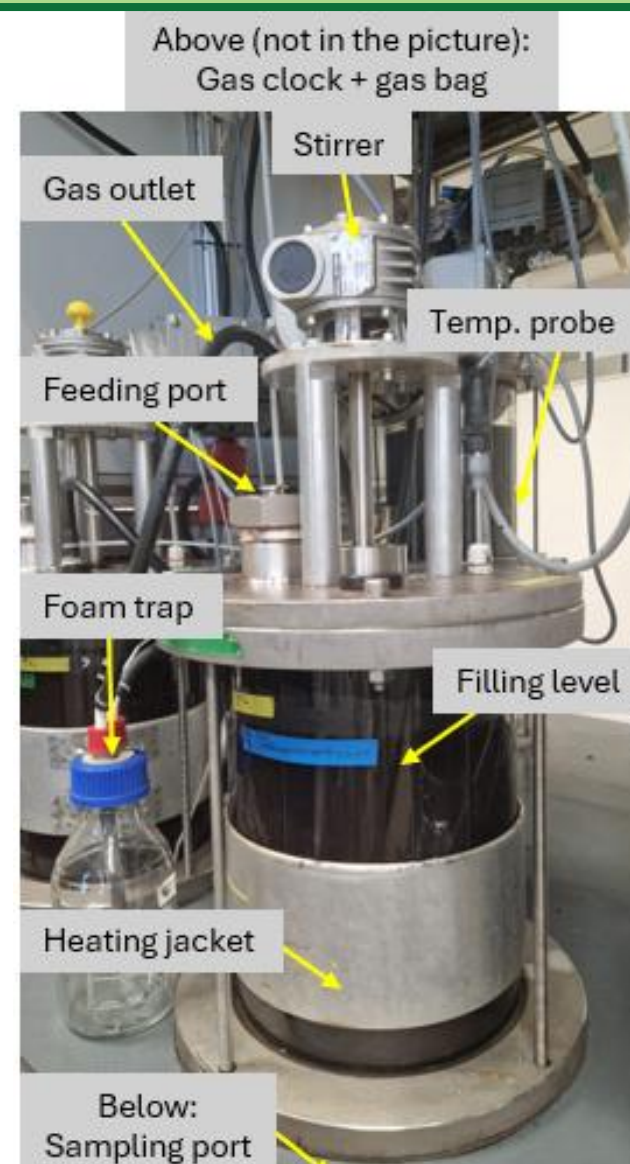


Figure 1: Picture of applied anaerobic bioreactor including explanations

Challenges of the feedstock:

The major challenge of the utilized substrate were microbial inhibitions due to e.g. high sulfate and nitrogen load, as well as high salt levels. Therefore, sulphur inside the anaerobic bioreactors was precipitated with iron particles forming FeS . For this, Fe_2O_3 was chosen as it has a stable long-term effect in contrast to liquid FeCl_3 , which is more commonly used.

The measured H_2S concentrations in the biogas could be significantly decreased from initial levels of over 2500 ppm to ~500 ppm – resulting in an improved process stability and higher biogas production.

Additionally, with the excessive dosing of trace elements (Co, Cu, Ni, Se, Mo) their bioavailability was increased.

Fermentation of nutrient-rich solids:

For the valorization of solid residues, they were diluted with deionized water to maintain a TKN concentration of 6 g/kg in the feed. High dosage of trace elements and Fe_2O_3 ensured a stable process. Results are shown in Fig. 2 & 3.

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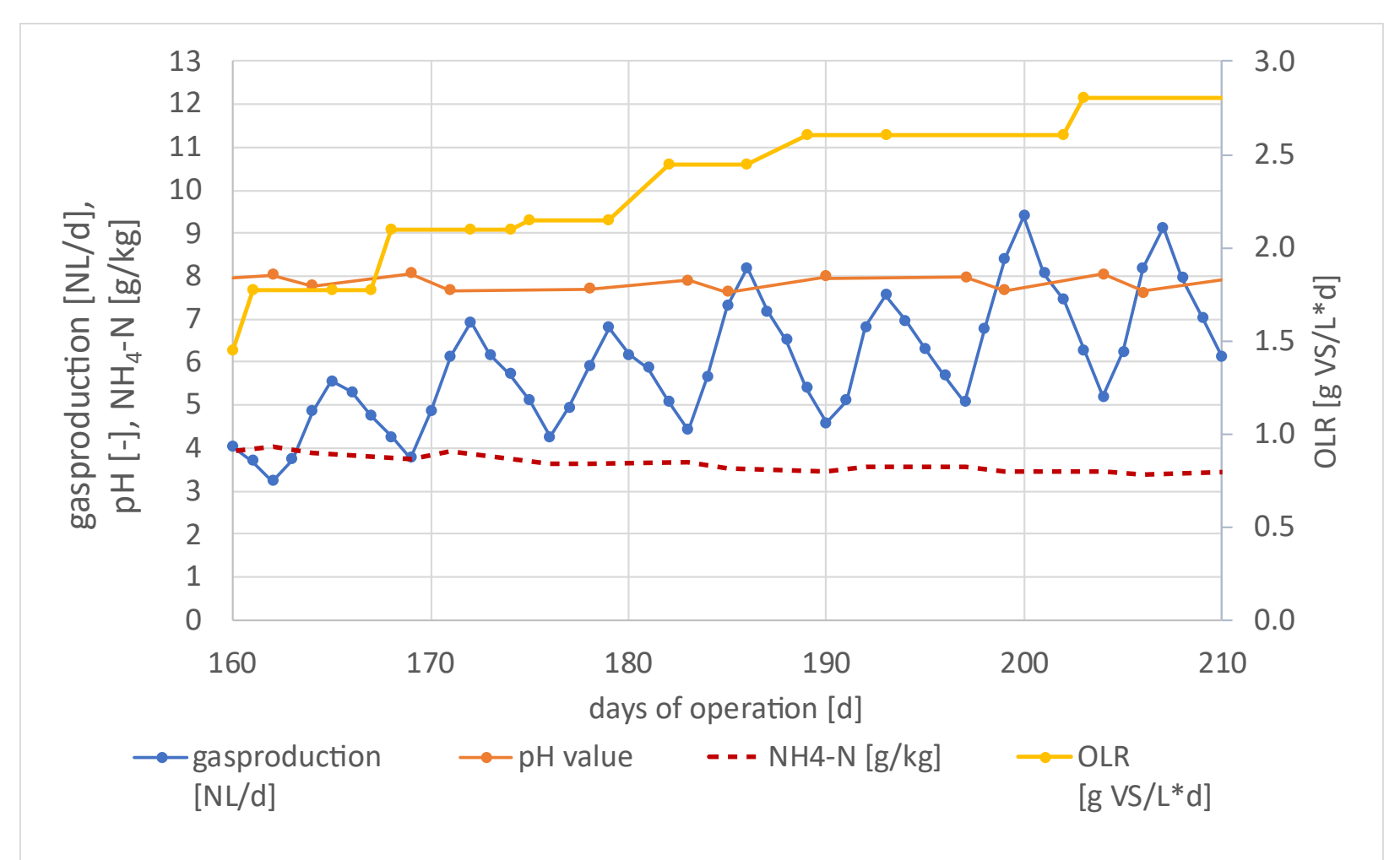
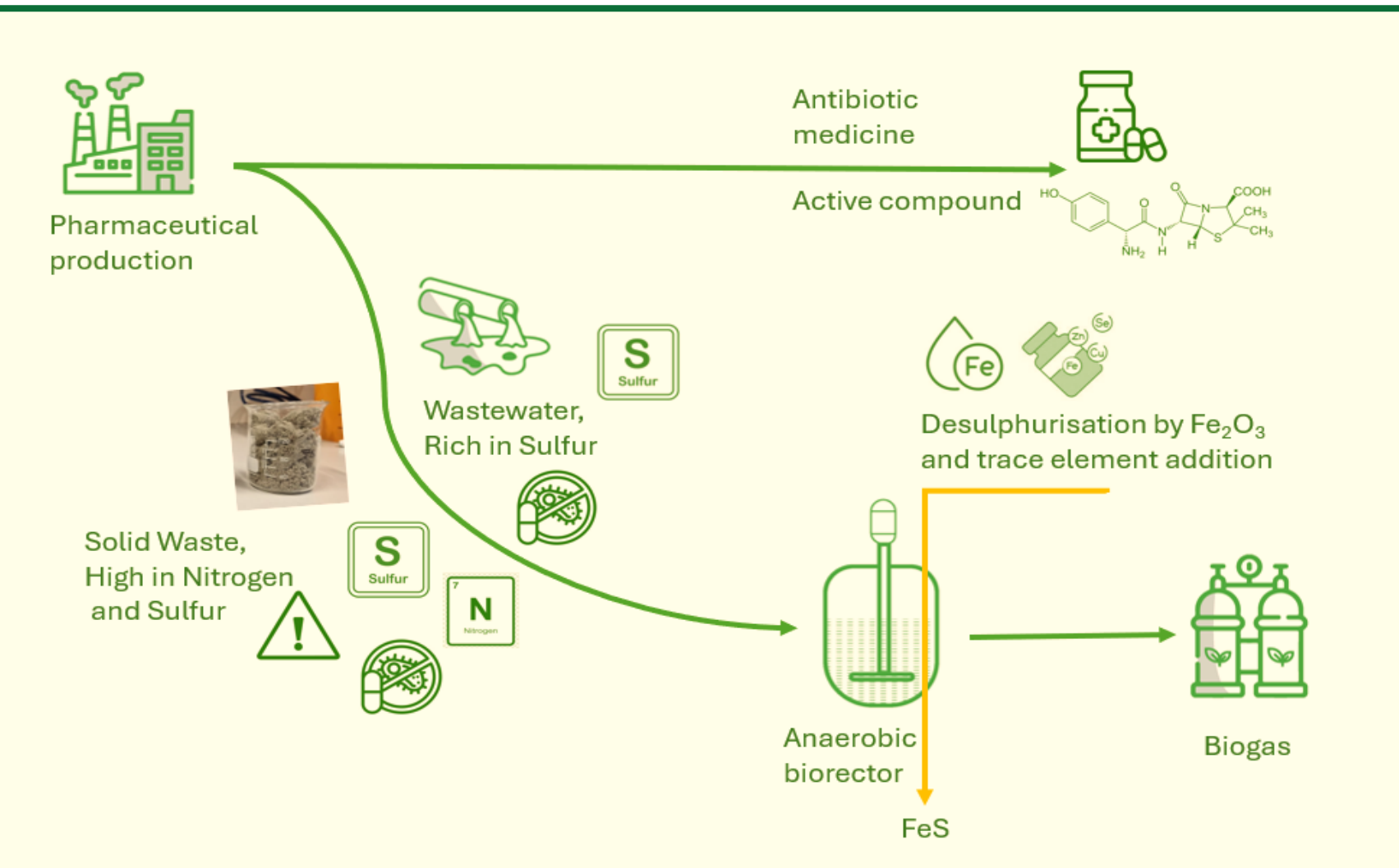


Figure 2: Process parameters - gasproduction [NL/d], pH [-], $\text{NH}_4\text{-N}$ [g/kg] and Organic loading rate (OLR [g VS/L*d]) during the biogas trial

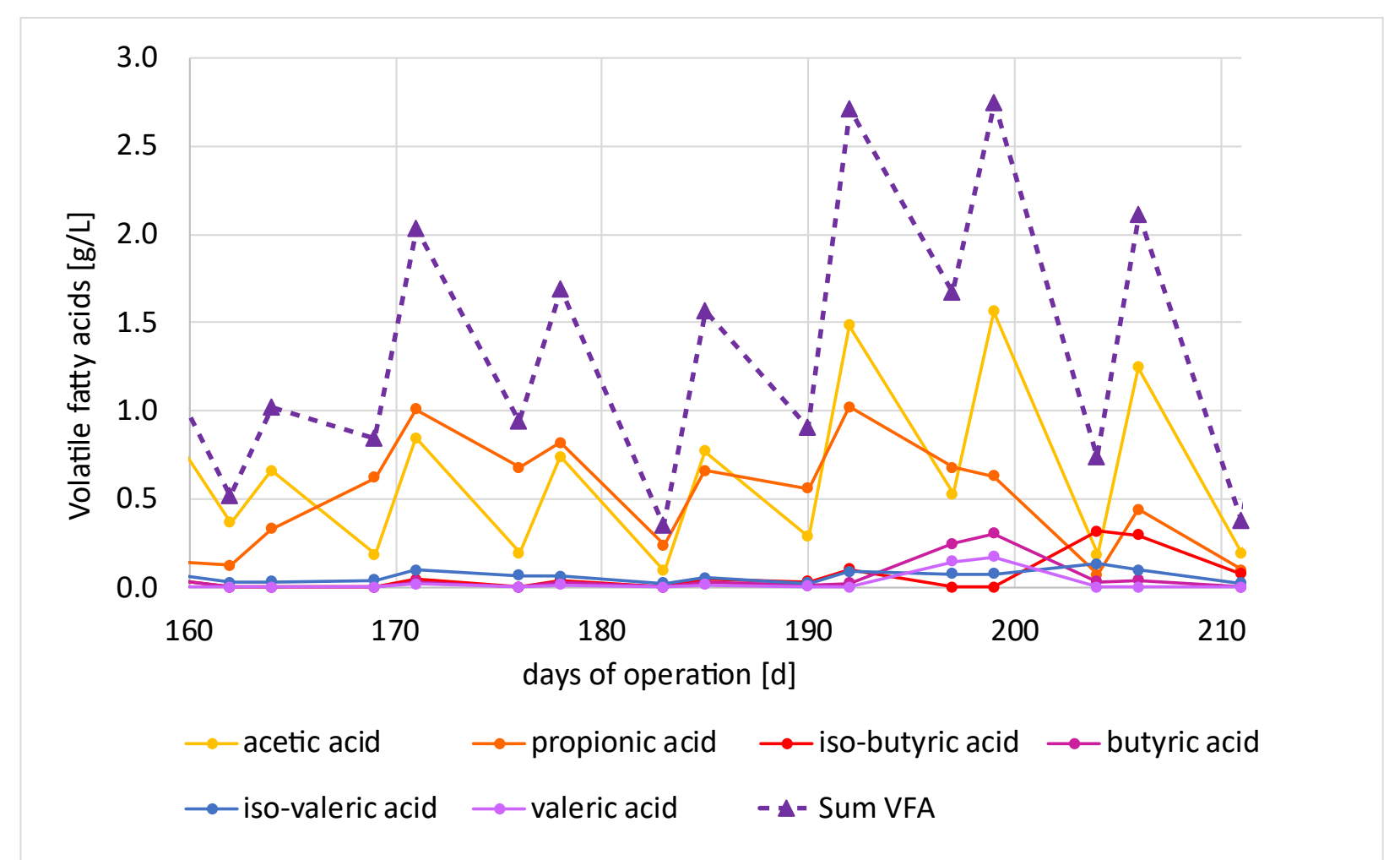


Figure 3: VFA - Volatile fatty acids [g/L] and their Sum, during the biogas trials

Conclusion:

The graphs above indicate that a stable biogas production is possible despite the inhibitory potential of the solid fraction of the pharmaceutical residue. This was guaranteed by adding Fe_2O_3 and trace elements, as well as an adaptation of the microbial culture.

At an organic loading rate (OLR) of ~3 g VS/(L*d) stable biogas production and low VFA concentrations were achieved. This parameters indicate potential process parameters of a future industrial biogas plant, overcoming the challenge of a high N- and S-load.