Simulation of syngas fermentation

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Description

The potential in the production of sustainable fuels has increased during the last years by the introduction of several waste conversion technologies. One of the methods to convert waste streams into bio-ethanol (and other biofuels) is using syngas fermentation. Syngas, a mixture with CO, H_2 and CO_2 as main constituents, can easily be obtained from gasification of agricultural residues, from electrolysis of CO2 and from industrial waste streams (Abubackar et al. (2011), Köpke & Simpson (2020)).

The syngas is subsequently converted into ethanol in by acetogenic bacteria like *Clostridium autoethanogenum*. This conversion is the basis of the industrial process for ethanol production from syngas, which is being done now at larger scales by the company LanzaTech. This conversion takes place in gas-lift reactors (see Figure 1). In this reactor, the syngas is fed from the bottom and rises to the top in the riser part. The downcomer enables recirculation of the liquid and the biomass. This way, liquid mixing is enabled, whilst maintaining concentration gradients in the gas and liquid phases. These concentration gradients are expected to impact the metabolism of the organism substantially, causing large deviations in syngas consumption rates along the reactor height.

By coupling fluid dynamics with the cellular dynamics, the spatial differences in microbial behaviour can be determined. This will be used for the development of optimal reactor models for industrial syngas fermentation processes.

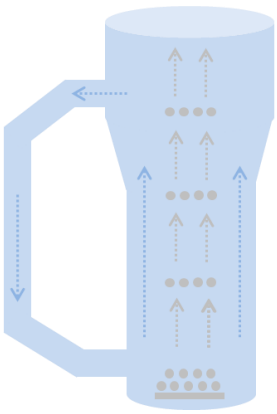

Figure 1. a) Industrial scale gas-lift reactors as being used by LanzaTech for syngas fermentation. b) Schematic representation of these reactors, describing the mixing pattern.

References

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