LABORATORY FOR CHEMICAL TECHNOLOGY

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Coach	Supervisor(s)	Funding
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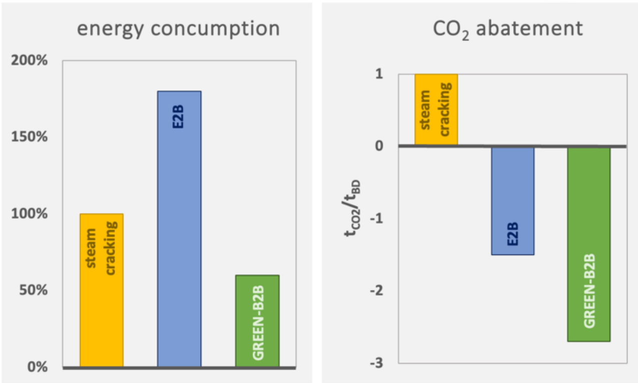
Dehydration of bio-based 1,3-butanediol into green 1,3-butadiene: industrial-scale process development and techno-economic assessment

Aim

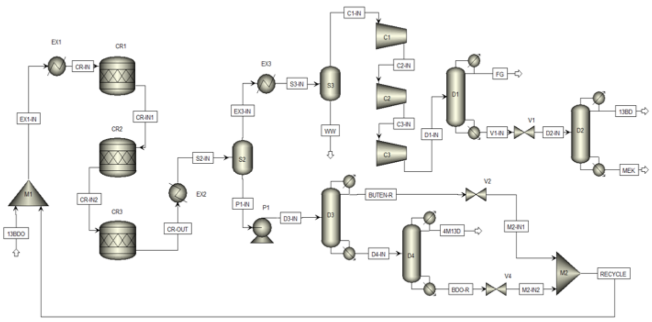
Development of an integrated process concept (Aspen Plus) for the dehydration of biomass-derived 1,3-butanediol to green 1,3-butadiene based on available data. The process will be analyzed and optimized guided by the process economics to yield an economically and environmentally viable alternative to the current fossil-based production routes.

Justification

1,3-Butadiene (BD) is a key building block for the polymer industry (17 Mt/a representing 19 billion EUR) and is currently mainly produced as a byproduct of the energy-intensive steam cracking. As there is a tendency to move towards lighter steam cracking feedstocks (e.g., ethane instead of naphtha) less BD is produced through the latter process and **novel (on-purpose) production processes are needed to meet the increasing BD demand**. Moreover, the steam cracking process generates more than one ton of CO_2 per ton of BD. Both economic and environmental reasons, thus, plead for a diversification of BD production processes, preferably from renewable feedstock and with a reduced CO_2 footprint.



This master thesis is part of the GREEN-B2B project [1], in which the production of green butadiene is envisaged via the **CO_2 co-processing fermentation of paper/-cardboard waste into 1,3-butanediol (1,3-BDO) and subsequent acid-catalyzed dehydration into BD**. Preliminary calculations already suggest that this process will heavily outperform the current benchmark process (i.e., steam cracking) as well as its most important green competitor (Ethanol-to-butadiene (E2B)). Given these promising prospects, GREEN-B2B aspires to push the technology up to the industrial scale.



To facilitate this industrial adaptation, a realistic, industrial-scale process design is needed to calculate the BD production cost and determine its economic viability. The **engineering of such a 30 kt/a BD process model** in Aspen Plus based on the experimentally obtained reactor-outlet compositions will be the core of this Master thesis. An exploratory design already exists (see flow diagram) and could serve as a basis, if desired. The techno-economic assessment (TEA), will then be performed using a proven, well-defined, costing method, e.g., the Lang-method (see course notes Process Systems Design). The obtained production cost will then guide the decision-making process in terms of process configuration, equipment selection, etc., and as such, generate fundamental insights into the overall question: **"Does this technology make sense as a whole?"**

Program

- Literature study: dehydration of biomass-derived 1,3-BD
- Engineering a industrial-scale process model for the dehydration of 1,3-BDO into BD
- TEA of the developed process, specifically focused on the industrial viability of the technology

[1] https://moonshotflanders.be/mot1-green-b2b/

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