**Bipolar electrodialysis for purification of fermentation-based products**

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**Motivation**
- Raw-material and energy efficiency in downstream processing (DSP) of fermentation-based products

**Objective:** Evaluating bipolar electrodialysis (ED) as one promising technology in hybrid processes

- Exemplary system: γ-amino butyric acid (GABA)

**Experimental setups**
- Two-loop batch arrangement on 5 litre scale
- Inline measurement of membrane resistances using platinum wires (BPM, CEM, AEM)
- Two functions of bipolar ED
  1. Desalination of ionic GABA by removing ions through anion exchange membranes (AEM) or cation exchange membranes (CEM)
  2. Caustic / acid generation using bipolar membranes (BPM) depending on configuration [Fig. 4 / Fig. 5]

**Experimental results**
- Spec. energy consumption lower in "caustic stack" config. (0.5-0.8 kWh/kg GABA) [Fig. 6]
- Drop in current efficiency observed in reference experiments in “acid stack” over time, most likely due to blockage of the AEM by GABA [Fig. 7]
- Regeneration of “acid stack” by NaOH [Fig. 7]
- Reversible sorption of GABA into BPM observed by analyzing resistance [Fig. 8]

**Summary and Outlook**
- Method for detailed analysis of membrane resistances in stack operation mode using platinum wires developed
- Combination of bipolar ED and IEX using NaOH recirculation most promising

**Bipolar electrodialysis in DSP**

**Fig. 1:** Charge of GABA as function of pH value.

**Fig. 2:** Flowsheet integrating bipolar ED and Ion Exchange.

**Fig. 3:** Flowsheet integrating bipolar ED and extraction.

**Fig. 4:** Configuration 1 consisting of BPM and CEM ("caustic stack").

**Fig. 5:** Configuration 2 consisting of BPM and AEM ("acid stack").

**Fig. 6:** Spec. energy consumptions in GABA desalination experiments.

**Fig. 7:** Current efficiencies in reference experiments (NaOH or H₂SO₄).

**Fig. 8:** Current-resist. curves of BPM in subseq. tests (I-III) after GABA run.

**Runs with original fermentation broth (effect of impurities)**
- Hybrid system will be run in continuous operation (SMB and bipolar ED) @ BASF in cooperation with Xendo
- Main challenge: Enrichment of impurities in continuous run