

Recovery and esterification of carboxylic acids from wastewater

PhD-student: Carlos I. Cabrera-Rodriguez
Promotor: Prof. Luuk van der Wielen, Dr. Adrie J. J. Straathof
Supervisor: Dr. Adrie J. J. Straathof
Institute: Delft University of Technology, Department of Biotechnology, Bioprocess Engineering section
Project term: Nov 2013 – Nov 2017
Financed by: STW/Paques

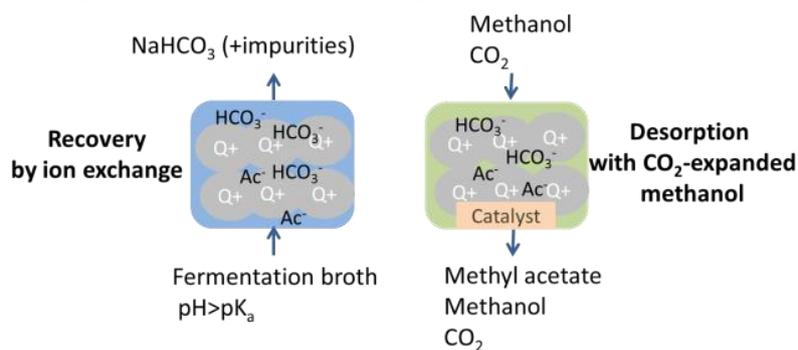


Description

Agro-industrial wastewater has traditionally not been considered as feedstock for chemicals production because of its complex composition. However, the cost of the wastewater treatment will be reduced when its organic components are utilized. Chemicals and energy can be produced using a versatile platform such as the carboxylate platform.

The carboxylate platform (or volatile fatty acids platform) is an emerging platform that can convert biomass into liquid fuels and chemicals. The advantage of this platform is the fermentation stage, which uses mixed cultures of microorganisms at non-sterile condition. These microorganisms convert the biomass components, such as carbohydrates, proteins and fats, into a mixture of carboxylate salts. The carboxylates salts produced are mainly acetate, propionate, butyrate and lactate.

The main limitation of the process is the recovery of the carboxylate salts from the fermentation broth. One alternative is the direct downstream transformation of the carboxylate salts into other chemicals such as esters. This research project focuses on a direct route for the production of esters. The carboxylate salts are recovered by anion-exchange, and the esters are produced by direct downstream catalysis.



Integration of all reaction and separation steps, with proper recycling, is pursued to eliminate waste streams and minimize energy use.

Dissertation

Cabrera-Rodríguez, C.I., Upgrading carboxylates from wastewater, PhD Thesis, Delft University of Technology, 110 pp, 2018. <https://doi.org/10.4233/uuid:058eb17c-79eb-4ad8-a071-2fac08fdd53f>

Publications from the dissertation

1. Cabrera-Rodríguez, C.I., van der Wielen, L.A.M., Straathof, A.J.J. (2015) Separation and Catalysis of carboxylates: Byproduct reduction during the alkylation with dimethyl carbonate. [Ind. Eng. Chem. Res. 54 \(44\), 10964-10973.](#)
 2. Cabrera-Rodríguez, C.I., Paltrinieri, L., de Smet, L.C.P.M., van der Wielen, L.A.M., Straathof, A.J.J. (2017) Recovery and esterification of aqueous carboxylates by using CO₂-expanded alcohols with anion exchange. [Green Chem. 19 \(3\), 729-738.](#)
 3. Cabrera-Rodríguez, C.I., Moreno-González, M., de Weerd, F.A., Viswanathan, V., van der Wielen, L.A.M., Straathof, A.J.J. (2017) Esters production via carboxylates from anaerobic paper mill wastewater treatment. [Bioresour. Technol. 237, 186-192.](#)
 4. Cabrera-Rodríguez, C.I., Cartin-Caballero, C.M., Platarou, E., de Weerd, F.A., van der Wielen, L.A.M., Straathof, A.J.J. (2018) Recovery of acetate by anion exchange with consecutive CO₂-expanded methanol desorption: A model-based approach. [Sep. Purif. Technol. 203, 56-65.](#)
-