Recovery of carboxylates via anion exchange chromatography

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HIGHLIGHTS:

- Carboxylates were successfully separated from a co-fermented waste stream
- Longer compounds showed higher selectivity compared to shorter carboxylates
- Desorption profiles were better for longer compounds

BACKGROUND: The focus of this research was to study the recovery of a mixture of carboxylates from a complex waste stream. Different technologies for carboxylate recovery have been studied (1,2), but high potential was presented using anion exchange chromatography for carboxylates from waste streams (3). Recovery of longer compounds such as hexanoate and heptanoate is however less known. Some of the technologies applied up to date are membrane electrolysis (4) and anion exchange (5) for hexanoate recovery. In this study, anion exchange chromatography was used to recover a mixture of carboxylates containing hexanoate and heptanoate. This technology has been proved successful for shorter chain carboxylates such as acetate, propionate and butyrate, but its efficiency in longer carboxylates is still not well studied.

RESULTS & DISCUSSION: Municipal sewage sludge and the organic fraction of municipal solid waste were co-fermented for carboxylate production as a revalorization strategy. Hexanoate and heptanoate represented 21 and 9.5% respectively of the final composition in the effluent. The mixture of carboxylates was successfully separated from the waste stream via anion exchange chromatography. Most of the shorter carboxylates ranging from 2 to 5 carbon atoms presented a similar adsorption trend and selectivity, while valerate, hexanoate and heptanoate showed higher selectivity (Figure 1). Desorption of the compounds with CO2-expanded alcohol was also proved successful, where hexanoate and heptanoate showed a better desorption profile as well. Similar trends were observed for both the synthetic mixture and the real co-fermented sample.

The influence of bed volumes and adsorption length was also studied with the co-fermented sample. Results show that by increasing the duration of the adsorption, it is possible to desorb some of the shorter carboxylates and increase the loading of hexanoate and heptanoate in the resin.

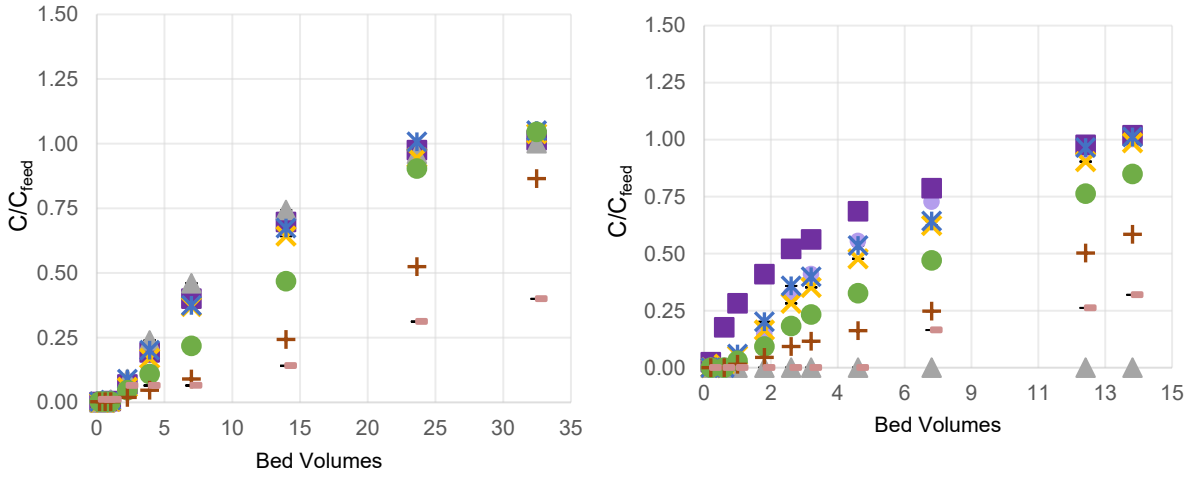

Figure 1. Breakthrough curves for a) synthetic mixture of carboxylates at pH 5.18 and b) co-fermented municipal sewage sludge and food waste at pH 5.07 (C, effluent concentration; C_{feed}, feed concentration). Average values of duplicate experiments.

CONCLUSION: This study validated the use of anion-exchange chromatography and CO_2-expanded alcohols for carboxylate recovery from waste streams, with especial emphasis on medium chain carboxylates. In addition, it presented the possibility to use the adsorption time as a tool to boost hexanoate and heptanoate content in the column.

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