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Renewable Aromatics from Waste Water by Catalytic Aromatization of Volatile Fatty Acids

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PURPOSE OF THE ABSTRACT

Waste water streams can serve as a valuable source of carbon for the production of renewable, value-added chemicals. Such upgrading efforts contribute to establishing closed carbon loops and to the minimization of waste. For example, waste water fermentation can yield short-chain carboxylic acids, so-called volatile fatty acids (VFAs). These carboxylic acids can then be upgraded catalytically to a wide range of compounds, such as mixed ketones, which can in turn serve as valuable bio-based platform chemicals. These ketones can serve as intermediates for the production of renewable aromatics, for example. The low concentration of the VFAs in the fermentation broth makes direct conversion unfeasible, however, and efficient extraction is required first. Different separation techniques are known to be effective for the VFAs separation from dilute aqueous solution, including extraction by an ionic liquid or by adsorption on a polymeric resin. Subsequent (in-line) catalytic gas-phase ketonization over amphoteric reducible metal oxides can then yield a mixture of ketones, a mixture than can in turn be converted to BTX by a zeolite-catalyzed aromatization reaction.

Here, we report on the highly efficient aromatization of waste-water derived VFA to give renewable BTX, detailing the catalyst structure-property relationships that govern the VFA ketonization and ketone aromatization reactions, as well as the results of direct, tandem ketonization-aromatization reaction. Details are provided on the conversion of VFAs mixtures, at topic that has received only limited attention, on the development of new (transition metal doped) ketonization catalysts, the effect of the presence of water in the feed on catalyst performance (in particular stability) and on the influence of preparation method of promoted zeolite catalysts used for ketone aromatization. High carbon selectivities to BTX of over 70% are obtained, at full conversion. The results thus present an efficient and novel route for renewable, drop-in aromatics production.

FIGURES

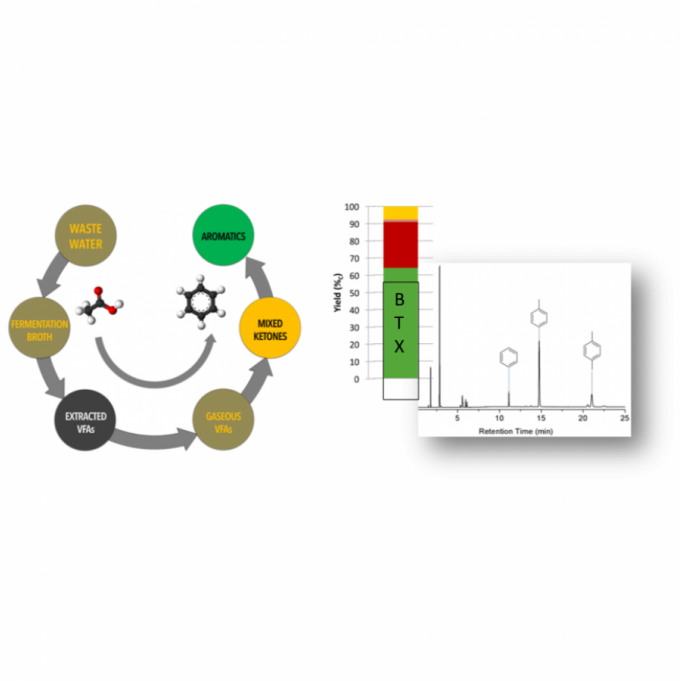

FIGURE 1

Figure 1

Waste-to-aromatics by efficient (tandem) catalytic VFA conversion.

FIGURE 2

KEYWORDS

heterogeneous catalysis | volatile fatty acids | waste water | aromatics

BIBLIOGRAPHY