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Ketonization of volatile fatty acids recovered from waste water streams

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PURPOSE OF THE ABSTRACT

Waste water streams can serve as a valuable source for the production of renewable value-added chemicals, together with simultaneous minimization of waste. Fermentation of such waters results in a production of short chain carboxylic acids (up to C6), so-called volatile fatty acids (VFAs). The functionality of carboxylic acids facilitates their catalytic upgrading to a wide range of compounds. Indeed, VFAs are valuable platform chemicals and can be converted to, for example, mixed ketones. [1]

Typically the concentrations of the VFAs in the fermentation broth are very low (~ 1 wt. %) which makes direct conversion unfeasible. In order to overcome this issue the VFAs should be extracted prior to the catalytic reaction. Different separation techniques are known to be effective for the VFAs separation from dilute aqueous solution, such as adsorption on a polymeric resin, for example. [2, 3] The extracted acids can be easily recovered from a resin by stripping with hot nitrogen, followed by catalytic gas-phase ketonization.

Ketonization is a reaction that converts two carboxylic acids into a ketone, carbon dioxide and water. Amphoteric reducible metal oxides (such as TiO2 for e.g.) are known to possess high ketonization activity and selectivity towards the ketones. [4] Although the gas-phase ketonization of single acids has been extensively studied in the past, limited attention has been paid for the conversion of VFAs mixtures. In addition, little attention has been paid to the influence of feed impurities on catalyst performance.

Here, we report on the catalytic ketonization of the VFA mixture (C2-C4 acids, in particular) extracted from the fermentation broth over TiO2 P25 doped with different metals. Stability of the catalyst was studied with increasing of feed complexity from single acids to VFAs mixture extracted from a real feed. Studies on the effect of catalyst pre-treatment (such as reduction in H2) on activity and the effect of metal-doping on titania selectivity towards ketone will be reported.

FIGURES

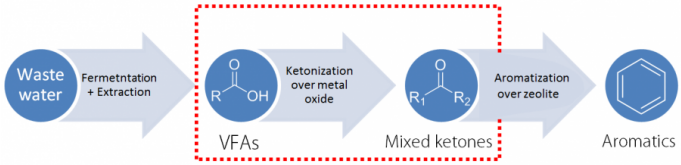

FIGURE 1
General overview

FIGURE 2

KEYWORDS
ketonization | titanium dioxide

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