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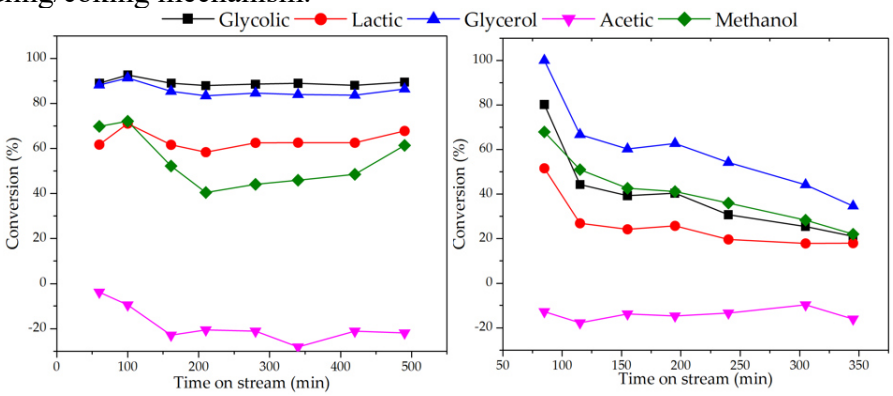
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Green hydrogen production from wastewater derived from lignin-rich hydrothermal liquefaction

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Hydrothermal processes of biomass can lead to renewable fuels. For example, the hydrothermal liquefaction (HTL) of lignocellulosic biomass produces a biocrude with higher heating value and stability then the one obtained by pyrolysis, thanks to the lower oxygen content. However, the management of the aqueous by-product is an important bottleneck in the development of such technologies. It has been estimated that the cost of aqueous by-products disposal is second only to feedstock's cost. For this reason, the water fraction should be valorized. In this work, the aqueous phase reforming (APR) has been investigated with a double goal. First, it can convert the carbon-laden aqueous phase into a hydrogen-rich gas mixture, providing the hydrogen necessary for the upgrade of the bio-crude [1]; second, it can clean the aqueous phase that can be recycled to the liquefaction step, reducing the need for water make-up. Aqueous phase reforming has been tipically studied with model compounds, like poly-alcohols [2]. In the present work, a real aqueous-phase derived from lignin-rich HTL was used as a feedstock. The tests were performed in a continuous fixed-bed reactor, using a developmental 5% Pt/C catalyst by a commercial supplier. The influence of several reaction conditions was investigated, such as temperature, weight-hourly space velocity, co-feeding of an inert weeping gas. Beside the use of a real aqueous phase, a synthetic representative mixture was employed to highlight differences in the reactive behavior. Among the obtained results, in Figure 1, a comparison between the synthetic and real mixtures is reported. It is highlighted that the synthetic mixture showed a stable conversion of the reactants (glycolic and lactic acid, glycerol, methanol), while acetic acid was indeed produced by side-reactions. On the other hand, the real mixture reported deactivation phenomena after 250 min. The study of the textural properties of the catalyst reported that the surface area decreased, suggesting a deactivation by fouling/coking mechanism.



Sample	BET surface area (m^2/g)
Fresh	965
Synthetic	968
Real	618

Figure 1. APR of synthetic (left) and real (right) mixtures. Reaction conditions: 0.8 mL/min feed flowrate, 1 g Pt/C, 270 °C.

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[1] G. Pipitone, G. Zoppi, S. Bocchini, A. M. Rizzo, D. Chiaramonti, R. Pirone and S. Bensaid, *Catal. Today*, 2020, **345**, 237–250.

[2] R. D. Cortright, R. R. Davda and J. A. Dumesic, *Nature*, 2002, **418**, 964–967.

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