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Continuous hydrodeoxygenation of liquid phase pyrolysis oil together with oil refinery intermediates

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PURPOSE OF THE ABSTRACT

In order to sustainably increase the biogenic fraction in fossil-based fuels, utilization of non-food biomass is a promising option. As the depletion of fossil resources is limited, existing refineries may be faced with low capacity problems in near future. To make biomass valorization economically attractive, this process capacity gap could be used for biomass processing. Implementation requires process conditions in biomass valorization compatible to fossil-fuel processing.

Liquid phase pyrolysis oil [1] is formed as a byproduct during the production of biobased fuels from lignocellulosic raw material via liquid phase pyrolysis with the heat carrier vacuum gas oil (bioCRACK process [2, 3]). The non-polar biomass pyrolysis products can be directly processed with the cracked vacuum gas oil in the refinery, while the liquid phase pyrolysis oil contains the more polar constituents from the biomass. This leads to a high water and oxygen content in the liquid phase pyrolysis oil and hindering direct usage as fuel. To upgrade the liquid phase pyrolysis oil, continuous hydrodeoxygenation was investigated in a plug flow reactor (Parr Instruments) with inline-sulfided metal-oxide catalyst. For implementation in existing refineries, a pressure level of 80 bar would be beneficial, therefore the influence of pressure reduction from 120 to 80 bar was evaluated. Additionally co-processing of liquid phase pyrolysis oil with refinery intermediates was investigated.

As the liquid phase pyrolysis oil is immiscible with refinery intermediates due to the high water content, a first mild hydrodeoxygenation step at 300°C was performed. The water and oxygen content were highly reduced in this first step, enabling further co-processing with refinery intermediates. Therefore, 10 wt% hydrodeoxygenated liquid phase pyrolysis oil was mixed with 90 wt% of a highly hydrogenated heavy gas oil fraction for a second hydrodeoxygenation step at 400 °C, producing a fuel with 8.9 % biogenic carbon content. After the second hydrodeoxygenation step the water content in the liquid phase pyrolysis oil was reduced from 58.9 wt% to 0.01 wt%, making it feasible for integration into further processing with fossil based fuel.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

biomass valorization | hydrodeoxygenation | continuous processing | liquid phase pyrolysis oil upgrading

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