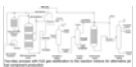

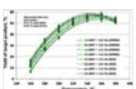

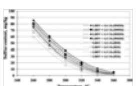

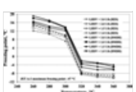

Fuel

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Full Length Article

Advanced production process of jet fuel components from technical grade coconut oil with special hydrocracking

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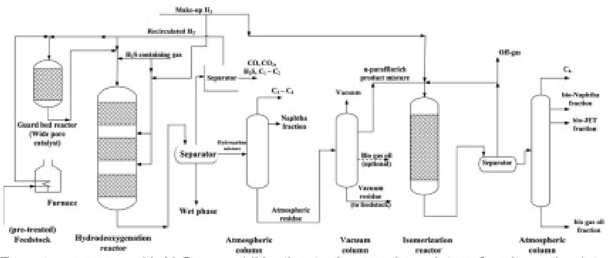
Abstract

The quality requirements for jet fuels have become stricter in the last few years. The reason of this is that more severe environmental regulations have been introduced and the increasing demand for performance requirements. Furthermore another requirement for jet fuels is that they should contain components of alternative origin to fulfil the requirements of the standard and to contribute to CO_2 reduction. The aim of our experimental work was to study the production of jet fuel from natural triglycerides (technical grade coconut oil) with special hydrocracking (hydrogenation of olefinic double bonds, propane split, hydrodeoxygenation, decarbonylation and decarboxylation) with lower chemical and energy costs, less harmful material emission and better economy. Experiments were carried out on a sulfided $NiMo/Al_2O_3$ catalyst at different process parameters (temperature: 280–380 °C, pressure: 30 bar, liquid hourly space velocity: 1.0–3.0 h^{-1}, H_2/feedstock volume ratio: 600 Nm^3/m^3). Two possibilities for keeping the catalyst in sulfide-state during the special hydrocracking were investigated. These are the H_2S containing hydrogen gas and the liquid sulfidation agent (dimethyl-disulfide). It was found that at the favourable process parameters (temperature 360 °C, pressure 30 bar, liquid hourly space velocity: 1.0 h^{-1}, H_2/feedstock volume ratio 600 Nm^3/m^3) the product yields were higher with 0.5–2.0 absolute % in case of H_2S containing hydrogen gas application. The jet fuel fractions were mixtures of saturated straight chain hydrocarbons; they were aromatic and olefin free, so they have excellent oxidation stability. The highest difference in the quality of jet fuel fractions obtained by the dimethyl-disulfide and H_2S containing gas application was the sulfur content of the products ($\leqslant$2 mg/kg with H_2S, 7–9 mg/kg with dimethyl-disulfide). The freezing point of jet fuel fractions obtained by special hydrocracking was high either when using dimethyl-disulfide or hydrogen-sulfide sulfidating agents (−11 °C with H_2S and −8 °C with dimethyl-disulfide) compared to the value of the standard (maximum −47 °C). Isomerisation on Pt/SAPO-11 catalyst was used to decrease the freezing point of the high *n*-paraffin containing jet fuel fractions resulting in products of freezing points of −45 °C to −41 °C (T = 360 °C, P = 45 bar, liquid hourly space velocity = 1.1 h^{-1}, H_2/feedstock ratio = 350 Nm^3/m^3). These values can be further decreased by using low level additivation (15 mg/kg and 20 mg/kg) to −49 °C and −48 °C respectively. These products fulfil the standard requirement.

It was concluded that H_2S containing H_2 gas forming as a side product during the desulfurization of jet fraction or diesel fuel in a crude oil refinery is useful to maintain the sulfide-state of the catalyst. A further advantage is that there is no need to extract the H_2S from this gas stream with absorption/desorption. This means significant chemical and operation cost decreasing, less energy consumption, moreover less harmful material emission. This solution can be integrated easily in the structure of a crude oil refinery.

Graphical abstract

Two-step process with H_2S gas additivation to the reaction mixture for alternative jet fuel component production.



Two-step process with H_2S gas additivation to the reaction mixture for alternative jet fuel component production

Keywords

Biojet fuel; Natural triglyceride; Unconventional catalyst sulfidation; Energy saving; Various sulfide-state maintaining; Special hydrocracking

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