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Short Communication

Oxidative stability of waste cooking oil and white diesel upon storage at room temperature

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HIGHLIGHTS

- "White diesel" maintains high oxidation stability after extended storage time (1 year).
- Increased oxidation stability of "white diesel" can be attributed to a high paraffinic content and absence of unsaturated bonds.
- Waste Cooking Oil is susceptible to oxidative degradation after extended storage.

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ABSTRACT

Renewable diesel fuels are alternative fuels produced from vegetable oils or animal fats. Catalytic hydrotreating of waste cooking oil (WCO) was carried out at pilot-plant scale and a paraffinic diesel, called "white" diesel was obtained. The white diesel and WCO samples were stored for one year at room temperature under normal atmospheric conditions, but not exposed to sunlight. Viscosity, total acid number (TAN), induction period (IP), carbonaceous deposits, density, cold flow properties, distillation and water content were monitored. TAN and density of the white diesel stored in conventional bottles changed from 0 to 0.221 mg KOH/g and from 787 to 838 kg/m^3, respectively. The remaining parameters did not vary significantly. Water content of WCO increased from 482 to 2491 mg/kg, TAN from 0.744 to 0.931 mg KOH/g, whereas viscosity, IP and carbon residues fluctuated mildly. The results are indicative of the white diesel's stability, rendering it suitable for prolonged storage.

1. Introduction

Catalytic hydrotreating, a technology that has been extensively employed by the classical petrochemical industry for upgrading fuel quality (Farrauto and Bartholomew, 1997) can also be applied to renewable lipid sources such as vegetable oil, animal fat and waste cooking oil (WCO), leading to the production of a paraffinic diesel fuel (Kovács et al., 2011; Sotelo-Boyás et al., 2011; Zhao et al., 2011). Due to the associated saturation, deoxygenation, decarboxylation and decarbonylation reactions, the paraffinic fuel is free of oxygen and double bonds. Catalytic hydrotreatment was also applied to WCO (Bezergianni et al., 2010a, 2011a,b) and the resulting fuel, named "white diesel", had a high cetane number and high heating value. The diesel consists of normal and iso-paraffins with 8–25 carbons, while a small percentage of unconverted triglycerides (3.2–7.7 wt.%) are also present (Bezergianni et al., 2010a,b).

In the present study, the oxidative stability of white diesel produced from catalytic hydrotreatment of WCO and of WCO was investigated over a 12-month storage period under different storage conditions.

2. Methods

The technology developed for the production of white diesel via the catalytic hydrotreatment of WCO over a $NiMo/Al_2O_3$ commercial catalyst has been previously described (Bezergianni et al., 2010a, 2011a,b). WCO was obtained primarily from local restaurants and tavernas collaborating for this study.

White diesel and WCO samples (500 mL each) were stored for 12 months in glass bottles without inert atmosphere at room temperature without exposure to sunlight. Specifically, the WCO samples were stored in conventional (not air-tight) bottles, while white diesel samples were stored both in conventional and air-tight bottles prohibiting direct contact with air. As WCO is collected from restaurants, tavernas, homes in conventional

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