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DESULFURIZATION OF PYROLYSIS FUEL PRODUCED FROM WASTE LUBE OILS, TYRES AND PLASTICS

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DESULFURIZATION OF PYROLYSIS GASOIL OBTANIED FROM WASTE LUBE OILS, TYRES AND PLASTICS

1. Purpose

Sulphur compounds remaining in petroleum fractions from topping, hydroskimming or deep conversion processes are a growing concern for oil refiners since in the lapse of a few years the sulphur specification for motor fuels has dropped from 500 mg/kg to 10 mg/kg in most European countries. This increasingly stringent regulation has forced refineries to greatly improve their hydrodesulfurization units, increasing the desulfurization rates and thus consuming huge amounts of hydrogen.

In recent years, the search for effective motor fuels from waste materials has experienced a great push, partly impelled by regulations that try to involve the life cycle of products and materials. One of the processes which has received more attention is the pyrolysis of waste materials to produce diesel or heating fuels, such as waste lube oils, waste tyres and waste plastics. However in all three cases, especially in the first two ones, the amounts of sulphur compounds in the fuels obtained by pyrolysis of these waste materials is even higher than in the fuels distilled from crude oil. The reason is that the waste tyres contain a great amount of sulphur coming from the vulcanization process, and the waste lube oils contain also a great amount of sulphur additives to improve the lubricity, and this sulphur ends up in the pyrolysis products as final compounds. Moreover, the companies carrying out pyrolysis processes do not usually have the facilities for hydrodesulfurization like the refineries and also lack of a secure supply of cheap hydrogen. This work is based in the development of a desulfurization process of waste pyrolysis products that could be carried out in small facilities with a moderate expenditure.

2. Design, Methodology or Approach

The selected desulfurization method is the oxidation of the sulphur compounds remaining in the pyrolysis fraction with hydrogen peroxide in an acidic medium of formic acid, and extraction of the most polar oxidized sulphur compounds with a polar solvent like methanol, followed by a topping of the final fuel by silica adsorption.

These methods, although not new in the literature [3-9], allow lowering the total amount of sulphur and sulphur compounds. The analytical methods used to follow the decrease in sulphur has been X-ray fluorescence spectroscopy (Oxford Lab-X3000, standard UNE EN ISO 20.847, ENAC accredited) for the total sulphur content and gas chromatography-flame photometric detector (a sulphur selective detector) for the sulphur compounds (Agilent 5890 Series II-FPD, standard ASTM D-5623).

3. Results/Findings

Figure 1 shows the selective chromatograms of sulphur compounds of a pyrolysis fuel from waste lube oil a) before and b) after the desulfurization process carried out in this work, the total amount of sulphur measured by XRF being indicated in the insert:

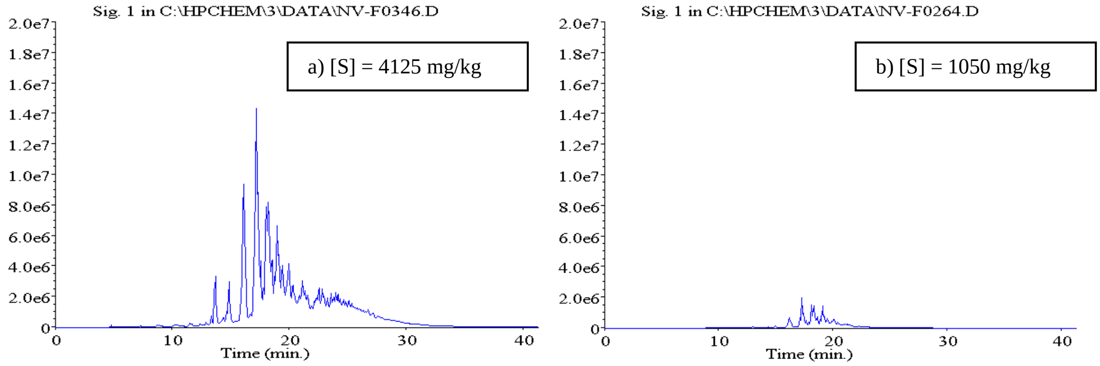

Figure 1

The typical desulfurization rate for a diesel fuel range fraction is around 67 %, reducing the amount of sulphur from around 4125 mg/kg to 1050 mg/kg, closer to the sulphur specification for heating fuel (sulphur less than 1000 mg/kg), but very far from the hydrodesulfurization rates of more than 99 % found in oil refineries.

4. Conclusions

The procedure described in this work could allow the pyrolysis fuels from waste materials to be blended with another waste origin material like animal fat biodiesel (between 35 and 49 mg/kg of sulphur) and to be sold as heating fuel.