Validation of HDO as bio-oil upgrading process

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Catalytic hydrotreatment is the most promising approach for biooil upgrading for biofuel application. Concepts based on hydrodeoxygenation (HDO) for bio-oil conditioning during hydrotreatment have been previously reported. These concepts aim to produce bio-oil as an alternative to conventional petroleum-derived chemical and liquid fuels compatible for blending with conventional ones. The evaluation of previous studies indicates that the main bottlenecks for commercial applications of bio-oil are the upgrading techniques. The oxygen removal is vital due to the complex composition of the feeding material. Although completely deoxygenated liquid is obtained, severe coking and catalysts deactivation generally reduce its industrial implementation. Hydro-processing removes oxygen as water by catalytic reaction with hydrogen. The process occurs downstream of the fast pyrolysis, and it needs high hydrogen pressure (about 20 MPa) and moderate temperature (up to 400ºC). Until now, most research has focused on optimizing reaction conditions and, specially, improving catalytic materials. Another possible approach is the introduction of catalysts in the pyrolysis process and/or using hydrogen instead of nitrogen in pyrolysis.

This study aimed to upgrade the bio-oil produced via hydrotreating, establishing the best operating conditions to improve the fuel properties of the bio-oil derived from the pyrolysis of agricultural and forestry wastes. The first step was the assessment of both the yield and bio-oil composition in terms of oxygenated and nitrogen compounds, viscosity, and heating value. Then, the bio-oil was upgraded by the hydrodeoxygenation process (HDO). This process was optimized, and different catalysts were tested. The process parameters that have the higher influence in the upgraded bio-oil yield and properties include temperature, hydrogen pressure, residence time, type and amount of catalyst used. So, operating parameters like temperature, pressure and solid loading of the different catalyst types were optimized. The upgraded product was compared with the bio-oil obtained by catalytic pyrolysis of biomass using hydrogen atmosphere.

The yield and characterization of both raw and upgraded bio-oils were assessed through elemental analysis, GC-MS, higher heating value, viscosity, density, boiling point, and total acid number.

The work performed intended to validate the HDO as an upgrading process for reaching adequate fuel qualities (and blends with conventional fuels).

This paper will analyse and compare the results obtained in both HDO and catalytic pyrolysis of biomass using hydrogen atmosphere.

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