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An efficient and convenient upgrading process for hydrothermal liquefaction of crude bio-oil to fuel-oil by activated red-mud (ARM)

Seong Jae Park, Masud Rana, Mohammad Nazrul Islam, Golam Taki, Shin Dong and **Jeong Hun Park**
Chonnam National University, Republic of South Korea

Improving the quality of bio-oil from hydrothermal liquefaction (HTL) process is very important in bio-refinery. Because, the produced bio-oil cannot be utilized as fuel-oil due to its deteriorated properties such as high viscosity, low stability, strong acidity and lower heating value. In this study, we selected red-mud (RM) and activated red-mud (ARM) to investigate their catalytic efficiency on upgrading of crude bio-oils produced from HTL process. Experiments were performed in a batch reactor at 350°C and bio-oils were analyzed by GC–MS (Gas Chromatography- Mass Spectrometry) and elemental analysis. The catalysts were characterized by BET (Brunauer-Emmett-Teller) and SEM (Scanning electron microscopy) analysis. The GC–MS results showed that crude bio-oil composition was altered to the upgraded bio-oil when ARM was used in the catalytic upgrading process. Hydrogen-carbon (H/C) ratios escalated from 0.08 to 0.19 % and higher heating values (HHVs) of bio- oils obtained from the crude bio-oil increased from 28.93 to 31.09 MJ/kg in the presence of 10 wt% calcined ARM catalyst. The results of upgraded crude bio-oil with ARM catalysts indicated that this catalyst favored the oxygen removal process (from 24.09 to 21.01%) and reduced the nitrogen content (from 0.15 to 0.08 %) in the upgraded bio-oil. Moreover, it is worth noting that the major components in the upgraded bio-oil were mostly aromatic compounds which might be ascribed to the further depolymerization of oligomers (derived from lignin) during upgrading process. From different results, it was also noticeable that, the light component proportion of ARM upgraded bio-oils was higher than that of bio-oils obtained with RM and without catalyst.

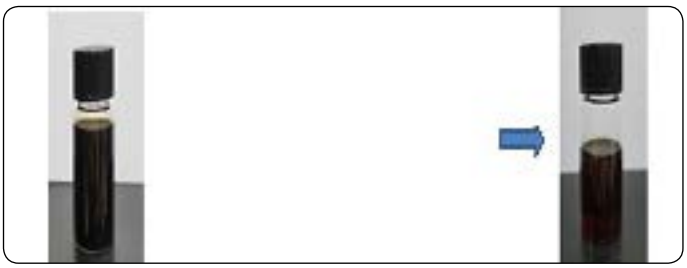

Figure 1: Upgrading of crude bio-oil with activated red mud (ARM).

Recent Publications:

1. Rajdeep S et al. (2018) Catalytic upgrading of bio-oil produced from hydrothermal liquefaction of *Nannochloropsis* sp. Bioresource Technology. 252:28-36. Doi: 10.1016/j.biortech.2017.12.067.
2. Shouyun C, Lin W, James J and Muhammad R (2017) Upgrading pyrolysis bio-oil through hydrodeoxygenation (HDO) using non- sulfide Fe-Co/SiO2 catalyst. Energy Conversion and Management. 150:331-342. Doi: 10.1016/j.enconman.2017.08.024.
3. Cheng S et al. (2017) Hydrodeoxygenation upgrading of pine sawdust bio-oil using zinc metal with zero valency. Journal of the Taiwan Institute of Chemical Engineers. 74:146-153. Doi:10.1016/j.jtice.2017.02.011.
4. Irwan K et al. (2017) *In-situ* catalytic upgrading of bio-oil derived from fast pyrolysis of lignin over high aluminum zeolites. Journal of the Energy Institute. 167:730-737. Doi: 10.1016/j.fuproc.2017.08.026.
5. Shouyun C et al. (2017) Upgrading pyrolysis bio-oil to hydrocarbon enriched biofuel over bifunctional Fe-Ni/HZSM-5 catalyst in supercritical methanol. Fuel Processing Technology. 167:117-126. Doi:10.1016/j.fuproc.2017.06.032.

Notes:

Biography

Seong Jae Park graduated from Chonnam National University, Republic of South Korea in the second half of 2015 and majored in Chemical Engineering. Before graduation, he studied the principle, characteristics and sensitivity mechanism of fluorescent pH sensor. He is interested in the field of environment. After graduation, he worked as a Research Assistant at the same university and entered the Graduate School of Environmental Energy Engineering in 2017. For the first time, he conducted a variety of studies on soil and red clay in the field of soil environment. Through this knowledge, we are actively studying the upgrading of lignin through the catalytic transformations using red-mud, activated red-mud and various other catalysts.

qkrtjdwo1234@naver.com

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