



Assessment of Hydrotreatment for Hydrothermal Liquefaction Biocrudes from Sewage Sludge, Microalgae, and Pine Feedstocks

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Results and Discussion

Bulk property measurement, simulated distillation, gas chromatography mass spectrometry (GC-MS), and ultrahigh resolution Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) are utilized for direct description and comparison of the chemical composition of raw and hydrotreated biocrude samples from pine, microalgae (*Chlorella* sp.), and sewage sludge. With hydrotreatment, the nitrogen, oxygen, and sulfur content as well as viscosity, density and moisture content of all biocrudes decreased to yield a more desirable product. For upgraded biocrudes, simulated distillation and GC-MS data reveal that the microalgae and sewage sludge products are comprised of a high proportion of n-alkanes which distill between 260°C and 350°C whereas the pine hydrotreated biocrude product has a lower concentration of n-alkanes and is more compositionally diverse with an abundance of saturated cyclic compounds. FT-ICR MS analysis of the raw biocrudes showed predominantly O_x species whereas raw microalgae and sewage sludge biocrudes are comprised of primarily N_xO_y species. After hydrotreatment, FT-ICR mass spectra of all three biocrudes revealed a significant reduction in mass spectral complexity (observed as the loss of O_x , N_x , and N_xO_y species) and the formation of hydrocarbon compounds, as expected. The hydrodeoxygenation and hydrodenitrogenation reactions of hydrotreatment convert higher (>2) heteroatom-containing species to a variety of hydrocarbon and lower heteroatom-containing species.

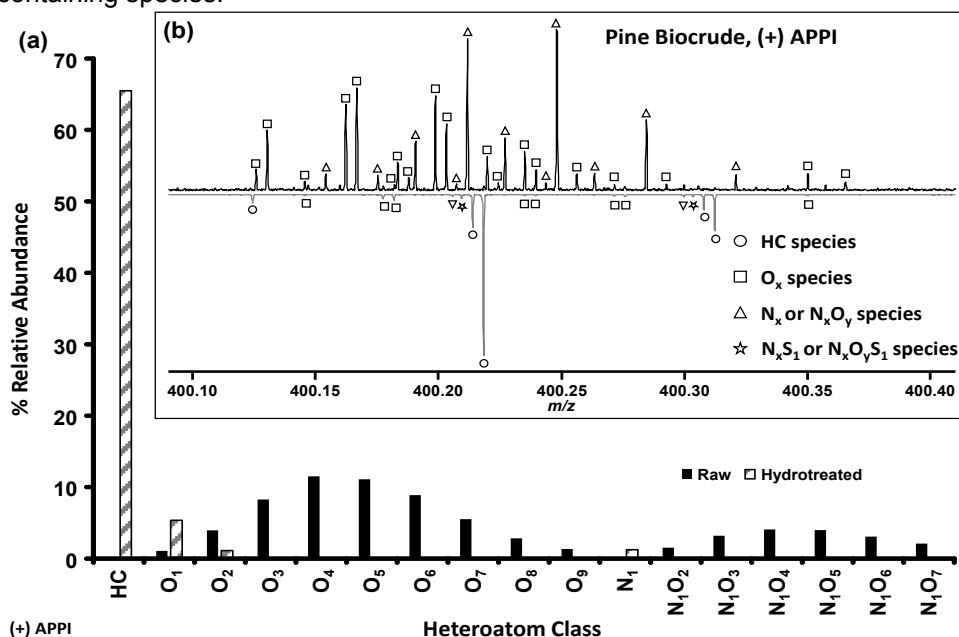


Fig.1 a) Heteroatom class distributions derived from the (+) APPI mass spectra of the raw (gray) and hydrotreated (blue) biocrude from pine feedstock. b) Zoom inset at m/z 400 within the raw (gray, top) and hydrotreated (blue, bottom) pine biocrude mass spectra.

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Reference

[1] Jarvis, J., *et al.* Energy & Fuels **32**, 8483-8493 (2018).