Characterization of Fast Pyrolysis Products Generated from Several Western USA Woody Species

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Results and Discussion

Woody biomass has the potential to be utilized at an alternative fuel source through its pyrolytic conversion. Here, fast pyrolysis bio-oils derived from several western USA woody species are characterized by negative-ion electrospray ionization Fourier transform ion cyclotron resonance mass spectrometry (ESI FT-ICR MS) to determine molecular-level composition. The composition and properties (pH, electrical conductivity, and elemental analyses) of the biochar byproduct were also determined. The bio-oils are comprised mainly of O_x species. Oak (*Quercus garryana* Douglas ex Hook), mixed conifer (*Pseudotsuga menziesii* Mirb. Franco, *Tsuga heterophylla* (Raf.) Sarg, *Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr.), and scotch broom (*Cytisus scoparius* (L.) Link) bio-oils contain lower O_x (O_1–O_7) species that exhibit bimodal distributions whereas mixed conifer feedstock from a fire salvage harvest contains a larger range of O_x species (O_2–O_{13}) that exhibit a mainly monomodal distribution. Boron-containing species in the pyrolysis oils were also identified for the first time by FT-ICR MS. Biochar analysis revealed that all biochars had similar pH values (~7−8); however, the electrical conductivity and elemental analyses varied across the samples. Understanding the composition of pyrolysis byproducts will help direct their uses to the most appropriate locations.

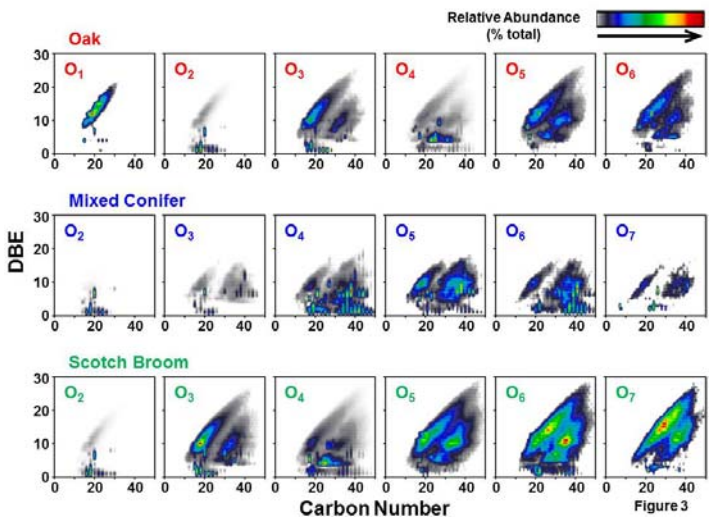

Figure 1. Isoabundance-contoured plots of double bond equivalents (DBE) versus carbon number for oak, mixed conifer, and scotch broom bio-oils for O_2 – O_7 classes derived from negative-ion electrospray ionization FT-ICR MS. The O_2 class in all bio-oils is dominated by C_{12}–C_{30} saturated fatty acids at DBE 1. The most abundant O_2 compounds in the oak and scotch broom bio-oils most likely correspond to the fatty acids palmitic and steric acid whereas the most abundant compounds in the mixed conifer bio-oil possibly correspond to resin acids at C_{20} and DBE 6−7 (abietic acid, dihydroabetic acid, and/or isomers). Mixed conifer bio-oil appears to consist of di-acids of low DBE and carbon numbers >30 in high abundance. O_x classes in all bio-oils have multimodal distributions when the oxygen number is >2. The multimodal distributions along with the similar slopes of all the O_x plots points to polymeric addition.

Acknowledgements

This work was supported by NSF Division of Materials Research (DMR-11-57490) and the State of Florida. Funding for biochar and bio-oil production was from ARRA grant #WFM-0615-02B.

References

[1] Jarvis, J.M. *et al.*, Energy Fuels, **28**, 6438-6446 (2014)