Waste to Bio-oils

With our growing population and its demands on available land, our ability to just throw out the trash might not be possible in the future. But what if we could turn that trash and other wastes into energy, or more specifically, bio-oil?

Researchers at ISTC investigated energy recovery from several wastes – including used coffee grounds, swine manure, and digested sludge – as well as algae. Hydrothermal liquefaction was used to convert the manure, sludge, and algae to bio-crude oil. The conversion rate ranged from about 9% (digested sludge) to 33% (algae). While all the oils exhibited similar energy potential, the composition of the oils varied dramatically and was based on the feedstock.

Additionally, spent coffee grounds were studied to produce biodiesel, bio-oil, and biochar. The spent coffee grounds were defatted and the lipids were converted to biodiesel. Although the pure biodiesel performed poorly – displaying high viscosity, moisture, sulfur, and poor oxidative stability – biodiesel blends performed the same as the certified standard.

Slow pyrolysis of defatted coffee grounds generated bio-oil and biochar as valuable co-products. The bio-oil was analyzed for a variety of properties including elemental and functional group composition, compound identification, and molecular weight and boiling point distributions. Because the feedstock was defatted prior to pyrolysis, bio-oil yields, energy density, and aliphatic functionality were reduced, but the number of low-boiling oxygenates were increased. This bio-oil will likely require upgrading because of the high heteroatom (ringed atoms other than carbon) content. The biochars derived from spent and defatted grounds both displayed similar surface area and elemental constituents. Application of these biochars with fertilizer more than doubled sorghum-sudangrass yields, indicating the potential of **biochar as a soil amendment**.

Waste Utilization

- **Advancing Use of Recycled Material in Asphalt**
- **Beneficial Use of Plastic Wastes**
- **Biochar**
- **Bio-oils and Biolubricants**
- **Approaches to the Comparison of Oil Extraction Methods for Algae**
- **Antioxidants from Wood-derived Pyrolyzates (Bio-oils)**
- **Oils and Antioxidants in Beans**
- **Complete Utilization of Coffee Grounds**
- **Chemical Properties of Biocrude Oil from the Hydrothermal Liquefaction of Spirulina Algae, Swine Manure, and Digested Anaerobic Sludge**
- **Gear Oil**
- **Heat-bodied Oils make Good Industrial Lubricants**
- **Milkweed Seed Fatty Acids**
- **Low Value Natural Oils to Biolubricants and Biofuels**
- **Predicting Products from Algae**
- **Upgrading Bio-crude Oils**
- **Waste to Bio-oils**
- **Novel Catalyst for Breaking Down Lignin**
- **Biobinders**
- **Clean Coal**
- **Liquid Rubber Modifier in Asphalt Binders**
- **Mud to Parks**
- **Nano-CarboScavengers**
- **Solar PV**
- **Read about older waste utilization projects**

Meet the Scientists

- **B.K. Sharma**
- **John Scott**

Publications

- **Chemical properties of biocrude oil from the hydrothermal liquefaction of Spirulina algae, swine manure, and digested anaerobic sludge**
- **Thermochemical conversion of raw and defatted algal biomass via hydrothermal liquefaction and slow pyrolysis**
- **Complete utilization of spent coffee grounds to produce biodiesel, bio-Oil, and biochar**

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