Biobinders

Besides fuels, petroleum is used in a wide variety of items including plastics, construction adhesives, asphalt, lubricants, chemicals, and waxes. With petroleum being a limited resource, researchers are interested in finding sustainable alternatives to petroleum for these products. Bio-oils from plant residue such as wood chips or cornstover as well as fast growing energy crops such as algae are an attractive alternative to petroleum.

ISTC researchers teamed up with researchers from the North Carolina A&T State University to study the properties of bio-asphalt derived from several different feed stocks. Like biofuels, bio-asphalt comes from bio-oil that is produced by the processes of pyrolysis (Pyr) of solid bio feedstocks (e.g., Miscanthus) or hydrothermal liquefaction (HTL) of liquid feedstocks (e.g., liquid manure or algae). The team tested the bio-oil produced from swine manure (HTL), Miscanthus (Pyr), cornstover (Pyr), and wood pellets (Pyr). They found that different feedstocks change the chemical and rheological (non-newtonian flow of liquids) properties of the bio-oil. The swine manure produced the highest amount of vacuum gas oil, which is the starting feedstock for petrochemicals such as asphalt. In addition, the swine manure bio-oil had the lowest amount of asphaltenes of the four feedstocks. Asphaltenes are fused poly aromatic rings that are highly susceptible to oxidation; oxidation causes degradation of the bio-oil. However, the swine manure bio-oil had average performance in shear strain compared to Miscanthus, which had the lowest stress buildup due to shear strain. Low stress buildup means that the bio-oil can take more shear strain before it fails. This property and resistance to deterioration are important properties for a bio-asphalt. Asphalt is the binder that holds rocks together to form pavement. The more resistant asphalt or bio-asphalt is to shear stress and weathering, the longer the road will last without forming cracks or potholes.

ISTC researchers and researchers at the University of Illinois (Departments of Civil & Environmental Engineering and Agricultural & Biological Engineering) tested the behavior of bio-binders as a partial replacement for traditional petroleum asphalt. Again they saw that the feedstock affected the quality of the asphalt/bio-binder mixture, although, a mixture of 8:1 (asphalt:biobinder) had similar structural components as traditional asphalt. However, biobinders are susceptible to moisture and lose all viscoelastic characteristics (the ability for a material to deform without breaking) after weathering and aging. The bio-binders properties show promise in applications such as recycled asphalt pavements or recycled asphalt shingles. But, more research on modifications to prevent rheological and chemical changes with aging in asphalt/bio-asphalt mixtures is needed before use in those applications.

Read about older waste utilization projects

Water Use and Reuse

Hazardous Waste Research Fund

Meet the Scientists

- B.K. Sharma

Publications

- Physiochemical characterization of synthetic biooils produced from bio-mass: a sustainable source for construction bio-adhesives
- Rheological and chemical characterization of biobinders from different biomass resources

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