Spray Atomization of Bio-Oil/Ethanol Blends with Externally Mixed Nozzle

Author(s)

Akwasi A. Boateng

Mark Schaffer

Peter L. Mtui

Iddi Mkilaha

Abstract

Experiments were conducted to investigate the properties of sprays of pyrolysis oil (bio-oil) blends with ethanol using an air assisted atomization nozzle operated without combustion. This was done in order to explore the potential for pyrolysis oil combustion in industrial and residential furnaces. The liquid samples investigated were bio-oil blends with ethanol (EtOH), neat ethanol and diesel. The bio-oil:EtOH blends were prepared in concentrations of 20:80 and 40:60vol%. Twin-fluid externally mixed nozzles SU2, SU4, and SU5 with liquid orifice areas of 0.40, 1.82 and 5.07mm2, respectively, were used in the spray experiments. The liquid and atomizing air flow rates as well as temperature were controlled to maintain constant liquid flow rates (cc/s) equivalent to 30 and 50kW energy input. Images of atomized spray droplets were measured to determine their size and velocity. Results show that it is possible to spray bio-oil/ethanol mixtures containing up to 40% bio-oil that has a low water content (12.60%). High viscosity and a tendency to coagulate were the main drawbacks; however, the 20:80 bio-oil:EtOH blend and neat ethanol in all three nozzles exhibited spray characteristics similar to that of diesel over