PYROLYSIS OF RESIDUES FROM WELL-ESTABLISHED BIOCHEMICAL PROCESSES FOR BIOMASS CONVERSION INTO LIQUID FUEL

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This project focuses on the pyrolysis of residues from well-established biochemical processes into liquid fuel. The residues examined come from two major conversion processes; wastewater treatment facilities, and biogas digesters. These processes produce low value, unconverted residues that are refractory to further biochemical conversion. Pyrolysis is an aggressive thermochemical conversion process that is ideally suited to such residues.

Currently, these residues are viewed as a low-value or waste products that must be disposed of. The environmentally friendly disposal of wastewater sludge is a common problem for many municipalities, where the sludge is often incinerated or disposed of in landfills. Anaerobic digestate can be used as a soil amendment but is often landfilled as waste. The key goal of this project is to find a solution to the disposal issues associated with these residues, while improving the overall process economics, through the production of high quality bio-oil and bio-char streams.

The optimal pyrolysis conditions were determined using two small-scale mechanically fluidized reactors (MFR) at the “Institute for Chemicals and Fuels from Alternative Resources” (ICFAR). The first MFR uses batch processing and slow pyrolysis conditions with heating rates of 10 ^{o}C per minute and high residence times. The second MFR operates continuously under fast pyrolysis conditions with the biomass being heated from ambient temperatures to reaction temperatures in less than 2 seconds. Pyrolysis temperatures from 350-600 ^{o}C will be examined for each of the feedstocks to determine optimal conditions. Both reactors utilize a fractional condensation system developed at ICFAR for the collection dry bio-oil, high acidity aqueous condensate, non-condensable gases, and solid biochar streams. Preliminary runs have shown that the heating value of the dry bio oil produced is more than double that of the raw feedstock.

The next step in this project is to scale up the pyrolysis process using the previously determined optimum conditions. This scale-up will be done using the Jumbo MFR developed at ICFAR. This reactor can process 60 kg/hr of feedstock to produce barrel quantities of pure bio-char and dry bio-oil. Data collected from these runs will be distributed to industrial partners so that they may perform analysis to see if pyrolysis of their residues is an economically and environmentally attractive option.

This project shows promising new opportunities in creating valuable resources from what is normally considered waste or extremely low-value residues.