ENVIRONMENT

Roving mobile processing plants to produce biofuels

Darren Quick | July 8th, 2010

The new method for processing agricultural waste and any available biomass into biofuels that could enable roving, mobile processing plants (Image: Rakesh Agrawal, Purdue University School of Chemical Engineering)

Biofuels are seen as a more environmentally friendly fuel source than petroleum-based fuels, but transporting the bulky biomass used to produce them is expensive because of their volume. It's much more economical to transport the liquid fuel after it has been processed but this isn't possible if the processing facilities are located far from the source of the biomass. A new method to process agricultural waste and other biomass could enable the creation of mobile processing plants that would rove the Midwest to produce fuels where the biomass is sourced.

"Material like corn stover and wood chips has low energy density," says Rakesh Agrawal, the Winthrop E. Stone Distinguished Professor of Chemical Engineering at Purdue University. "It makes more sense to process biomass into liquid fuel with a mobile platform and then take this fuel to a central refinery for further processing before using it in internal combustion engines."

The new method developed by chemical engineers at Purdue is called fast-hydropyrolysis-hydrodeoxygenation, which they have shortened to H2Bioil - pronounced H Two Bio Oil. It works by adding hydrogen into the biomass-processing reactor. The hydrogen for the mobile plants would be derived from natural gas or the biomass itself. However, its creators envision the future use of solar power to produce the hydrogen by splitting water, making the new technology entirely renewable.

Increasing the liquid-fuel yield

The researchers say their method would produce about twice as much biofuel as current technologies when hydrogen is derived from natural gas and 1.5 times the liquid fuel when hydrogen is derived from a portion of the biomass itself.

Biomass along with hydrogen will be fed into a high-pressure reactor and subjected to extremely fast heating, rising to as hot as 500 degrees Celsius, or more than 900 degrees Fahrenheit in less than a second. The hydrogen containing gas is to be produced by "reforming" natural gas, with the hot exhaust directly fed into the biomass reactor.

"The biomass will break down into smaller molecules in the presence of hot hydrogen and suitable catalysts," Agrawal said. "The reaction products will then be subsequently condensed into liquid oil for eventual use as fuel. The uncondensed light gases such as methane, carbon monoxide, hydrogen and carbon dioxide, are separated and recycled back to the biomass reactor and the reformer."

The researchers had previously invented an approach called a "hybrid hydrogen-carbon process," or H2CAR which followed the same general concept of combining biomass and carbon-free hydrogen to increase the fuel yield. Both H2CAR and H2Bioil use additional hydrogen to boost the liquid-fuel yield, but H2Bioil is more economical and mobile than H2CAR.

"It requires less hydrogen, making it more economical," he said. "It is also less capital intensive than conventional processes and can be built on a smaller scale, which is one of the prerequisites for the conversion of the low-energy density biomass to liquid fuel. So H2Bioil offers a solution for the interim time period, when crude oil prices might be higher but natural gas and biomass to supply hydrogen to the H2Bioil process might be economically competitive."

The Purdue University team's findings are detailed in a research paper appearing online in the journal *Environmental Science & Technology*.

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