Team converts wet biological waste to diesel-compatible fuel

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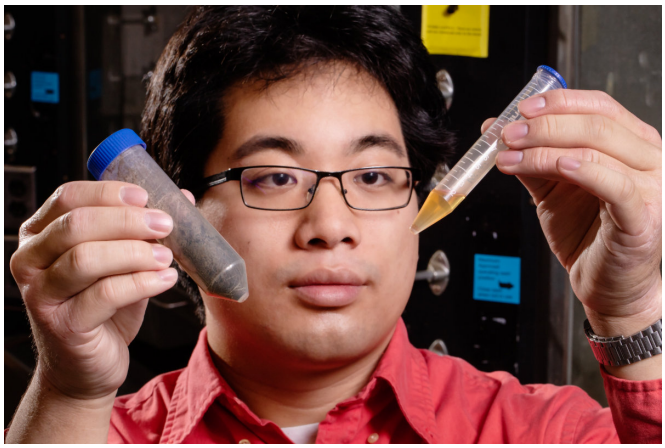

Mechanical science and engineering graduate student Timothy Lee holds a sample of waste and a sample of distillate the team derived from that waste. Credit: L. Brian Stauffer

In a step toward producing renewable engine fuels that are compatible with existing diesel fuel infrastructure, researchers report they can convert wet biowaste, such as swine manure and food scraps, into a fuel that can be blended with diesel and that shares diesel's combustion efficiency and emissions profile.

The researchers report the findings in the journal *Nature Sustainability*.

"The demonstration that fuels produced from wet waste can be used in engines is a huge step forward for the development of sustainable liquid fuels," said Brajendra K. Sharma, a research scientist with the Illinois Sustainable Technology Center at the University of Illinois' Prairie Research Institute and a co-author of the study. U. of I. agricultural and biological engineering professor Yuanhui Zhang led the research. His former graduate student Wan-Ting (Grace) Chen is the first author of the paper and a professor at the University of Massachusetts, Lowell. Mechanical science and engineering professor Chia-Fon Lee and graduate student Timothy Lee led the engine tests.

"The United States annually produces 79 million dry tons of wet biowaste from food processing and animal production," with more expected as urbanization increases, the researchers wrote. One of the biggest hurdles to extracting energy from this waste is its water content. Drying it requires almost as much energy as can be extracted from it.

Hydrothermal liquification is a potential solution to this problem because it uses water as the reaction medium and converts even nonlipid (nonfatty) biowaste components into biocrude oil that can be further processed into engine fuels, the researchers report.

Previous studies have stumbled in trying to distill the biocrude generated through HTL into stable, usable fuels, however. For the new research, the team combined distillation with a process called esterification to convert the most promising fractions of distilled biocrude into a liquid fuel that can be blended with diesel. The fuel meets current standards and specifications for diesel fuel.

"Our group developed pilot-scale HTL reactors to produce the biocrude oil for upgrading," Chen said. "We also were able to separate the distillable fractions from the biocrude oil. Using 10-20 percent upgraded distillates blended with diesel, we saw a 96-100 percent power output and similar pollutant emissions to regular diesel."

Led by Zhang, the team is building a pilot-scale reactor that can be mounted on a mobile trailer and "has the capacity to process one ton of biowaste and produce 30 gallons of biocrude oil per day," Zhang said. "This capacity will allow the team to conduct further research and provide key parameters for commercial-scale application."

More information: Wan-Ting Chen et al, Renewable diesel blendstocks produced by hydrothermal liquefaction of wet biowaste, *Nature Sustainability* (2018). DOI: 10.1038/s41893-018-0172-3

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