



Synthetic oils from municipal waste offers hope of alternative jet fuels

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That pizza box that was too cheesy to be recycled may still have a shot at a second life outside of a landfill—and in the fuel tank of your next flight.

In a process supported by the University of Dayton Research Institute, ASTM International has approved the use of a synthetic oil derived from municipal waste in the manufacture of jet fuel at petroleum refineries. The co-processing of "syncrude" with petroleum at the refinery level is the second new specification for jet fuel approved this spring by ASTM, which develops technical standards for product design and manufacturing across a number of industries.

UDRI, which coordinates testing and evaluation of all new alternative fuels through the Federal Aviation Administration sponsored "D4054 Clearinghouse," also supported the recent ASTM approval of a new algae-based biofuel developed in Japan. D4054 refers to the ASTM standard for the qualification and approval of alternative jet fuels and additives.

"Approval by ASTM effectively greenlights the use of the new fuels in commercial and military aviation, because it signals to the industry that they meet all testing criteria for certification as viable and safe products," said Steve Zabarnick, division head for fuels and combustion at UDRI.

For companies like Fulcrum BioEnergy of Pleasanton, California, ASTM approval is a critical step in bringing a new fuel product or manufacturing process to market. At its new Sierra BioFuels Plant—currently under construction outside of Reno, Nevada—Fulcrum plans to begin mass production of its alternative fuel feedstock later this year.

Billed as the "world's first garbage-to-jet-fuel plant," Sierra will process 175,000 tons of municipal solid waste each year to create 11 million gallons of synthetic crude oil, which will then be delivered to Marathon Petroleum for use in transportation fuels.

The Research Institute has supported the approval process of all seven alternative fuels now available for aviation, beginning with the first alternative fuel and petroleum blend approved by ASTM in 2009. Since 2015, UDRI has coordinated the testing and evaluation of new fuels through the Clearinghouse—including the algae fuel developed by IHI Corp. of Tokyo. IHI's was the first fuel approved under a new fast-track process, developed by UDRI, ASTM and the FAA, which expedites the approval of candidate fuels whose composition and properties are very similar to currently approved fuels, Zabarnick said.

D4054 Clearinghouse support comes from the FAA Center of Excellence for Alternative Jet Fuels and Environment, also known as the Aviation Sustainability Center (ASCENT), a multi-university research program.

"The Clearinghouse serves as a one-stop shop for fuel producers who want to introduce a new aviation fuel into the marketplace," Zabarnick said. "We work closely with them to guide them through the process, which involves testing and analysis of fuel samples for composition, material properties and performance, as well as for compatibility with engine components."

Zabarnick and his team perform most of the initial laboratory testing, and coordinate additional evaluations, such as full-scale engine testing, at external facilities as needed.

Once testing is completed, a technical report on the research results is sent to aircraft engine and airframe manufacturers, such as GE, Pratt & Whitney, Boeing and Airbus for evaluation. When the original equipment manufacturers are satisfied, the report on the candidate fuel is sent to ASTM for a vote on whether to approve the product for standardization, which defines the specifications for manufacture and use.

ASTM's technical committee on jet fuel comprises hundreds of volunteer experts representing oil and additive companies, airlines, engine and aircraft manufacturers, regulatory agencies, military, research and other organizations, all of whom have a vested interest in the quality and safety and of any new fuel product, Zabarnick said.

The newly revised ASTM specification for aviation fuel, which allows for up to five percent of a Fischer-Tropsch synthetic liquid to be co-processed with petroleum at the refinery, is important to Fulcrum and other companies involved in alternative fuels, said Bruno Miller, managing director of fuels and regulatory affairs at Fulcrum BioEnergy.

Fulcrum's process involves gasifying household trash—contaminated cardboard and paper, textiles and other carbon-rich waste that remains after metals and inert materials such as glass, dirt and rocks are removed. The resulting "syngas" is then processed by a Fischer-Tropsch reactor into a wax which looks very similar to petroleum, but contains none of the sulfur, metals or other contaminants that can be found in petroleum, Miller said.

"It's a very clean product with a number of environmental benefits," Miller said. "Fuels made from a blend of petroleum and synthetic crude are cleaner and will help transportation companies decarbonize. And our process will help mitigate landfill issues by making a useful product out of something normally buried in a hole in the ground."

Approval of this process is significant for the entire alternative fuel industry, and it was an industry-wide effort to pursue approval, Miller said.

"We led the effort, but many other organizations joined the ASTM task force for Fischer-Tropsch co-processing—including oil companies, biofuel producers, aircraft and engine manufacturers, the FAA and others who will benefit from the new standard," he added.

Interest in alternative fuels has never been greater, largely for the environmental benefits, said Zabarnick, whose team has performed research and development in alternative fuels since 2005.

"Alternative fuels are cleaner, and therefore cleaner burning, than fuels made only from petroleum, and six of the seven approved fuels are from renewable feedstocks, such as algae and plant-based biomass. Increasing the variety of approved alternative fuel feedstocks and manufacturing processes also strengthens national energy security by reducing our reliance on foreign-based petroleum fuel," Zabarnick added.

Miller credits UDRI's extensive expertise in the research and development of traditional and alternative fuels with a seamless approval process.

"Accuracy of testing data is critical for approval, and the Research Institute has developed an exceptional level of trust and respect within the fuels industry," he said. "They consistently perform the highest quality testing, and have developed a reputation for accuracy in evaluation and data reporting that is unquestioned."