Researchers convert farm waste to bio-oil

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Samy Sadaka reached into a garbage bag, picked up a mixture of cow manure and corn stalks, let it run through his fingers and invited a visitor to do the same... It wasn't that bad.

That mix of manure and corn stalks had spent 27 days breaking down in a special drying process. The end result looked like brown yard mulch with lots of thin fibers. There wasn't much smell. And it was dry to the touch.

"That's about 20 percent moisture," said Drew Simonsen, an Iowa State University sophomore from Quimby who's working on the research project led by Sadaka, an associate scientist for Iowa State's Center for Sustainable Environmental Technologies.

Other Iowa State researchers working on the project are Robert Burns, an associate professor of agricultural and biosystems engineering; Mark Hanna, an Extension agricultural engineer; Robert C. Brown, director of the Center for Sustainable Environmental Technologies and Bergles Professor in Thermal Science; and Hee-Kwon Ahn, a postdoctoral researcher for the department of agricultural and biosystems engineering.

The project is being supported by $190,000 in grants from the Iowa Biotechnology Byproducts Consortium.

The researchers are working to take wastes from Iowa farms -- manure and corn stalks -- and turn them into a bio-oil that could be used for

boiler fuel and perhaps transportation fuel.

"The way I see manure, it's not waste anymore," Sadaka said. "It is bio-oil."

But it takes a few steps to make that transformation.

First, the manure needs to be dried so it can be burned. Sadaka's idea for low-cost and low-odor drying is to mix the manure with corn stalks, put the mix in a big drum, use a small blower to keep the air circulating and use an auger to turn the mixture once a day. Within about five days, bacteria and fungi working to decompose the mix have naturally raised the temperature to about 150 degrees Fahrenheit. Within another 20 days or so the moisture content is down from 60 percent to about 20 percent. Sadaka calls the process bio-drying.

That makes it possible to move to the next step: rapidly heating the mixture in a bubbling, fluidized bed reactor that has no oxygen. It's a process called fast pyrolysis. The process thermochemically breaks the molecular bonds in the mixture. It produces charcoal that can be used to enrich soil. And it produces vapors that are condensed to a thick, dark bio-oil.

Preliminary tests indicate every kilogram of dried mixture produces .2 to .5 kilograms of bio-oil depending on the operating conditions.

Sadaka said the energy content of dry manure is 12 to 18 gigajoules per ton. Canada's Office of Energy Efficiency says one gigajoule of electricity will keep a 60-watt bulb continuously burning for six months. Sadaka figures if half the animal manure in the country were processed into bio-oil, that would produce the equivalent of 45 million tons of oil.

Sadaka is experimenting with the process in 900-liter drums at the Iowa

Energy Center's Biomass Energy Conversion Center in Nevada. So far, he has dried a mixture of cow manure and corn stalks. Next he'll test the process with poultry manure. And then he'll try pig manure.

This fall he'll work with Dave Struthers, a Story County farmer whose family runs a 1,000-sow, farrow-to-finish farm east of Collins, to try the bio-drying process on a farm.

Struthers said the farm's pigs live in hoop buildings and their manure is mixed with bedding material. That mixture is applied to the surface of crop ground as fertilizer.

He's working with Sadaka to convert some of the farm's manure into bio-oil because he supports alternatives to petroleum.

"And there may be more value in using manure as a fuel source than a fertilizer source," Struthers said.

Sadaka is convinced this process can help solve some of Iowa's challenges with agricultural wastes while producing renewable energy. "My goal," he said, "is to keep on demonstrating this for all the farmers around."

Source: Iowa State University