Nation

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Corncob tank could solve alternative fuel's biggest problem

BY ERIC HAND
St. Louis Post-Dispatch

ST. LOUIS - Peter Pfeifer wants to turn corncobs into the natural gas fuel tank of the future.

Pfeifer, a physicist at the University of Missouri at Columbia, bakes the cobs into a charred carbon that can hold 163 times its own volume of natural gas, much like a sponge holds water.

Early next month, engineers in Kansas City, Mo., will test the carbon tank in a natural gas-powered pickup. If it works, it will show automakers a way past the alternative fuel's biggest problem: It's hard to pack enough natural gas for long trips in the bulky high-pressure tanks currently used. Low-pressure carbon tanks could store natural gas in the unused nooks of a car.

With gasoline prices pushing $3 a gallon, alternative fuels are jostling for attention. Natural gas - clean, cheap, plentiful and domestically produced - is in the race. The story of Pfeifer's corncob carbon tanks shows how ideas that didn't make economic sense a decade ago now have traction.

"If this pans out, it could be revolutionary," said Sam Swearngin, the fleet manager for the city of Kansas City's 218 natural gas vehicles. "It could change the face of natural gas vehicles."

Last week, Swearngin pulled his Ford F-150 pickup alongside a filling station pump a few hundred yards from the spot by the Missouri River where Kansas City draws its water.

He snapped a yellow collar over the pickup's fuel injector, spun a valve and pushed a green start button. Instead of the glug of gasoline, out came the high-pressure hiss of natural gas. It poured in at 3,600 pounds per square inch.

In three minutes, he had filled his tank with the equivalent of eight gallons of gasoline - at only $1.40 per gallon.

"For the American public, it comes down to brass tacks: Is it cheaper? We may be getting there," he said.

Surging demand has kept ethanol and biodiesel prices as high as gasoline. At the moment, natural gas is the cheapest of them all. It burns far cleaner than gasoline.

There are geopolitical reasons for supporting natural gas, too. The United States produces 85 percent of the natural gas it burns, with Canada piping in most of the remainder. Domestic reserves can meet decades of demand.

And natural gas is potentially renewable: Engineers could harvest natural gas from decomposing trash in bioreactor landfills.

The problem for natural gas vehicles is storage. It takes 123 cubic feet of natural gas to match the energy of one gallon of gasoline.

Engineers have to stuff that volume of gas into high-pressure tanks. Swearngin has spent hundreds of thousands of dollars on high-pressure pumps.

Even with the bulky tanks, most of Swearngin's fleet is limited to a range of 200 miles - not enough to travel from Kansas City to St. Louis. That's not a problem for airport bus drivers or parking enforcers, who don't stray from home base.

But it tethers drivers who want to travel farther and who need natural gas filling stations, which are still few and far between.

That's where Pfeifer's work comes in.

To explain why his carbons are so special, he pulls out a piece of cauliflower. The vegetable buds repeat a whorling pattern.

"No matter how zoomed in or out you are, you still see the same pattern," he said. The patterns are

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called fractals. Ferns and clouds and lungs are also fractals.

Four years ago, Pfeifer discovered that the labyrinth of pore spaces in carbons was fractal. The fractal nature of the interconnected tunnels makes Pfeifer's carbons good at trapping gas and letting it flow in and out.

In a pressurized tank, molecules of natural gas still take up a lot of room. But the narrow tunnels in Pfeifer's carbons are over one nanometer wide, just the right size to pack in two natural gas molecules side by side.

And he only needs low pressures of 500 pounds per square inch to infuse the carbon with natural gas. At lower pressures, Pfeifer isn't limited to cigar-shaped tanks.

He envisions thin-walled tanks that could conform to unused spaces - for example, the space under a pickup's flatbed. The analogy would be airplanes, which take advantage of limited space by stuffing hollow wings with jet fuel.

Low pressures also mean cheaper pumps, because they can rely on cheaper hoses and gaskets and compressors. High-pressure pumps - even the home version that Honda sells for its natural gas-powered Civic - cost thousands of dollars.

Every square inch of Parag Shah's basement laboratory space is covered in carbon soot. Shah, a University of Missouri graduate student in chemical engineering, has tinkered with the carbon recipe, which starts with ground-up corncobs. Shah then marches the granular nuggets through a series of chemical baths and stints in the oven.

Others have tried to make carbons from olive pits or coconut shells. An Atlanta Gas Light project used peach pits to make working carbon tanks for a pickup - but that project died in the late 1990s, when gasoline cost half as much as it does today.

They also weren't able to store as much natural gas as Pfeifer, who says his knowledge of fractals will help him optimize the carbons.

Phil Buckley, an engineer on the project at the Midwest Research Institute in Kansas City, hopes the atmosphere for alternative fuel research is warmer today. "The situation in energy today is a lot different then it was nine or 10 months ago," he said.

In another basement room, a grimy fan blows to keep acidic gases from the lungs of Demetrius Taylor, an undergraduate student in physics and chemistry.

He pulls a lever on a hydraulic press that's packing Shah's charred bits into hockey pucks an inch thick. He grabs one of the finished pucks, lightweight and surprisingly sturdy given the holey network hidden within.

This week, Shah and Taylor plan to deliver 280 of the carbon pucks to the Midwest Research Institute.

Engineers there will stick them into aluminum cylinders attached to the bed of one of Swearngin's natural gas-powered pickups. All summer long, the pickup's engine will draw from the low-pressure carbon tanks rather than its high-pressure tank.

Pfeifer hopes the test will help him land a grant from the U.S. Department of Energy this summer. His current funding, from the National Science Foundation, will be exhausted soon.

Taylor realizes that, ultimately, they have to interest the automotive companies.

"Why isn't anyone kicking down our doors? We still have to prove ourselves," he said.