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Hydraulic hybrids: the answer for start-stop vehicles

By Cherry Sokoloski
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Everyone knows when it's trash pick-up day. The trash-hauling trucks make a big accelerating roar after each stop, and that's often accompanied by a belch of black smoke.

However, hydraulic hybrid technology could change all that - while helping the environment enormously. Czero, a Fort Collins company, is one of many firms working on hydraulic hybrid technology. The particular niche for Czero is making retrofit kits that can plug into existing vehicles.

Hydraulic hybrid technology is particularly useful for trucks that start and stop a lot, such as trash-hauling vehicles and city buses. That's because the hydraulic system captures energy when vehicles are slowing down and then gives the engine a boost when the vehicle starts moving forward again. As a result, the vehicle does not have to rely so much on braking, and that big engine acceleration isn't necessary,

either.

Czero's co-owner, engineer Guy Babbitt, is currently talking about his product with a local trash hauler, as well as Fort Collins city officials. They hope to put a demonstration project together in the near future.

A three-year-old company, Czero is focused on renewable energy and energy efficiency. The company has two divisions: products, such as the hydraulic hybrid retrofit kits; and engineering consulting with other automotive and renewable energy companies. The company is listed as inventor on several patents.

Fuel saver.
Guy Babbitt of Czero (right) explains hydraulic hybrid technology at the Sustainable Living Fair in September. In the first-generation prototype above, the long chamber is the accumulator, where energy is stored.
-- *Photo by Cherry Sokoloski*

"We're very much about saving energy," Babbitt said.

For saving fuel and reducing pollution, the hydraulic hybrids provide big advantages. Babbitt expects fuel savings of 20 to 30 percent for any vehicle using the technology, meaning 5,000 to 10,000 gallons each year per vehicle. That translates to "tens of tons of carbon dioxide saved," he said - for every vehicle using the system.

Of course, fuel savings like these also reduce dependence on foreign oil. Many researchers are working on hydraulic hybrid technology, including some who are putting the system into passenger vehicles. The military is also looking at possible applications.

How it works

Hydraulic hybrid technology has been around for many decades, but it becomes more attractive when fuel prices are high. The technology was looked at seriously during the '60s and '70s, and now interest is on the rise again.

The technology works on the principle of storing up energy from a vehicle that is slowing down, then releasing it as a boost to acceleration.

The energy comes from momentum. When a person takes his or her foot off the accelerator, a vehicle does not stop immediately, because momentum continues to carry it forward. This momentum is energy. In a hydraulic hybrid system, that energy is transferred to a special pump, which then uses it to pump hydraulic fluid and compress nitrogen gas in a chamber called an "accumulator."

The accumulator holds both nitrogen and hydraulic fluid, but hydraulic fluid cannot be compressed very much, while nitrogen can be.

The energy from the moving wheels causes the nitrogen to compress, so pressure builds up in the accumulator. It takes a lot of work on the part of the vehicle to compress the nitrogen, so this process slows the vehicle down.

Less braking is needed, and that's another savings - the brakes last much longer.

When the hybrid vehicle starts moving again, the pressure in the accumulator is released. The high-pressure hydraulic fluid now operates the pump as a hydraulic motor, and the energy is transferred back to the vehicle's wheels to help the vehicle move. Babbitt pointed out that the hybrid technology can recover about 75 percent of the energy typically wasted during braking.

In a nutshell, the hydraulic system helps the vehicle slow down, then helps it accelerate again. The process could be compared to a wind-up car or airplane. Winding up such a toy creates tension, or stored energy. When it's released, it drives the toy forward.

High-power hybrid

Babbitt noted that both electric and hydraulic hybrids are effective - but for different applications. Electric hybrids can store more energy, so they're better for long-distance use. Hydraulic hybrids are better for producing power, so they function best for acceleration. Hydraulic hybrids can save larger amounts of fuel than electrics, Babbitt noted, in vehicles that repeatedly stop and start.

Czero has one prototype truck up and running, a project that cost $30,000 and took six months to design. The company expects to have a second-generation retrofit ready later this fall. The improved model is a more compact system with a minimum of custom parts, so it's easier and less expensive to install.

Babbitt said that as development proceeds and volume increases, it should be possible to produce a hydraulic hybrid retrofit kit for parts costs of $7,000 to $10,000, which would allow for a two- to three-year payback period.

Czero has partnered with Colorado State University in developing its hydraulic hybrid technology, working closely with CSU's Engines and Energy Conversion Laboratory. The company has also received support from local and national industries.

"It's been a community effort making this happen," Babbitt said.

Web site by S. Virginia De Herdt, Freelance Writer
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