Hydraulic Hybrid Technology – A Proven Approach

Higher fuel efficiency. Lower emissions. Reduced operating costs. Better acceleration performance. These are just some of the advantages of the hydraulic hybrid drivetrain.

The U.S. Environmental Protection Agency (EPA) is developing this innovative technology to provide cost-effective, ultra-clean and ultra-efficient improvements for vehicles. With a hydraulic hybrid system, nearly all of the energy typically lost during vehicle braking is captured and used to propel the vehicle the next time it needs to accelerate.

EPA's goals for this technology are to:

- Achieve higher fuel economy
- Reduce vehicle emissions
- Save consumers money over time
- Maintain or improve vehicle acceleration performance
- Focus on cost-effective technology that can be commercialized and transferred to the private sector

The Development of EPA's Hydraulic Hybrid Technology

EPA's multi-year research program to develop hydraulic hybrid technology has produced a proof-of-concept test chassis that:

- Triples the fuel economy of conventional vehicles (80 miles per gallon (mpg) for a midsize family sedan that also incorporates improved tires and aerodynamics)
- Saves the consumer money (consumer payback [i.e., recouping the higher vehicle cost] within 1 to 3 years through fuel savings and less brake wear)
- Accelerates from 0 to 60 miles per hour (mph) in approximately 8 seconds
- Attains higher fuel efficiency without using expensive lightweight materials (test weight of chassis is 3800 lb) to facilitate commercialization

EPA's proof-of-concept test chassis demonstrating hydraulic hybrid technology.

The hydraulic system offers great advantages for vehicles operating in stop-and-go conditions because the system can capture large amounts of energy when the brakes are applied. This energy is subsequently used to propel the vehicle. Technical challenges with hydraulic hybrids include noise and packaging issues, but EPA is continuing to develop this technology to resolve these issues. With the success of its hydraulic hybrid chassis, EPA has begun to transfer the technology to the private sector. EPA is currently developing the hydraulic hybrid technology in urban delivery trucks and large sport utility vehicles (SUVs) and pickup trucks; other attractive applications include school buses, and waste disposal trucks.

Clean Automotive Technology…

Clean, efficient, cost-effective

Using Hydraulics in Urban Delivery Trucks

Urban delivery trucks are likely to be the first commercial application of the hydraulic hybrid technology. One of the options uses hydraulic "launch assist" or "power assist." A hydraulic package of a reversible hydraulic pump/motor and accumulators is added to the vehicle to optimize fuel economy, while keeping the vehicle's conventional engine and transmission. Benefits include:

EPA's F-550 fleet demonstration vehicle with hydraulic launch assist.

- 25 to 45 percent improvement in fuel economy for city driving
- Reduction of emissions by 20 to 30 percent (potentially up to 75 percent in certain cases)
- Better acceleration
- Less brake maintenance
- Reduced operating costs (consumer payback of 4 to 5 years for city driving)

EPA has modified a Ford F-550 delivery truck to demonstrate the technology of the hydraulic launch assist system. EPA also has begun work to demonstrate the application of a full series hydraulic hybrid in an urban delivery vehicle. A consumer payback of 1 to 3 years for city driving is expected.

The Next Generation of Large SUVs and Pickup Trucks

EPA's design for the large SUV or pickup truck replaces the conventional drivetrain with a hydraulic drivetrain. This configuration of the full hydraulic design reduces the cost of the vehicle because it eliminates the need for a transmission and transfer case. A large SUV or pickup truck equipped with a full hydraulic drive is projected to achieve benefits such as:

- 30-40 percent improvement in fuel economy for combined city/highway driving (percentage of improvement is much higher for city driving)
- Lower emissions
- Better acceleration
- Lower brake maintenance costs
- Reduced operating costs (consumer payback of the higher vehicle cost within 1 to 2 years for city/highway driving)

Showcasing the use of hydraulics in a Ford Expedition.

EPA has modified a Ford Expedition to demonstrate and further advance the full hydraulic system.

EPA also has developed clean diesel combustion technology, which incorporates an engine design that is simultaneously clean, efficient, and cost effective. Using this concept in conjunction with the full hydraulic drive is projected to improve the fuel economy of this vehicle by 85 percent (percentage is much higher for city driving).

In its efforts to advance and commercialize hydraulic hybrid technology, EPA has developed strategic partnerships with Ford Motor Company, Eaton Corporation, and Parker-Hannifin.

EPA420-F-04-024
March 2004