ovonic hydrogen systems

ovonic® hydrogen hybrid vehicles

These commercial hybrid-electric vehicles have been modified to operate on clean hydrogen fuel. The 1.5 liter internal combustion engine, electric drive motor, nickel metal hydride (NiMH) battery pack, and many other standard vehicle components were retained. Fuel-saving features include regenerative braking, engine shutoff at closed throttle, and capability for all-electric operation at low speed.

To match power and torque levels achieved by the production gasoline engine, a turbocharger with charge-air intercooler is incorporated. Engine air-fuel ratio and spark timing are calibrated and electronically controlled to minimize fuel consumption and NOx emissions.

An Ovonic® metal hydride storage system provides up to 3.6 kg of hydrogen storage capacity in two patented storage vessels enabling a driving range of nearly 200 miles. The Ovonic® Hydrogen Hybrid Vehicle satisfies California's SULEV / PZEV tailpipe emission standards. Additionally, hydrogen fueling eliminates 99% of tailpipe CO2, yielding a "near-zero" emission vehicle.

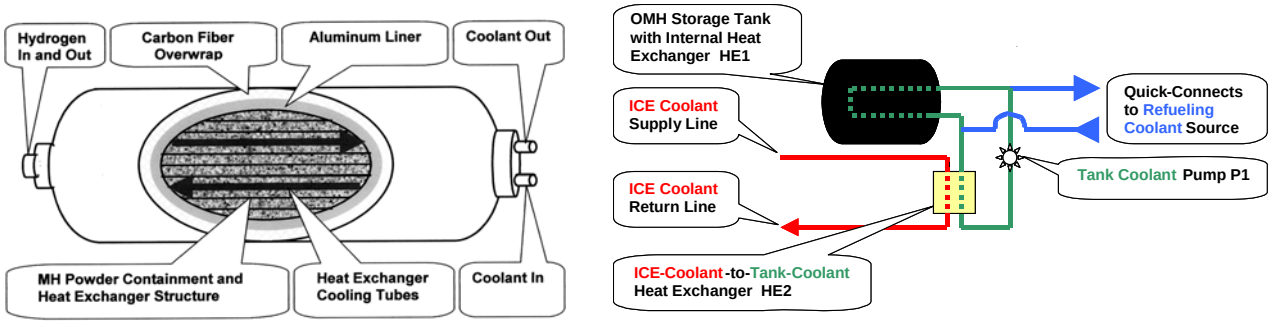
	HC (g/mi.)	CO (g/mi.)	NOx (g/mi.)	CO2 (g/mi.)	City fuel economy	Highway fuel economy
2005 Ovonic® Hydrogen Hybrid Vehicle	0.001	0.002	0.014	1.6	54-56 mi./kg	50-52 mi./kg
2005 Commercial (Gasoline) Hybrid baseline	0.004	0.386	0.004	176.5	52 mi./gal	48 mi./gal
SULEV / PZEV standard	0.010	1.0	0.020	na		

Employing conventional internal combustion engine technology, the Ovonic® Hydrogen Hybrid Vehicle achieves operational characteristics similar to those of a fuel cell vehicle, and establishes the viability of a near-term, economically attractive, alternative pathway to a hydrogen based economy.

Ovonic® Metal Hydride Storage System

In the patented* Ovonic® Solid Hydrogen Storage system, atomic hydrogen is chemically bonded to a proprietary host metal alloy that is contained in powder form within the storage tank. When gaseous hydrogen is introduced to the tank, it is chemically absorbed by the host metal, which is transformed into a metal hydride (MH) during this process. This transformation reaction is exothermic, meaning that heat is released during the absorption process. The process is self-regulating. Unless process heat is removed, absorption of hydrogen will automatically stop.

To permit fast refueling, the Ovonic® system incorporates a proprietary integral heat exchanger (HE1) capable of quickly removing this process heat. The heat exchanger also serves as a containment structure for the host metal powder. Cooling is provided by a network of stainless steel tubes within the tank. Liquid coolant from an external source is circulated through the tubes during refueling to remove heat released by the absorption process.



During vehicle operation, the chemical process is reversed. Gaseous hydrogen withdrawn from the tank to operate the engine or fuel cell must be replenished with hydrogen desorbed from the MH powder. The desorption process is endothermic (absorbs heat), causing the MH temperature to drop. Unless makeup heat is provided, the MH powder will cool to a point at which hydrogen desorption will stop. The integral heat exchanger (HE1) delivers the heat required to sustain the desorption process. A small electric pump (P1) circulates tank coolant through an external heat exchanger (HE2) where it is warmed by waste heat from the engine or fuel cell. The warmed tank coolant then flows through the tubes within the Ovonic® vessel, delivering the heat required to sustain hydrogen desorption.

Unlike high-pressure storage systems that require fueling pressures of over 6000 psi, the Ovonic® Solid Hydrogen Storage system is refueled at a pressure of only 1500 psi. Reduced fueling pressure enables savings in hydrogen compression costs, resulting in a lower delivered fuel cost. Shortly after refueling, vehicle operation causes pressure in the Ovonic® vessel to drop from 1500 to about 300 psi, where it remains until the next refueling. Lower onboard storage pressure enhances vehicle safety.

In the same physical space, the current Ovonic® system will store almost three times as much hydrogen as a 5000 psi tank. New alloys currently under development are expected to improve this advantage in the future.

*US patents 6,709,497, 6,820,706, 6,860,923, and 6,918,403

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