Plasmatron Fuel Converter

Onboard production of hydrogen fuel for improving internal combustion engine vehicles

ENERGY EFFICIENCY AND RENEWABLE ENERGY

OFFICE OF TRANSPORTATION TECHNOLOGIES

Transportation FOR THE 21ST CENTURY

Background

Engineers have long known that adding hydrogen to gasoline makes an engine run cleaner and more efficiently. However, finding a practical way to produce hydrogen onboard a vehicle had proved an elusive goal. In the mid-1990s, as a spin-off from the U.S. Department of Energy's (DOE's) fusion energy science program, scientists at the Massachusetts Institute of Technology (MIT) began looking at plasma technology as a possible solution to this problem. The available technology appeared promising if it could be miniaturized and transformed into the equivalent of a "super carburetor" device.

In 1997, DOE's Office of Transportation Technologies, Office of Heavy Vehicle Technologies, began funding MIT's unconventional plasmatron research in collaboration with Pacific Northwest National Laboratories. The resources of DOE's Oak Ridge National Laboratory were also made available to the project.

Today, MIT has a prototype plasmatron fuel converter that works as an onboard "oil refinery" to rapidly convert gasoline, diesel petroleum, and several types of biocrude fuels to hydrogen-rich gas. The Plasmatron received the 1999 *Discover Magazine* Award for Technological Innovation in Transportation in a competition that included the Toyota Prius hybrid vehicle.

The Technology

A special type of plasma electrical discharge boosts partial oxidation reactions between gasoline and air, producing hydrogen-rich gas. The plasma boosting facilitates the realization of a rapid-response, compact and robust fuel-converter device. The hydrogen-rich gas, produced by conversion of a fraction of the gasoline, is fed into the vehicle's gasoline engine where it promotes more efficient combustion. The fuel converter is about the size of a wine bottle and is compatible with advanced engine technology. It operates on less than 500 W of electricity.

This technology could provide a viable means for reducing emissions of greenhouse gases and urban air pollutants (such as nitrogen oxides) in the transportation sector. It will also help reduce the use of non-renewable, fossil-fuel energy resources. It is anticipated that these results could be achieved at a relatively low net cost, and without reducing vehicle range or sacrificing vehicle performance—all key factors in gaining widespread market acceptance.

MIT researchers are investigating the use of the hydrogen-rich gas in two additional areas—to significantly improve the performance of after-treatment catalysts for diesel exhaust emissions, and to make further improvements in the efficiency of hydrogen-enhanced, spark ignition engines.

Commercialization

In September 2001, ArvinMeritor—a premier $7-billion global supplier of a broad range of integrated systems, modules, and components for the motor vehicle industry—signed an exclusive technology license and development agreement with MIT. The agreement focuses on commercializing advanced emissions-after-treatment technologies and other systems for the automotive industry.

Benefits

- **Has the potential to increase gasoline engine efficiency by 20 to 25%**
- **Could potentially reduce U.S. oil imports by 1.5 million barrels per day**
- **Could reduce nitrogen oxide emissions from gasoline engines by up to 90%**
- **May reduce diesel engine exhaust emissions by 90%**
- **Requires modest engine modifications, but no major redesign of the vehicle**
- **Offers one of the few near-term, cost-effective solutions for significantly improving engine efficiency and reducing harmful vehicle emissions**

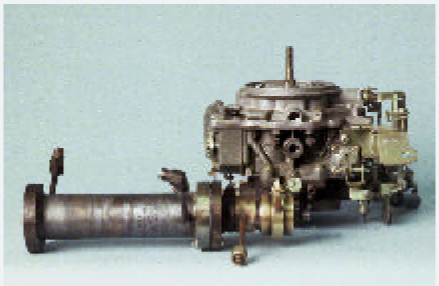

Photo courtesy of Massachusetts Institute of Technology

Plasmatron fuel converter compared to a carburetor (plasmatron in front)

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