



THE FUEL

Fuel Cell Today – Education Kit 4

Most types of fuel cells require hydrogen as a fuel source. A major issue, especially for automotive applications, is the way in which the hydrogen will be supplied to the cells. The long-term goal of fuel cell research is to produce a totally non-polluting power source. In order to achieve this, the fuel cell must run on a fuel generated by renewable means (see Education Kit 6). The technology and infrastructure to achieve this efficiently and cheaply is unlikely to be perfected for some years. In the meantime, fuel cells will be powered by hydrogen extracted from fossil fuels by reforming (see Education Kit 5).

	Diesel	Gasoline	Hydrogen (gaseous)	Hydrogen (liquid)	Methanol	Natural Gas
Safety Issues	Medium	Medium	Medium	High	High	Medium
Ease of Reforming	Very hard	Hard	None required	None required	Easy	Medium
Availability	Good	Very good	Poor	Very poor	Okay	Good
Infrastructure	Very good	Very good	Poor	Poor	Poor	Very good
Environmentally friendly	Low	Low	Very	Medium	Medium	Medium
Applications	Light and heavy vehicles, buses, trains	Light vehicles	Light vehicles, buses	Light vehicles, buses	Residential, portable applications	Residential, Stationary, vehicles

Hydrogen is the lightest chemical element and offers the best energy to weight ratio of any fuel. The major drawback to using hydrogen is that it has the lowest storage density of all fuels. It is possible to compress hydrogen and store it in containers onboard a vehicle that could be refilled with relative ease. The size and weight of the tanks needed to withstand the high pressures involved.

Buses running on liquefied hydrogen have also been designed. Liquid hydrogen has the highest storage density of all the methods discussed. However, the boiling point of hydrogen is -253°C so it needs to be contained in well-insulated tanks to halt evaporation.

The drawbacks to using compressed or liquefied hydrogen have led to a search for alternative storage methods. One idea is to trap hydrogen by forming metal hydride complexes. It is known that some metals can absorb many times their own weight in hydrogen when heated. Upon cooling the hydrogen becomes trapped as a metal hydride species. The hydrogen can then be liberated by reheating the structure. Unfortunately, these metal structures tend to be very heavy.

Carbon nanotubes are also being investigated as a hydrogen storage medium. These can be pictured as elongated fullerenes (or tubes) with open ends through which hydrogen can enter and become trapped. Another potential storage medium is glass microspheres. The hydrogen can permeate through the glass at high temperatures and remains trapped within the spheres once the temperature and pressure are lowered. Heating the glass then releases the trapped gas.