TECH TUESDAY

Tip of the Week

Exploring Alternative Fuels

Alternative fuels are derived from resources other than petroleum. Some are produced domestically, reducing our dependence on imported oil, and some are derived from renewable sources. Often, they produce less pollution than gasoline or diesel. Alternative fuels include gaseous fuels such as hydrogen, natural gas, and propane; alcohols such as ethanol, methanol, and butanol; vegetable and waste-derived oils; and electricity. These fuels may be used in a dedicated system that burns a single fuel, or in a mixed system with other fuels including traditional gasoline or diesel, such as in hybrid-electric or flexible fuel vehicles.

In this series we will be exploring four alternative fuels: Compressed Natural Gas (CNG), Liquified Natural Gas (LNG), Liquified Petroleum Gas or Propane (LPG) and Hydrogen (H2).

What's the difference between CNG, LNG, LPG and Hydrogen?

The following is a brief summary highlighting the main differences of these fuels. Much more comprehensive details of the fuel properties and compositions is will be discussed in the coming weeks of Tech Tuesday.

Compressed Natural Gas or CNG Natural gas consists mostly of methane and is drawn from gas wells or in conjunction with crude oil production. As delivered through the pipeline system, it also contains hydrocarbons such as ethane and propane as well as other gases such as nitrogen, helium, carbon dioxide, sulfur compounds, and water vapor. A sculpture-based odorant is normally added to CNG to facilitate leak detection. Natural gas is lighter than air and thus will normally dissipate in the case of a leak, giving it a significant safety advantage over gasoline or LPG. CNG is stored on the vehicle in high-pressure tanks - 20 to 25 MPa (200 to 250 bar, or 3,000 to 3,600 psi).

Liquefied Natural Gas or LNG LNG is natural gas stored as a super-cooled (cryogenic) liquid. The temperature required to condense natural gas depends on its precise composition, but it is typically between -120 and -170°C (-184 and –274°F). The advantage of LNG is that it offers an energy density comparable to petrol and diesel fuels, extending range and reducing refueling frequency. The disadvantage, however, is the high cost of cryogenic storage on vehicles and the major infrastructure requirement of LNG dispensing stations, production plants and transportation facilities.

LNG has begun to find its place in heavy-duty applications in places like the US, Japan, the UK and some countries in Europe. For many developing nations, this is currently not a practical option.

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Liquefied Petroleum Gas or LPG (also called Auto gas) consists mainly of propane, propylene, butane, and butylene in various mixtures. It is produced as a by-product of natural gas processing and petroleum refining. The components of LPG are gases at normal temperatures and pressures. One challenge with LPG is that it can vary widely in composition, leading to variable engine performance and cold starting performance. At normal temperatures and pressures, LPG will evaporate. Because of this, LPG is stored in pressurized steel bottles. Unlike natural gas, LPG is heavier than air, and thus will flow along floors and tend to settle in low spots, such as basements. Such accumulations can cause explosion hazards, and are the reason that LPG fuelled vehicles are prohibited from indoor parking garages in many jurisdictions.

Hydrogen or H2 gas is highly flammable and will burn at concentrations as low as 4% H2 in air. For automotive applications, hydrogen is generally used in two forms: internal combustion or fuel cell conversion. In combustion, it is essentially burned as conventional gaseous fuels are, whereas a fuel cell uses the hydrogen to generate electricity that in turn is used to power electric motors on the vehicle. Hydrogen gas must be produced and is therefore is an energy storage medium, not an energy source. The energy used to produce it usually comes from a more conventional source. Hydrogen holds the promise of very low vehicle emissions and flexible energy storage; however, many believe the technical challenges required to realize these benefits may delay hydrogen's widespread implementation for several decades.

Hydrogen can be obtained through various thermochemical methods utilizing methane (natural gas), coal, liquefied petroleum gas, or biomass (biomass gasification), from electrolysis of water, or by a process called thermolysis. Each of these methods poses its own challenges.

Be sure to login next week, when we will start breaking down each of these Alternative Fuels individually. We will start next week's Tech Tuesday off with Compressed Natural Gas and it's applications.

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