Influence of energetics and ecologics parameters in internal combustion engines using hydrogen as an alternative fuel

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1. Advatages of alternative fuels used on internal combustion engines

The Increasing problems of urban air quality and global warming have brought about a need to consider alternative fuels and Cosworth Technology has valuable experience in this area. The regulated emissions from vehicles, which affect urban air quality, are hydrocarbons (HCs), oxides of nitrogen (NOX), carbon monoxide (CO) and, in the case of diesels, particulate matter (PM). Carbon dioxide (CO2) emissions, though not regulated, do contribute to global warming. Measuring CO2 emission levels is the best way to quantify the effect of vehicle fuel consumption on the environment, when considering fuels of such widely varying energy density and chemical composition.Alternative fuels offer significant reductions in all these emissions. In addition, when running on alternative fuels, engines are quieter than an equivalent diesel engine.

Alternative fuels for internal combustion engines:

- liquid petroleum gas (LPG)
- compressed natural gas (CNG)
- liquefied natural gas (LNG)
- rapeseed methyl ester (RME)
- methanol - usually blended with 15% gasoline (M85)
- ethanol - usually blended with 15% gasoline (E85)
- hydrogen
- di-methyl ether (DME)

1.1. Liquid Petroleum Gas (LPG)

- Liquid Petroleum Gas is a mixture of (30-100%) propane and the balance butane.
- It is stored in pressure vessels at 7 bar depending on ambient temperature.
- The fuel offers significant HC and CO emissions benefits and up to 13% reduction in CO2, compared with gasoline.
- The fuel has 80% of the energy density of gasoline and so requires a slightly larger fuel tank to achieve the same range.

A gasoline engine can run on LPG with only minor mechanical changes - usually restricted to the valve seat insert material.

1.2. Compressed Natural Gas (CNG)

- Compressed natural gas, which is mainly methane, is stored in pressure vessels at either 200 or 250bar.
- When stored at 250bar, it still only has 32% of the energy density of gasoline. The fuel tanks are therefore quite bulky and heavy, due to the pressure they have to withstand.

the combustion of gasoline and other fossil fuels. These benefits are explained in more detail below.

2.1. Reduce Greenhouse Gas Emissions

Greenhouse gases are thought to be responsible for changes in global climate. They trap excess heat from the sun's infrared radiation that would otherwise escape into space, much like a greenhouse is used to trap heat. When we drive our cars, and light, heat, and cool our homes, we generate greenhouse gases. But if we used hydrogen in very high efficiency fuel cells for our transportation and to generate power, we could significantly reduce the GHG emissions - especially if the hydrogen is produced using renewable resources, nuclear power, or clean fossil technologies.

2.2. Reduce Air Pollution

The combustion of fossil fuels by electric power plants, vehicles, and other sources is responsible for most of the smog and harmful particulates in the air. Fuel cells powered by pure hydrogen emit no harmful pollutants. Fuel cells that use a reformer to convert fuels such as natural gas, methanol, or gasoline to hydrogen do emit small amounts of air pollutants such as carbon monoxide (CO), although it is much less than the amount produced by the combustion of fossil fuels.

2.3. Improve Energy Efficiency

Fuel cells are significantly more energy efficient than combustion-based power generation technologies. A conventional combustion-based power plant typically generates electricity at efficiencies of 33 to 35 percent, while fuel cell plants can generate electricity at efficiencies of up to 60 percent. When fuel cells are used to generate electricity and heat (co-generation), they can reach efficiencies of up to 85 percent. Internal-combustion engines in today's automobiles convert less than 30 percent of the energy in gasoline into power that moves the vehicle. Vehicles using electric motors powered by hydrogen fuel cells are much more energy efficient, utilizing 40-60 percent of the fuel's energy. Even Fuel Cell Vehicles that reform hydrogen from gasoline can use about 40 percent of the energy in the fuel.

3. Hydrogen used as bi-fuel for internal combustion engines

First of all, a vehicle need not be restricted to a single fuel. If a vehicle is to be used in an area where an alternative fuel is not readily available, the ability to run on gasoline or diesel as well as some alternative fuel is a safety net against getting stranded without enough fuel to drive to the nearest alternative-fuel refuelling station. Vehicles that run on an alternative fuel without the ability to run on gasoline, are referred to as *dedicated* alternative-fuel vehicles; in that sense, most cars and trucks are "dedicated" gasoline or diesel vehicles.

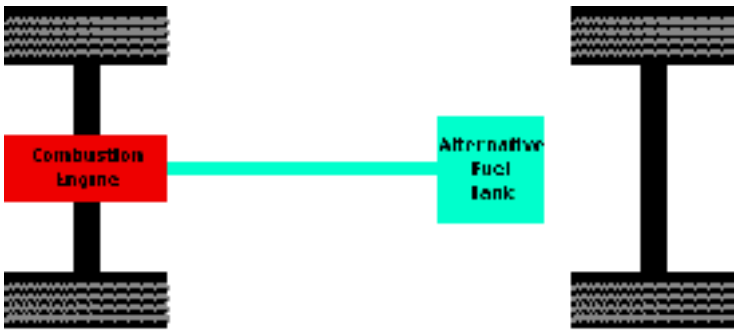

Fig. 3.1. Alternative fuel tank