

Automotive materials & Sustainability ACHA 6012

1.) Hydrogen is a possible alternative fuel that inherently has reduced emissions compared to traditional fuels. This is due to the lack of carbon within the fuel. This means when burnt with oxygen, the only emissions would be water (H_2O).

However the chemical make up of Air is not just pure oxygen. Amongst other gases, air contains nitrogen which when burnt at a high enough temperature can produce NO_x . This is a harmful emission that is regulated by the Euro emissions standards.

To ensure Hydrogen produces low ~~or~~ ^{or} zero NO_x emissions, the combustion temperatures would have to be regulated. This can be done with current systems such as ~~ex~~ exhaust gas recirculation. This re-introduces a portion of non-combustible exhaust gas back in to the fuel to reduce the possible temperature.

Impact and practicalities

Hydrogen is not currently widely used meaning that there are very few places to buy the fuel. This causes impracticality for the user as they would have to plan their life around when and where they would need to fill up. For the wide spread success of Hydrogen to be achieved, a drastic overhaul of infrastructure is required. Without nation wide filling stations, it is unlikely the public will adopt this fuel.

1) Hydrogen can not be used in any vehicle apart from those specifically designed for it. This is due to the ~~high~~ difference in storage requirements. Hydrogen needs to be stored in pressurised tanks and would simply evaporate in a standard petrol tank.

The engine of the vehicle is also required to be designed differently due to the higher calorific value of Hydrogen. This is approximately 3 times higher than that of petrol or diesel. If run in a standard engine it could cause serious damage.

All this means the user of the car would be restricted to only use Hydrogen. This is a massive inconvenience with the current lack of infrastructure.

E85

using E85 Fuel with a flex fuel car has the potential to reduce the green house gasses produced by 50%. E85 is a fuel ~~and~~ made up of 85% ethanol. This fuel produces less emissions due to the lack of harmful additives that are found in standard gasoline. This discovery was made by the American Coalition for Ethanol.

Practicalities

while ethanol can be burnt in standard petrol engines, the control systems and fuel ~~system~~ system are required to be adapted to an ethanol safe, flex fuel system. for new cars this is often included in the manufacture of the car.

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Practicalities of E85

Ethanol requires more fuel to reach its optimum fuel to Air ratio. This means cars running ethanol use more fuel per mile than petrol. This means increased ~~the~~ running costs for the user. This makes E85 less appealing to the public.

Like Hydrogen, there are limited locations that offer E85 at the pump. For wide spread use of the fuel this would have to increase.

However, a flex fuel car is not limited to only using E85. meaning that if the fuel is not available the car can still drive on petrol.

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Q2

a Ionic bonds donate an electron from its outer shell to another atom.

covalent share the electrons in its outer shell equally between the atoms.
these are always non metals atoms

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Q4)

a) i. 7000 series aluminium uses Zink as its main alloying element. This series of alloys is known as the strongest Aluminium alloys. This is due to the increased shear strength of this Alloy.

ii. The first number indicates the main alloying element, for this example the "1" means it is a carbon steel. The 3rd and 4th numbers indicate the amount of carbon in hundredths of a percent by weight.

04)

B) The three types of composite are

- Polymer matrix composite (PMCs)
 - metal matrix composite (MMCs)
 - Ceramic matrix composite (CMCs)
- Polymer composites use continuous fibres set in a polymer matrix. the fibres are used to distribute load through out the matrix. the orientation of the ~~matrix~~ the fibres can be used to gain strength or flexibility in different areas. these are generally light weight, stiff and corrosion resistant.
- metal composites are usually made up of aluminium to give it strength. carbon, silicon or ceramic fibres are embedded in the metallic matrix of the material. these have increased specific strength, specific stiffness and elevated temperature strength.
- ceramic composites consist of ceramic or carbon fibres immersed in a ceramic matrix. these are generally more temperature resistant.

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$$\sigma = 30 \text{ MPa}$$

$$v_f = 0.45 \text{ \textit{45\%}}$$

$$E_f = 65 \text{ GPa}$$

$$E_m = 3.2 \text{ GPa}$$

$$A = 300 \text{ mm}^2$$

$$E_{cl} = ((65 \times 10^9) \times 0.45) + ((3.2 \times 10^9) \times 0.55) = 31.016 \text{ GPa}$$

$$\frac{F_f}{F_m} = \frac{((65 \times 10^9) \times 0.45)}{((3.2 \times 10^9) \times 0.55)} = 16.61 \text{ Fm}$$

$$F_c = (30 \times 10^6) \times (300 \times 10^{-6}) = 9000 \text{ N}$$

$$\text{if } F = 16.61 F_m + F_m \rightarrow F_c = 17.61 F_m$$

$$F_m = \frac{9000}{17.61} = 511.07 \text{ N}$$

$$F_f = 16.61 F_m = 16.61 \times 511.07 \text{ N} = 8488.87$$

$$\text{Force matrix} = 511.07 \text{ N}$$

$$\text{Force Fibre} = 8488.87 \text{ N}$$