DIHYDROGEN AS A FUEL

Dihydrogen, which is another term for molecular hydrogen (H_2), is a highly reactive gas known for its ability to release substantial amounts of heat when it undergoes combustion. In the study of energy release from various fuels, including dihydrogen, methane, and LPG (liquefied petroleum gas), it is customary to compare the data based on consistent units such as moles, mass, and volume. This comparison allows for a better understanding of the energy content and efficiency of different fuels.

Here's a more detailed breakdown

Dihydrogen Combustion: When dihydrogen (H_2) is burned, it reacts with oxygen (O_2) to produce water (H_2O) and releases a significant amount of heat in the process. This heat release is harnessed and used for various applications, including electricity generation and as a source of energy in fuel cells.

Comparing Energy Data

To evaluate and compare the energy content of different fuels, it is essential to standardize the measurements. This standardization involves looking at the energy released in the combustion of equal amounts of substance in terms of moles, mass, and volume.

In Moles

By comparing the energy release per mole of the respective fuel, it provides a direct measure of the energy content at the molecular level. This is particularly useful in understanding the chemical properties of the fuel.

In Mass

Expressing the energy content in terms of mass, typically grams, helps assess the practical energy yield of a given quantity of fuel. This is important for real-world applications where fuel is often measured by weight.

In Volume

Comparing energy data based on volume is useful when dealing with gases like dihydrogen, as gases are often stored and transported in containers with known volumes, such as tanks or cylinders.

Energy Efficiency and Applications

The comparison of energy data in these various units allows for the assessment of the energy efficiency of different fuels and their suitability for specific applications.

For example, hydrogen is often used as a fuel in fuel cells where the energy content per mole and mass is a critical factor. On the other hand, methane and LPG are commonly used for heating and cooking applications where the energy content per volume may be more relevant.

In summary, dihydrogen is known for its high energy content, and when comparing its energy data with other fuels like methane and LPG, it's essential to standardize the measurements to gain insights into its performance and applications. This standardization involves considering energy release in terms of moles, mass, and volume, which helps evaluate the suitability of different fuels for various purposes. are shown in Table

The Energy Released by Combustion of Various Fuels in Moles, Mass and Volume

Energy released on combustion in kJ state	Dihydrogen (in gaseous state)	Dihydrogen (in liquid)	LPG	CH_4gas	Octane (in liquid state)
per mole	286	285	2220	880	5511

per gram	143	142	50	53	47
per liter	12	9968	25590	35	34005

The data provided in the table clearly demonstrates that, when comparing equal masses, dihydrogen has the potential to release considerably more energy than petrol, approximately three times as much. Additionally, the combustion of dihydrogen produces fewer pollutants compared to petrol. In dihydrogen combustion, the primary pollutants are the nitrogen oxides, attributed to the presence of trace amounts of dinitrogen impurities in dihydrogen.

To mitigate this, a practical approach is to inject a small quantity of water into the combustion chamber, thereby lowering the temperature and preventing the reaction between dinitrogen and dioxygen. However, it's important to consider the weight of the containers used to store dihydrogen. A cylinder filled with compressed dihydrogen weighs approximately 30 times more than a tank of petrol containing an equivalent amount of energy.

Moreover, transforming dihydrogen gas into a liquid state necessitates costly, well-insulated tanks, as this transition occurs at extremely low temperatures around 20 Kelvin. For storing dihydrogen in smaller quantities, tanks made from specific metal alloys like $NaNi_5$, $Ti–TiH_2$, and $Mg–MgH_2$ are commonly used.

These inherent limitations have prompted researchers to explore alternative methods for efficiently harnessing dihydrogen. One such alternative is the concept of a "Hydrogen Economy." The fundamental idea behind the Hydrogen Economy is to store and transport energy in the form of either gaseous or liquid dihydrogen. An advantage of the Hydrogen Economy is that it transmits energy as dihydrogen rather than as electric power.

An interesting development occurred in India in October 2005, with the launch of a pilot project that used dihydrogen as a fuel for automobiles. Initially, a blend of 5% dihydrogen with Compressed Natural Gas (CNG) was introduced for use in four-wheeler vehicles. The plan is to incrementally increase the dihydrogen content to reach an optimal level.

Presently, dihydrogen is also employed in fuel cells for electricity generation. It is anticipated that in the coming years, economically viable and secure sources of dihydrogen will be identified, making it a common and dependable source of energy.