International Journal of Education, Social Science & Humanities.
Finland Academic Research Science Publishers
ISSN: 2945-4492 (online) | (SJIF) = 7.502 Impact factor
Volume-11| Issue-8| 2023 Published: |22-08-2023|

HYDROGEN ENERGY

https://doi.org/10.5281/zenodo.8382641

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Abstract

this article is written about Hydrogen, the quality of hydrogen fuel with pure oxygen, not to be confused with atmospheric gases, being a carbon fuel, carbon dioxide emissions, etc.

Keywords

Hydrogen, fuel, energy, liquid, temperature, pressure, metal, odorless, tasteless, colorless, molecular formula, gas, carbon.

Introduction

Hydrogen is a clean fuel. It is an energy carrier that can be used for a broad range of applications. Also it could serve as a possible substitute to liquid and fossil fuels. Its physical properties could be stated as following. At standard temperature and pressure, hydrogen is a nontoxic, nonmetallic, odorless, tasteless, colorless, and highly combustible diatomic gas with the molecular formula H2. Hydrogen fuel refers to hydrogen which is burned as fuel with pure oxygen (not to be confused with atmospheric gases). It can be a zero-carbon fuel, provided that it is created in a process that does not involve carbon. However, most hydrogen comes from fossil fuels, resulting in carbon dioxide emissions.[1]

Occurrence and storage

Speaking of its natural occurrence, it is the most abundant element in the universe. The sun and other stars are composed largely of hydrogen. Astronomers estimate that 90% of the atoms in the universe are hydrogen atoms. Hydrogen is a component of more compounds than any other element. Water is the most abundant compound of hydrogen found on earth.

Molecular hydrogen is not available on Earth in convenient natural reservoirs. Most hydrogen on Earth is bonded to oxygen in water and to carbon in live or dead and/or fossilized biomass. It can be created by splitting water into hydrogen and oxygen. Water is again formed, when hydrogen is used.

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On the other hand, its preparation could be done by breaking the chemical bonds from compounds. A few common methods include electrolysis, from steam and hydro carbon or carbon, reaction of metals with acids, ionic metal hydrides with water, etc. Currently, global hydrogen production is 48% from natural gas, 30% from oil, and 18% from coal; water electrolysis accounts for only 4%.

Its storage is important because it has wide range of applications. They range from stationary power, portable power to transportation, etc. Also it has the highest energy per mass of any fuel. However, its low ambient temperature density results in a low energy per unit volume, therefore requiring the development of advanced storage methods that have potential for higher energy density.

Hydrogen can be stored physically as either a gas or a liquid. Storage of hydrogen as a gas typically requires high-pressure tanks (350–700 bar [5,000–10,000 psi] tank pressure). Storage of hydrogen as a liquid requires cryogenic temperatures because the boiling point of hydrogen at one atmosphere pressure is −252.8°C. Hydrogen can also be stored on the surfaces of solids (by adsorption) or within solids (by absorption).

Hydrogen as a fuel

Hydrogen is considered an alternative fuel. It is due to its ability to power fuel cells in zero-emission electric vehicles, its potential for domestic production, and the fuel cell's potential for high efficiency. In fact, a fuel cell coupled with an electric motor is two to three times more efficient than an internal combustion engine running on gasoline. Hydrogen can also serve as fuel for internal combustion engines. The energy in 2.2 pounds (1 kilogram) of hydrogen gas contains about the same as the energy in 1 gallon (6.2 pounds, 2.8 kilograms) of gasoline.

Potential Applications

- Production of electricity, heat and water for various end uses
- Industrial applications
- Vehicular transportation
- Residential applications
- Commercial applications, including in telecom towers for providing back-up power

Advantages and disadvantages of Hydrogen fuel cells

Advantages

- It is readily available. It is a basic earth element and is very abundant. However, it time consuming to separate hydrogen gas from its companion

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substances. While that may be the case, the results produce a powerful clean energy source.

- It doesn't produce harmful emissions. When it is burned, it doesn't emit harmful substances. Basically, it reacts with oxygen without burning and the energy it releases can be used to generate electricity used to drive an electric motor. Also, it doesn't generate carbon dioxide when burnt, not unlike other power sources.
- It is environmentally friendly. It is a non-toxic substance which is rare for a fuel source. Others such as nuclear energy, coal and gasoline are either toxic or found in places that have hazardous environments. Because hydrogen is friendly towards the environment, it can be used in ways that other fuels can't even possibly match.
- It can be used as fuel in rockets. It is both powerful and efficient. It is enough to provide power for powerful machines such as spaceships. Also, given that it is environmentally friendly, it is a much safer choice compared to other fuel sources. A fun fact: hydrogen is three times as powerful as gasoline and other fossil fuels. This means that it can accomplish more with less.
- It is fuel efficient. Compared to diesel or gas, it is much more fuel efficient as it can produce more energy per pound of fuel. This means that if a car is fueled by hydrogen, it can go farther than a vehicle loaded with the same amount of fuel but using a more traditional source of energy. Hydrogen-powered fuel cells have two or three times the efficiency of traditional combustion technologies. For example, a conventional combustion-based power plant usually generates electricity between 33 to 35 percent efficiency. Hydrogen fuel cells are capable of generating electricity of up to 65 percent efficiency.
- It is renewable. It can be produced again and again, unlike other non-renewable sources of energy. This means that with hydrogen, you get a fuel source that is limited. Basically, hydrogen energy can be produced on demand.

Disadvantages

- It is expensive. While widely available, it is expensive. A good reason for this is that it takes a lot of time to separate the element from others. If the process were really simple, then a lot would have been doing it with relative ease, but it's not. Although, hydrogen cells are now being used to power hybrid cars, it's still not a feasible source of fuel for everyone. Until technology is developed that can make the whole process a lot more simpler, then hydrogen energy will continue to be an expensive option.

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- It is difficult to store. Hydrogen is very hard to move around. When speaking about oil, that element can be sent though pipelines. When discussing coal, that can be easily carried off on the back of trucks. When talking about hydrogen, just moving even small amounts is a very expensive matter. For that reason alone, the transport and storage of such a substance is deemed impractical.
- It is not easy to replace existing infrastructure. Gasoline is still being widely used to this day. And as of the moment, there just isn't any infrastructure that can support hydrogen as fuel. This is why it becomes highly expensive to just think about replacing gasoline. Also, cars need to be refitted in order to accommodate hydrogen as fuel.
- It is highly flammable. Since it is a very powerful source of fuel, hydrogen can be very flammable. In fact, it is on the news frequently for its many number of risks. Hydrogen gas burns in air at very wide concentrations – between 4 and 75 percent.
- It is dependent on fossil fuels. Although hydrogen energy is renewable and has minimal environmental impact, other non-renewable sources such as coal, oil and natural gas are needed to separate it from oxygen. While the point of switching to hydrogen is to get rid of using fossil fuels, they are still needed to produce hydrogen fuel.

National Hydrogen Energy Road Map (NHERM)

With a view to accelerate development of hydrogen energy sector in India, a National Hydrogen Energy Road Map (NHERM) was prepared and adopted by the National Hydrogen Energy Board in January, 2006 for implementation. The main objective of NHERM was to identify the pathways, which will lead to gradual introduction of hydrogen energy, accelerate commercialization efforts and facilitate the creation of hydrogen energy infrastructure in the country. NHERM covered all aspects of hydrogen energy development in India including its production, storage, transport, delivery, application, codes & standards, public awareness and capacity building. NHERM formed the basis for implementation of Hydrogen Energy Progamme in the country from 2006 - 07 onwards. NHERM suggested modifying and upgrading it later based on field experience in the country and new developments worldwide. Accordingly, a Steering Committee on Hydrogen Energy and Fuel Cells was constituted by the Ministry of New and Renewable Energy (MNRE) which has submitted its report - Hydrogen energy and Fuel Cells in India—A way forward.

The Ministry of New and Renewable Energy also supports research, development and demonstration projects on various aspects of hydrogen energy

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including its production, storage and use as a fuel for generation of mechanical/thermal/electrical energy. As a result, Hydrogen fueled small power generating sets, two wheeler (motor cycles), three wheeler, catalytic combustion systems for residential and industrial sectors and fuel cell buses have also been developed and demonstrated.

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