NANGARHAR UNIVERSITY
INTERNATIONAL JOURNAL OF BIOSCIENCES
REVIWE ARTICLE
e-ISSN: 2957-9988
NUIJB Special Issue, 2024

Received: 28 Dec 2023 Accepted After Revision: 22 Jan 2024 Published Online: 10 Feb 2024

The Useful Role of Hydrogen Energy on Climate Change

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ABSTRACT

This study was to review the useful role of hydrogen energy on climate change. After determining the dangers of using fossil fuels, Scientists are working on ways to find other energy sources that are easily accessible and have low pollution, a beneficial way is hydrogen energy, hydrogen is a substance that burns easily, and forms water vapors from combustion in open air, water electrolysis is a common method to obtain hydrogen, but the simplest way for producing water is from methane and steam, hydrogen is used as a liquid, in the form of compressed gas. Many car companies have made cars that are fueled by hydrogen, all the space agency uses it as fuel to launch defense satellites and missiles, so this energy has a bright future.

Keywords: Hydrogen Energy, Compressed Hydrogen gas, Electrolysis, Photolysis

INTRODUCTION

Hydrogen is an element with small atoms, each atom of hydrogen has only one proton. In nature, the sun is a large body made of hydrogen and helium. Hydrogen can be produced from other sources such as natural gas, coal, biomass, and water. The two main methods of producing hydrogen are carbonization and electrolysis, which splits water into hydrogen and oxygen. The method is currently the cheapest and most common procedure, while the electrolysis method is currently an expensive process. Currently, the source of global hydrogen production is natural gas, which contains 48% hydrogen Globally, 30% comes from petroleum, 18% from coal and 4% from water electrolysis (Ghergheleş & Ghergheles, 2008). Transporting hydrogen over long distances requires a lot of money, and transporting it in gaseous form also has problems, so it is converted into a liquefied gas. For example, graphite fibers have been made that can absorb three times the amount of hydrogen, another method of hydrogen conservation that has recently become significant is the use of solar cells in cars(Edwards & Kuznetsov, 2007). hydrogen energy has become significant and its level of pollution production is negligible (Bičáková & Straka, 2012). 200 years ago, hydrogen was used as an internal engine fuel in the 19th century, hydrogen was used in balloons and airships, in the 1960s, hydrogen energy took man to the moon, and today, and its production is needed for industrial and commercial purposes. The form has increased to produce 70 million tons annually(IRENA, 2019). Hydrogen has been produced and used on a large scale before, but attention has been paid to it as an energy-producing substance in recent years. It is made and used, but recently attention has been paid to it as an energy source (Jain, 2009). Hydrogen is a gas that has the characteristics of gold for environment, so if it is used for fuel, it does not harm the environment like fossil fuels, it does not have greenhouse effects like carbon dioxide and other gases, only the product of fuel is water. Therefore, hydrogen can be used as fuel in small and large rockets, as well as in transport vehicles and space satellites (Edwards & Kuznetsov, 2007). The study involved a comprehensive literature review of ten articles from Google Scholar and reliable books, presented in a phased report. The main goal of the study was to identify the importance of hydrogen energy and also to identify the deferent applications of hydrogen energy.

MATERIALS AND METHODS

This research has been completed according to the literature review of deferent research articles, twelve articles are collected from Google scholar and reliable books, related to the topic, and after the analysis, and it is presented as a phased report of this research and pictures are also provided for better understanding.

Sources of hydrogen fuel production

In nature, hydrogen does not exist as a pure element on earth, but it is usually obtained from water and fossil materials such as methane(Figure 1**)** which requires a large amount of energy in this process. We are under investigation to obtain hydrogen energy by means of them.

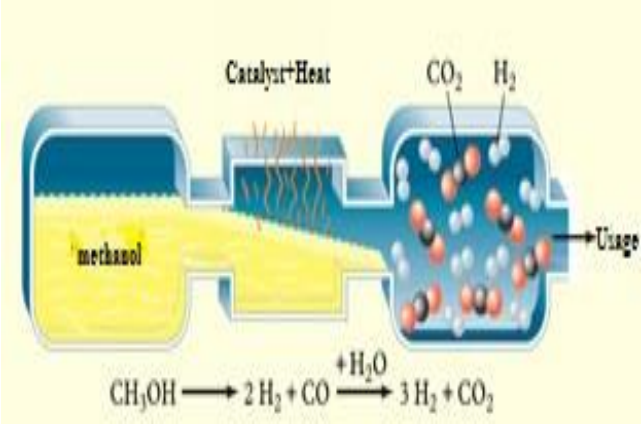

Figure 1: Hydrogen production system from methanol (Demirel, 2012).

Water electrolysis

Economically, this procedure is expensive, in this procedure, electrical energy is the type of energy source:

$2H_2O$ (l) + Electric Energy $\rightarrow 2H_2$ (g) + O_2 (g)

Unfortunately, half of the electrical energy will be converted into heat unintentionally, so it is lost in this process and if electricity is produced, by burning fossil fuels, carbon dioxide and air pollutants such as nitrogen oxides are dispersed in the air. It spreads when burning. One hope for the future is that it will be economical to use solar energy for the electrolysis of water. In Saudi Arabia and Germany, the first power plants have been built that use solar energy to produce hydrogen. Another possibility. However, with the help of nuclear energy or wind energy, hydrogen can be obtained according to the stepwise process (Colin, 2006).

Photolysis of water by sunlight

Instead of using solar energy for electrolysis of water, it is better to use sunlight to directly decompose water into hydrogen and oxygen, but a practical, fully useful procedure has not yet been discovered. They do not absorb radiation, but there are some materials that absorb sunlight and can be used for their energy distribution, but these proposed materials are not 100% conserved during this cycle and may be delivered continuously. This whole process is not economical (Bičáková & Straka, 2012).

The Hydrogen production from fossil fuels

Hydrogen gas can be produced from fossil materials such as coal, petroleum, or natural gas. When they react with water, they form hydrogen and carbon dioxide. Letting the hydrogen atoms form hydrogen gas, the effect of this is that the carbon in the original gold material is oxidized and the hydrogen is released.(Adaileh et al., 2015).

$$C(g) + 2H_2O(g) \rightarrow 2H_2(g) + CO_2(g)$$

The problem of hydrogen transport and storage

Hydrogen transportation is expensive and has issues, leading to its conversion into liquefied gas. To protect it, carbon or metal-based absorbents like graphite fibers can absorb three times the amount of hydrogen. Recently, solar batteries in cars have become significant, as they can absorb three times the amount of hydrogen (Demirel, 2012). Car manufacturers like Nissan, Ford, Honda, and Mercedes have developed hydrogen fuel cells for cars(Figure 2). These batteries have a proton exchange membrane that loses H_2 electrons in the anode, producing hydrogen ions that combine with O_2 to form water. The starters produce 0.7 volts of electricity, and a chain is connected to increase power. The Energy Conversion Device (ECD) stores H_2 from the car's stored tank or methanol, made of magnesium alloy that can absorb hydrogen gas. When heated, the ECD releases hydrogen, capable of traveling up to 300 miles (Edwards & Kuznetsov, 2007).

Figure 2: picture In the United States, the tank that can store and ship 600 kg of liquid hydrogen (Fatih Birol,2019).

The future of hydrogen fuel

Hydrogen gas is a crucial fuel for cars and power plants, with redox production processes. Experts predict the future economy will rely on hydrogen energy. NASA uses hydrogen for rocket launches (Figure 3). Iceland has a 30-year plan to expand hydrogen energy, and major car companies are working on hydrogen-powered cars (Fatih Birol, 2019).

Figure 3: The rocket that uses hydrogen energy as fuel (Zohuri & Engineering, 2018).

DISCUSSION

Olga Bekova and colleagues (2019) research shows that in the near future, hydrogen will be a valuable commodity that can help solve air pollution problems, it not produce Carbon dioxide , so it is taken care of as the key fuel of the future. According to a research conducted by Mustafa, hydrogen energy is the most reliable candidate for energy in the future. There are fossil and non-fossil methods of producing this energy. Currently, gas production technology is very common, but at a small level. Electrolysis technology is also used. Edward and Kuznets (2007) research shows that hydrogen energy is considered as an alternative to carbon-emitting sources for transportation vehicles, industrial and housing sectors. Before the revolution, the journey is long, but it is an emotional journey. Hydrogen energy holds a promising future due to its limited fossil fuels and potential for environmental protection, with ongoing research in both laboratory and commercial forms.

Table 1: comparation of hydrogen energy and other energy sources.

Fuel	Energy(MJ/Kg)	Fuel	Energy(MJ/Kg)
Hydrogen	120	Ethanol	49.6
Liquefied naturel gas	54.4	Methanol	19.7
Propane	49.6	Coke	27
Automotive gasoline	46.4	Wood(dry)	16.2
Automtive diesel	45.6	Bagasse	9.6

Hydrogen gas combines with oxygen during combustion to produce water and heat (Nicoletti et al., 2015).

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

In normal flame combustion, hydrogen combines with oxygen to produce heat, or it is done in low-temperature combustion in catalytic converters. Compared to other fuels, a small amount of hydrogen is needed, which produces less pollution(Figure 4). If the fuel is burned in a battery, the amount of energy is more useful than normal combustion. It is worth noting that hydrogen fuel does not cause pollution because water bubbles are produced from it, but this is not completely correct because at high temperature. The flame of gold combines with the nitrogen in the air and forms nitrogen oxides, as well as releasing a small amount of H_2O_2, so cars that burn hydrogen are not sulfur-emitting systems (Winter, 2006).

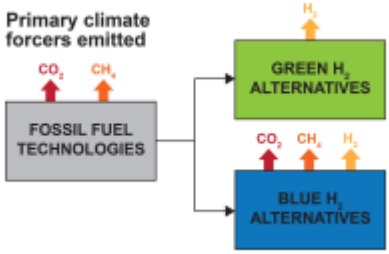

Figure 4: Primary climate forcers emitted from fossil fuel technologies and their clean hydrogen alternatives.

CONCLUSION

Due to the high consumption of energy, humans in the world have faced two major threats, environmental pollution and the rapid depletion of energy sources, environmental pollution and climate change, which are non-renewable sources of energy obtained from fossil fuels. Energy use is the main challenge. The continuous progress of recent years, population increase and energy misuse and other such factors are continuing with great intensity(Nicoletti et al., 2015). While hydrogen is mostly used for carbon-intensive industrial applications such as refining, ammonia and methanol production, the gas is expected to play a role in transport applications where electrification is most difficult, which can pave the way for aviation and maritime synthetic fuels manufacturing. In 2018, the GCC consumed the energy equivalent of 8.1 Mt of hydrogen in marine bunkers and 5.5 Mt of hydrogen in international aviation. Global demand for green hydrogen is estimated at 530 million tons (Mt) by 2050 and annual global export market for hydrogen is projected at US$ 300 billion by 2050(Gain Group, 2020). Hydrogen energy is a valuable non-carbon gas that forms in the air through hydrogen fuel, producing water vapor, reducing pollution. Despite the expensive electrolysis method, it is primarily obtained from fossil materials and methanol. Two storage methods exist for hydrogen: liquid storage and gas storage. Recent developments include systems storing hydrogen in fibrous layers and machines producing hydrogen from methanol simultaneously for fuel use. From the above research, it has been found that hydrogen energy is environmentally friendly energy and has a special role in preventing climate change because it does not release greenhouse gases into the air and water is obtained from it, so it has a role in preventing climate change. Hydrogen energy can be used instead of other energy sources.

Acknowledgment: Financial support of this research from Nangarhar University, is gratefully acknowledged

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