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Hydrogen as A Fuel Research Review Paper

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ABSTRACT

Power to hydrogen could be a promising solution for storing variable Renewable Energy (RE) to realize a 100% renewable and sustainable hydrogen economy. The four basic steps of the hydrogen-based energy system (energy to hydrogen to energy) are production, storage, safety, and use. To illustrate the interdependency and interconnectedness of those primary phases, the hydrogen-based energy system is portrayed as the four corners (stages) of a square-shaped integrated whole. The method for producing hydrogen and the particular technology used depend on the kind of energy and feedstock that are available as well as the level of purity needed for the final product. Hence, purification technologies are included within the pathway of the production for system integration, energy storage, utilisation . This research examines the interconnectedness and dependence of various hydrogen production methods and related technologies on the opposing corners of the hydrogen square. Despite having zero carbon emissions at the point of use, hydrogen depends on the efficiency of the assembly process and, consequently, the energy required to manufacture it. In order to consider hydrogen as clean energy, the assurance of its origin is crucial. A unique model is offered as a hydrogen cleanness index coding for additional investigation and development.

HYDROGEN AS AN ENERGY ALTERNATIVE: INTRODUCTION

Hydrogen is referred to be an energy carrier because it is hardly created from other sources of energy and does not exist freely in nature. In a very efficient cell, hydrogen and oxygen combine to produce heat and power with just vapour as a byproduct. Hydrogen is a clean-burning fuel. Additionally, hydrogen can be produced directly from biomass or fossil fuels, or it can be created by putting electricity through water and splitting it into its hydrogen and oxygen molecules. Some see a "hydrogen economy" in which hydrogen is produced through the expansion of energy sources, stored for later use, piped to the required locations, and then cleanly transformed into heat and electricity. Today, steam reforming gas is the primary method of producing hydrogen. But gas is already a good fuel and one that's rapidly becoming scarcer and dearer. it is also a fuel, that the gas released within the reformation process adds to the physical phenomenon.In order to store and transport hydrogen, which has a very high energy for weight but a very low energy for volume, new technology is needed. And electrical device technology continues to be in early development, needing improvements in efficiency and sturdiness.

This review paper provides an summary of hydrogen's role within the energy sector and therefore the transition towards 100% renewable, sustainable, green energy. this paper seeks to integrate the research findings in hydrogen production pathways and associated technologies in reference to the broader picture of the HydS. The discussion section during this paper is proscribed to hydrogen production for the energy sector only. one among the most contributions of this review paper, therefore, is to produce insights regarding into the design of hydrogen production systems through awareness of the four corners of HydS pathways. Various hydrogen production pathways and technologies are discussed from the angle of every of the opposite HydS corners instead of that specialize in cost-effectiveness of the assembly pathways only.

HYDROGEN AS AN ELEMENT

Hydrogen (H2) is that the most abundant element within the universe, which is found on our planet earth mainly in water and organic compounds . it's the lightest and simplest element which consists of 1 electron and one proton , colourless, odourless, flammable gas . Hydrogen's mass is 1.00794 mass units rounded at 1.008. This relative atomic mass number (1.008) was considered within the USA because the 8th of October (10/08) because the National Hydrogen and electric cell Day . This event was first recognised by the electric cell and Hydrogen Energy Association in 2015 to lift awareness of cell and hydrogen technologies yet because the vast potential the technologies have today and within the future . this present day is predicted to be the International day of hydrogen energy.

SAFETY OF HYDROGEN AS A FUEL

Since hydrogen is non-toxic and considerably lighter than air, it dissipates quickly when discharged and the fuel disperses relatively quickly in the event of a leak, making it safer than other spilled fuels. The main safety worry is that if a leak goes unnoticed and the gas builds up in a very small area, it might eventually catch fire and explode.

The safe use of any fuel, including hydrogen, focuses on avoiding circumstances in which the three components of combustion—ignition, oxidant, and fuel—are present. The diversity of hydrogen's features, such as its wide range of airborne flammable concentrations (4%–75%) and lower ignition energy, necessitate extra technical controls to ensure its safe usage (only one 10th the most amount energy to ignite as gasoline). The selection of materials for the HydS system must also take into account metal hydrogen embrittlement and the ability to interrupt materials at the site of leak. To ensure the safe use of hydrogen, it is essential to have a thorough grasp of its characteristics, design safety measures into hydrogen systems, and get training in safe hydrogen handling and storing.

On its website, the US Department of Energy wrote, "As more and more hydrogen demonstrations get going, hydrogen's safety record may expand and generate trust that hydrogen is also as safe as the fuels in broad use today."

HYDROGEN ECONOMY

It seems like there is a brand-new announcement concerning hydrogen for energy use and transportation every day. Since Hydrogen to X (H2X) has the ability to integrate into the current energy and transportation networks extremely rapidly and dramatically reduce pollution (zero-carbon-emission at point of use), the guarantees are intriguing. The security of the energy supply and price stability are also top political priorities. Since it was initially presented at the beginning of the 1970s "at General Motors (GM) Technical Center by "John Bockris" and Miami Meeting on Hydrogen," these factors are driving the world's transition away from the fuel economy toward a significantly cleaner hydrogen future. The literature demonstrates that the hydrogen economy has been extensively researched; several evaluations and case studies have also been generated, in addition to numerous roadmap reports that highlight significant advancements and, consequently, the potential of hydrogen in the energy sector. For the purpose of completeness, peer-reviewed literature research reveals an increasing interest in examining the techno-economic, environmental effect, policy implications, and social implications of the hydrogen economy. As a result, several national and international organisations have been established to instruct the general public, businesses, and decision-makers on how to develop a framework and promote preparation for the hydrogen economy age.

HYDROGEN PRODUCTION

In order to show the state-of-the-art hydrogen production methods, a synopsis of hydrogen production routes and technologies has been addressed and contrasted in this section. The four primary categories of hydrogen generation pathways in the literature are electrolysis, photolysis, biolysis, and thermolysis. These categories are further subdivided in accordance with any combination energy types used in the process. The majority of researchers in the field of hydrogen generation have thought about a few energy additions to the process as a catalytic energy to increase the technique efficiency. Additionally, the literature has listed a number of secondary energy sources for hydrogen synthesis, including radiation, plasma, and biological energy.A thorough review of the literature found a diverse range of hydrogen generation routes, each according to the energy consumed in the process and, consequently, the technology employed. However, the literature does not categorise the assembly paths, such as the 3S and 18S Models, and instead offers recommendations for brand-new classification models for hydrogen systems (techno-economic evaluation). The efficiency of the process is further increased by the need to recognise the input energy from the catalyst materials.

From a different angle, the literature discloses that the three primary colour codes of grey, blue, and green were used to characterise and mark the cleanness of hydrogen. Regardless of how thoroughly clean it is, the colour of hydrogen is only affected by the sort of energy or other technology used to make it. Grey hydrogen is therefore seen as a polluting kind of hydrogen. While grey hydrogen and carbon capture and storage (CCS) are both defined by blue hydrogen. A source of energy for producing hydrogen that is entirely renewable is referred to as "green hydrogen." Consequently, green hydrogen is regarded as a clean (hydrogen energy with low carbon emissions).

CONCLUSION

Since hydrogen is a developing energy carrier that will aid in the worldwide decarbonization of the industrial and energy sectors, producing hydrogen from renewable energy sources is of the highest significance right now. Hydrogen generation, the first corner of the proposed HydS paradigm, is linked to and reliant on the other three corners of the HydS. When selecting a hydrogen generation technique, it is important to consider the other three corners, which stand for the other key stages of the whole hydrogen energy system. Hydrogen purification must be taken into account while choosing the production pathway in order to have the optimal trade-off with purity and recovery inclusion, since it may lead to higher costs and pollution dependent on the other three HydS corners. The cleanness of any hydrogen, however, is determined by the cleanliness of the production process, despite the fact that hydrogen emits no carbon dioxide when utilised as energy. Therefore, the guarantee of hydrogen origin should be the most important factor when assessing the cleanliness of any hydrogen energy source. After reviewing more than 300 academic and commercial papers, a colour coding method was shown to indicate the source of hydrogen. However, as this was unable to determine the purity of the hydrogen, a new hydrogen cleanness index was provided for more study and development. It is hoped that governments, lawmakers, corporations, and utilities would use the study's findings as a guide to use hydrogen in the future.

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