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Solar-Hydrogen Fuel Cells Technologies for Sustainable Future-A Review

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ABSTRACT: It is considered as key input for environment and sustainable development. In process of producing energy we are polluting environment which is now an major issue along with depletion of fossil fuels. The solution for above problem is an use of naturally available non-polluting and non-depleting energy source. One such kind is natural hydrogen fuel which is abundantly available through solar rays and water which can be collected store efficiently with advanced technology Energy is the key element of interaction between nature and society.

The solar hydrogen fuel is efficiently and effectively used in most of the developed countries, such a concept has to be implemented in India to fulfil the energy requirement even though we don't have advanced technology to store hydrogen fuel which is explosive in nature. This paper also presents the possible future hydrogen energy utilization for better environment and sustainable development of country.

KEYWORDS:Energy, fuel cell, hydrogen, life cycle assessment,environment, economics, sustainable development.

I. INTRODUCTION

Every day sun sends tremendous amount of energy in the form of heat and radiation called as solar energy. It is inexhaustible source of energy which is available at no cost. The major advantage of solar energy is that it is eco friendly and found abundantly in atmosphere. the another factor is that sunlight can directly harvested into solar energy with the use of small and tiny photovoltaic solar cells. Now we are dependant completely on the fossil fuels which may exhausted in future but we cannot imagine a development without energy so there is requirement to develop some technology which offers us a continues energy without interruptions for the development of our country. The sun is a big spherical gaseous cloud made of hydrogen and helium atoms the emission of energy is due to the fusion action during the processof fusion for hydrogen atoms combines to form helium. The radiant energy from fusion is free from pollution.

Energy is a key element of the interactions between nature and society and is considered a key input for the environment and sustainable development. Environmental and sustainability issues span continuously growing range of pollutants, hazards and eco-system degradation factors that affect areas ranging from local through regional to global. Some of these concerns arise from observable, chronic effects on, for instance, human health, while others stem from actual or perceived environmental risks such as possible accidental releases of hazardous materials. Many environmental issues are caused by or Related to the production, transformation, and use of energy. forex. acid rain, stratospheric ozone depletion, and global climate change. Recently, a variety of potential solutions to the current environmental problems associated with the harmful pollutant emissions has evolved. Hydrogen energy systems appear to be the one of the most effective solutions and can play a significant role in providing better environment and sustainability.

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II. SUSTAINABLE DEVELOPMENT

Development requires sufficient supply of clean affordable energy resources that do not cause negative social impacts and supplies of such energy resources as fossil fuels and uranium are finite. Energy sources such as sunlight, wind and falling water are generally considered renewable and therefore sustainable over the relatively long term. Wastes and biomass fuels are also usually viewed as sustainable energy sources. Wastes are convertible to useful energy forms through such technologies as waste to energy incineration facilities.

Environment impact is associated with large energy source utilization ideally society needs sustainable development utilizes only energy resources that release minimum emission to the environment. However, since all the energy resource may somehow lead to environmental impact, increased efficiency regarding environmental emission and their negative impact. For the same service or products resource utilization and pollution is normally associated with increased efficiency. Sustainability often leads to local and national authorities to incorporate environmental consideration into energy planning. The need to satisfy basic human needs and aspiration combined with increasing world population, will make Sustainable the need for successful implementation of sustainable development increasing apparently.

III. VARIOUS HYDROGEN ENERGY RELATED CRITERIA THAT ARE ESSENTIALLY TO ACHIEVING SUSTAINABLE DEVELOPMENT IN A SOCIETY FOLLOW

- Environmental and sustainability education and training.
- Appropriate energy and energy strategies for better efficiency.
- Promoting environmentally design technologies.
- Development of sustainable hydrogen economy infrastructure.
- Commercially viable and reliable hydrogen energy system, including, storage and use.
- A reliable supply of financing and incentives.
- Academic-industry-government partnership programs.
- Policy development for sustainable energy programs.
- Appropriate monitoring and evaluation tools.

Environmental concern is significantly linked to sustainable development activity that continually degrades the environment. For example, the cumulative impact on environment of such activities often leads over time to a health, ecological and other problems.

Clearly, a strong relation exists between efficiency and environmental impact since, for the services and products, less source utilization and pollution is normally associated with increased efficiency. Note that improved energy efficiency leads to reduce the energy losses. Most efficiency improvement produces direct environmental benefits in two ways.

- Operating energy input requirements are reduced per unit output, and pollutant generated is correspondingly reduced.
- Consideration of the entire life cycle for energy resources and technologies suggest that improved efficiency reduced environmental impact during most stages of the life cycle.
- That is why assessing the future hydrogen technologies such as fuel cells over their entire life cycle is essential to obtain correct information on energy consumption and emission during various life cycle stages, to determine competitive advantages over advanced technologies, and to develop future scenario for the better sustainability. In recent year, the increased acknowledgement of humankind interdependence with the environment has been embraced in the concept of sustainable development with energy constituting a necessity for maintaining and improving standard of living throughout the world, the wide spread use of fossil fuels may have affected the planet in ways for more significant than first thought. In addition to that manageable impacts of mining and drilling for fossil fuels and discharging wastes from processing and refining operations, the "green houses" gases created by burning these fuels is regarded as major contribution a global warming threat. Global warming and large scale climate change have complication for the food chain disruption, flooding and weather events. for example, hurricanes. It is obvious that utilization of hydrogen and fuel cell.

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- Technologies can help to reduce environmental Damage and achieve sustainability. Such technologies essentially do not consume fuel, contribute to global warming, or generate substantial waste as long as hydrogen is produced through clean and renewable energy resources. In this respect, hydrogen and fuel cell technologies can provide more efficient, environmentally benign and sustainable alternatives to convectional energy technologies, particularly fossil fuel driven ones. Hydrogen and fuel cell technologies have a crucial role to play in meeting the future energy needs in both rural and urban areas. The development and utilization of such technologies should be given high priority, especially in the light of increased awareness of the adverse environment impact and political consequences of fossil fuel generation the need for suitable energy development is increasing rapidly in the world. In fact, wide spread use of these technology is important for achieving sustainability in the energy sectors in both developing and industrialized countries. These technologies are key component of sustainable development for four main reasons:
- They have numerous advantages such as energy efficient and compatible with renewable energy sources and carries for future energy security, economic growth and sustainable development
- They generally cause much less environmental impact than other conventional energy sources and technologies .The variety of hydrogen and fuel cell technologies provides a flexible array of option for their using various application.
- Hydrogen cannot be depleted because the basic source is water. If use carefully in appropriate application it can provide a fully reliable and sustainable supply of energy almost indefinitely. In contrast, fossil fuel and uranium sources are diminished by extraction of consumption.
- These technologies favor system decentralization local and individual solution that are somewhat independent of national network, thus enhancing the flexibility of the system providing economic and environmental benefits to small isolated population. In addition, the small scale of the requirement often reduces the time required from initial design to operation, providing greater adaptability is responding to unpredictable growth and/or changes in the energy demand.

It is important to note that if we produce hydrogen through convectional technologies using fossil fuels, this will not make hydrogen inherently clean in that they may cause some burden on the environment in terms of pollutant emissions, solid wastes, resource extraction, or other environmental disruptions. Nevertheless, the overall use of these technologies almost certainly can provide a cleaner and more sustainable energy system that increased controls on conventional energy systems. Financial incentive should be provided to reduce up-front investment commitments and infrastructure costs for production, transportation, distribution, storage and use.

IV. FUEL CELLS AS HYDROGEN ENERGY SYSTEMS

Fuel cell technology is clean, quiet, and flexible one and is already beginning to serve humanity in variety of useful ways. Nevertheless, production volume is low and costs are too high public support is needed to help generate initial demand this cycle.



Fig1.Four key factors of sustainable development under global sustainability

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The market automotive power and stationary generation conversion equipment is the largest market for capital equipment in the world. Fuel cells and fuel cell powdered vehicle will be economic growth leader in the coming decades securing high quality employment for many thousands of people. Fuel cells are considerably efficient power producers and create electricity in one simple step, with no moving parts and at very low temperature. The combustion process employed by traditional power plants: A fuel is burnt at high temperature to create heat, the heat energy is converted into mechanical energy, and that mechanical energy is into electric energy

Since fuel cells do not combust fossil fuels, they are known as clean power producers, they emit none of the acid rain are smog producing pollutants that are the inevitable byproduct of burning coal or oil or natural gas. In principle, a fuel cell operates like a battery. Unlike a battery, it does not run down or require recharging, produces energy in the form of electricity and heat as long as fuel is supplied. The fuel cell Converts chemical energy directly into electricity without combustion by combining oxygen from the air with hydrogen gas. It produces electricity as long as fuel, in the form of hydrogen, is supplied. The only by-products are water and heat. No pollutants are produced if pure hydrogen is used. However, very low levels of nitrogen oxides are emitted, but usually in the undetectable range. The carbon dioxide emission are relatively low because of high efficiency and are in the concentrated form, facilitating capture hydrogen can be produced from water using renewable solar, wind, hydro or geothermal energy. Hydrogen also can be extracted from anything that contains hydrocarbons including gasoline, natural gas, biomass, landfill gas, methanol, ethanol, methane and coal based gas. The type of fuel cells are typically distinguished by the electrolyte that is utilized and can be classified into two main categories, based on their operating temperature, such as low temp fuel cells (e.g., 60-250 ° C) and high temperature fuel cells(e.g., 600-1000° C). Low temperature fuel cells have made significant progress in transportation application due to their quick start times, compact volume and lower and lower weight compared to high temperature fuel cells.

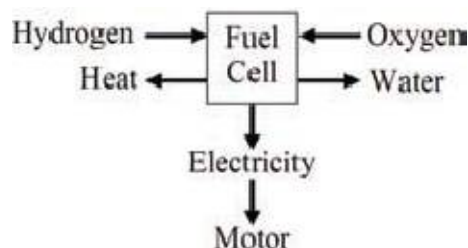


Fig2. Operation of a fuel cell, converting hydrogen and oxygen (from the air) into electricity, water, and heat.

The common types of lowtemperature fuel cells are proton exchange membrane fuelcells, phosphoric acid fuel cells, alkaline fuel cells,unitized regenerative fuel cells, direct methanol fuel cells.The high temperature fuel cells are more efficient than lowtemperature ones in generating electrical energy. Inaddition, they provide high temperature waste heat, whichis a benefit in stationary cogeneration applications, butpresents a problem for transportation applications. Twocommon ones are molten carbonate fuel cells and solid oxide electrolyte fuel cells Operation of a fuel cell, converting hydrogen andoxygen (from the air) into electricity, water, and heat.

V. HYDROGEN SAFETY

Hydrogen is intrinsically no more dangerous than many other fuels. Its different characteristics require different safety equipment and procedures, but all fuels have some potential for accidents; if they did not burn, they would notbe much use as a fuel. Hydrogen is used worldwide in the petroleum and chemical industries and elsewhere. It was also routinely used in the USA as a fuel (a component of ("town gas") before natural gas became widely available. Town gas is still used in some countries. Moreover, hydrogen ranks between propane and methane (natural gas) in safety. The physical properties of hydrogen make its safety characteristics rather different from those of other fuels. Its low density means that it tends to rise and disperse into theatmosphere in the event of a leak, rather than remaining in a "puddle" near the ground. This increases safety in well ventilated applications. Its low density also means that a hydrogen explosion

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releases less energy in a given volume than an explosion of other fuels, and compared to gasoline or natural gas, hydrogen requires much higher concentrations in the air to produce an explosion rather than just a flame. Furthermore, hydrogen's low ignition temperature and flammability over a wide range of concentrations make leaks a significant fire hazard, especially in confined spaces such as a garage. Because it is clear and odorless, leaking hydrogen is more likely to go undetected than a leak of gasoline or most other fuels. Even the flame of burning hydrogen is invisible. Techniques of leak detection have been and continue to be a research priority. A simple approach is to add an odorant like that added to natural gas, or possibly a colorant, or both. Any addition may detract somewhat from the environmental cleanliness inherent to pure hydrogen, however, and additives would need to be chosen with care to avoid destroying other important features. For example, contaminants may reduce the efficiency and/or lifetime of a fuel cell.

VI. CONCLUSION

The benefits of hydrogen and fuel cell systems is highlighted of using the principles of thermodynamics (particularly energy) and life cycle assessment to evaluate their key roles in sustainable development. The following concluding remarks, which will likely be useful to scientists, researchers and engineers as well as policy and decision makers, can be drawn from this study:

- Moving towards sustainable development requires that environmental problems be resolved. These problems cover a continuously growing range of air pollution, water pollution, solid wastes, pollutants, ecosystem degradation, and extend over ever-wider areas.
- Sustainable development requires a sustainable supply of energy resources that, in the long term, is sustainable available at reasonable cost and can be utilized for all required tasks without causing negative societal impacts. Energy resources such as solar, wind, hydro, and biomass are generally considered renewable and therefore sustainable over the relatively long term. The use of these sources in hydrogen production will be a key factor in sustainable development.
- Assessments of the sustainability of processes and systems, and efforts to improve sustainability, should be based in part upon thermodynamic principles, and especially the insights revealed through energy analysis.
- For societies to attain or try to attain sustainable development, effort should be devoted to developing hydrogen and fuel cell technologies. Renewable energy utilization in hydrogen production can provide a potential solution to current environmental problems. Advanced hydrogen and fuel cell technologies can provide environmentally responsible alternatives to conventional energy systems, as well as more flexibility and decentralization.
- To realize the energy, economic and environmental benefits of hydrogen and fuel cell technologies, an integrated set of activities should be conducted including research and development, technology assessment, standards development and technology transfer. These can be aimed at improving efficiency, facilitating the substitution of these technologies and other environmentally benign energy currencies for more harmful ones, and improving the performance and implementation characteristics of these technologies.

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