The Condition of Hydrogen and Cell Battery in Iran

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Abstract: Today, the consequences of human intervention in the environment are more evident than any time before. Development has been synonymous with the nature and environment protection and in economic indexes of national accounts, such as gross domestic product, taking natural and environmental resources into account is so important. Energy is a basic need for economic development and providing welfare and comport for human life. Regarding what was said, the only way to human is using new clean green and renewable energies. Therefore in this study, in addition to a brief introduction on hydrogen energy and cell battery, the condition of these kinds of renewable energies in Iran will be discussed.

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1- Introduction

In the 1980s, scientific evidence revealed that green house gases produced by human activities created some dangers for the global climate. Therefore public opinion sensed the necessity of establishing periodic international conferences and forming a treaty to solve this problem. In 1997, climate changes convention with the goal of fixing greenhouse gases concentration in the atmosphere up to the level that prevents dangerous intervention of human activities in climate wrote "Kyoto protocol". Under this protocol, industrial countries were obliged to reduce greenhouse gases [1, 2].

The ultimate objective of this convention was fixing greenhouse gases concentration in the atmosphere up to the level that prevents the intervention of human dangerous activities in climate. Such a level must be achieved in the determined time frame work so that ecosystems naturally adapt themselves with weather changes and it is assured that food safety is not threatened and economic development is not hampered. Thus, renewable energies are getting more and more share in global energy provision system. Renewable energy resources are alternately available and are not transportable or savable. For this reason they cannot be used as a fuel specially in transportation. So far the most common fuel for transportation in many countries in the world has been gasoline and diesel. Cars consuming gasoline or diesel generate harmful materials and pollutants with complicated chemical compounds. Although different measures have been taken to reduce them in the developed countries, they haven't helped much to the important issue of pollutants decrease. When fossil fuels are incompletely burnt with different hydro carbons, carbon monoxide, a poisonous material, is produced. Some unburned carbon atoms in fuel compounds and solid carbon particles are accumulated and exited as smoke and when subjected to sunlight, it is mixed with nitrogen monoxide compounds resulted from combustion and produce azoth [4].

Clean fuels have natural physical and chemical properties that make them cleaner than gasoline. These alternative fuels produce less unburned hydro carbons while combusting and the resultant materials produced by their burn have less chemical activities to produce other poisonous materials. Moreover, using alternative fuels reduce the formation and accumulation of carbon dioxide. Noticing technical-economic aspects of alternative fuels and their wide availability in Iran as well as increased consumption of hydro carbon liquid fuels in Iran which has caused a lot of damage to public budget and the environment has turned attention to introducing alternative fuels and studying about possibility of using them.

2- Hydrogen fuels features

Hydrogen is an abundant element on earth. It dose not exit in its pure form in the nature. So it is obtained from other elements by different methods. Hydrogen is the most important alternative as the new energy. This material compared to other fuels can turn other energies by much cleaner combustion

and higher efficiency. Nowadays using hydrogen in different industries is an urgent need. Hydrogen is widely used in chemical, food, metal and mineral industries, with the industrial development in the world and increased demand for energy, the world has encountered two important problems, namely in creased environmental pollution and the limitation of fossil fuels reserves. Since today one of the biggest problems of the world is pollutants caused by fossil fuels, hydrogen possesses some advantages in this regard. There fore noticing positive environmental, economic aspects of hydrogen, the world is driven toward steady development using hydrogen energy [1, 2].

Among advantages differentiating hydrogen from other fuel alternatives, abundance in consumption, insignificant production of pollutants, returnable production cycle and reduction of greenhouse effects can be named.

At present different countries in the world are investing in this section. Energy production seems one of the biggest challenges of the future. Thus using hydrogen to produce electricity seems essential. For this reason many countries are working on turning generators fuels into hydrogen fuel. Using hydrogen along with fuel cell is promising a bright perspective for the future. Hydrogen energy system, due to its independence from initial energy resources is also a permanent renewable infinite energy. Also it is predicted that in a near future, hydrogen production and consumption as an energy resource will spread all over the economic world; however, it must not be expected that hydrogen, at the beginning of its introduction to the world can compete with other energies in terms of price. On the other hand the role and share of gas fuel in the future is increasing with the movement toward the simultaneous production of heat and electricity in smaller power plants [1, 2].

In the future hydrogen and fuel cell can play a key role in controlling pollution in cities. Electric engines and fuel cell are suitable alternatives for combustible engines. In fact if hydrogen is provided from fossil fuels, fuel cell automobiles can result in zero pollutants in air. Total decrease in pollutants depends on the fact that if hydrogen is produced by fossil fuels or wind power or water – electricity power. Hydrogen as the best alternative and the most economical fuel cell automobiles has received a suitable position. Hydrogen is the simplest fuel to be used in fuel battery cars and increases their efficiency, with regard to producing hydrogen from natural gas (CNG) resources, its price is less than diesel and gasoline. Due to CNG resources available in the world and CNG distribution infrastructures in most countries as well as high efficiency of CNG transformer and its low environmental – natural damage, the use of CNG and changing it into hydrogen has attracted a lot of attention. The most important advantage of using hydrogen as a fuel is the fact that it produces water vapor and nitrogen oxide after combustion [1, 2].

3- Hydrogen production technology

Hydrogen is obtained from different sources including initial energy resources (Finite resources like petroleum), secondary energy resources (produced by initial energy sources such as gasoline) and renewable resources (produced naturally without human intervention like wind, such, water). Scientists call hydrogen the final fuel. At present hydrogen produced in industry is used as a chemical product. Hydrogen sale is less than %10 of its production in the world. In other words, %90 of the produced hydrogen is consumed in place.

Today hydrogen can be obtained by processes such as water electrolyses, CNG reforming and fossil fuel oxidation. At present more than %90 of the total produced hydrogen in the world is gained by fossil fuels and it is mostly used in oil industry and refinement.

Hydrogen is mostly used as a by product and now a small amount of the produced hydrogen is used as energy. Further study and research is required in order to optimize and diversify hydrogen production methods. Advanced methods are required to separate pollutants in order to decrease hydrogen price and increase its efficiency. Hydrogen is produced in big refineries, industrial are as and can be distributed easily to rural are as and customers homes [1, 2].

4- Fuel cell – hydrogen technology

Currently noticing energy crisis, fossil fuels restriction and problems caused by fossil fuels pollution, using new energy resources has attracted much more attention. For this reason a new viewpoint for using hydrogen due to its unique features has gained ground.

Using hydrogen as a fuel can decrease environmental pollutants and remove sulfur and carbon oxides caused by fossil fuels. The above – mentioned factors have put fuel cell cars in the center of attention. This technology, due to non – production of pollutants like nitrogen oxide, carbon monoxide and unburned hydrocarbons is a unique one.

Fuel batteries are kinds of energy trans formers that turn chemical energy directly into electrical energy. Fuel batteries act as a battery but unlike batteries, they keep working as long as they receive fuel and don't need recharge and their by products are water and heat.

Hydrogen needed for fuel batteries can be provided by different resources such as hydro carbon resources like petroleum, CNG, coal,… and renewable resources like wind, sun.
Common classifications for fuel battery based on type of their electrolyte are as follows:

- Polymer Fuel Cell (PEMFC)
- Alcoholic Fuel Cell (AFC)
- Phosphoric Acid Fuel Cell (PAFC)
- Melted Carbonate Fuel Cell (MCFC)
- Solid Oxide Fuel Cell (SFC)
- Metabolic Fuel Cell(DMFC)

Fuel cell consists of 2 electrodes and 1 electrolyte between them. Oxygen moves on cathode and hydrogen moves on Anode and produces electricity, water and heat.
Today these are enough attempts for the presence of Fuel cell in power plant industries, Transportation, and commercial stage.
Efficiency and the spreading Of Fuel cell cars are proper than common cars.
They also provide the decentralized production of energy as the 4th generation of power plants in future.
The possible uses of Fossil Fuel like Methanol and or natural gas in Fuel cell are other advantages of their system.
Today all car producers invest on commercial production of Fuel cell cars, these Fuel cell can be posed as a generator of energy for buses, boots, planes and even bicycles. In a small scale, they can be used in mobiles, phones and portable computers.
Fuel cell production technology like any other technology at the beginning might be quite expensive, but later in mass production and high rate of demand and technological development, its price will considerably decrease.
Fuel cell generally has many advantages as below:
High productivities, less chemical thermal and Audio, flexible installation, high safety, low Maintenance during and cost; division of administrative load, flexible in consumption of fuel, and possible thermal recovery. They have also other potential advantages. It produces carbon dioxide and less Nitrogen oxide against per KW produced Electricity and lack of presence of many moving parts Fuel cell can apply different gases such as natural gas, propane, gases produced from waste materials, Methanol and hydrogen as fuel. They even can be used for emergency light, housing electricity.
Iran has faced with two problems one is high Fuel consumption and another problem is lack of proper development in technology at car industries and power plant. And lack of attention to problems caused by environmental pollutions has increased this problem.
There for, producing Fuel cell can be a proper remedy for continuous development.
With certain consideration to this technology different research centers in Iran including Iran new energy organization has performed many projects.

5- Projects in Iran

5-1- energy pilot independent from Network based on solar Hydrogen and fuel cell

- Year start 1996
- Year and 2005
- place of implementation Taleghan sit Independent pilot from network with converting solar energy to electrical energy will provide production and hydrogen saving as energy carrier. This carrier can be converted to electrical energy and fulfill the ultimate user [3, 5].

Basic elements of this pilot are as follows:
Photolytic 10 KW capacity (Figure 1)
Electrolysis with 5 kw and Nominal production capacity 1 normal m/hr hydrogen (Figure 2)
Hydrogen tank (Figure 3)
Fuel cell system with 1.2 KW capacity (polymer – like) (Figure 4)
At present this pilot has lunched in Talegan energy site and is at data obtaining process.
Trained results:

- Practical feasibilities of photovoltaic system connection to hydrogen production systems.
- Presentation of independent energy system from network based on solar energy, hydrogen and Fuel cell.
- Analyzing application of solar hydrogen system independent firm network.
- Analyzing performing hydrogen as energy carrier.

Figure 1, Photolytic 10 kw capacity Power Plant

Figure 2, Electrolysis with 5 kw and Nominal production capacity 1 normal m/hr hydrogen

Figure 3, Hydrogen tank

Figure 4, Fuel cell system with 1.2 KW capacity

5-2- pilot installation of Hydrogen semi – industry with 200 kw capacity and purchasing and installation of Electrolyze device 30 normal per m (150 kw) and liquid making Equipment and other spare gas Analyzing systems.

Data started: 2001
Forecasting of date ended
Place Taleghan
Project goals:
- Hydrogen production with:
- Hydrogen storage with capacity of 20 m and 100 bar force
- Production of electricity with using of Fuel cell systems.
- Lunching a unit for hydrogen filling

Project description
The design of energy pilot accustomed with ecology which is performing in Taleghan energy site, is done with the aim of hydrogen Energy and providing conditions of recognizing bassinets of this energy carrier.
This pilot is consisted of production units (water electrolyzed), storage (gas – like under high pressure), transferring (hose line) and hydrogen consumption (Fuel cell), which hydrogen production unit consists of 2 electrolyzing device with 2 capacity 30 Nm/hr and 40 nm/hr and receive the needed electricity from worldwide network. The hydrogen produced in this stage, is prepared for entering to liquidation cycle (with capacity of 20 lit/hr) after purification processes with 99/95 purity, produced hydrogen, first will be stored in a 20 m tank under operative pressure of 10 Bar. And then will be saved in 20 m tank under operative pressure of 10 Bar [5].
Hydrogen, in this stage is prepared for Application in Fuel cell (25 Kw) and lastly for ultimate users. In case for transferring of (H) we can replace some parts of hydrogen in the mentioned tank with special cylinders.

5-3 performing feasibilities studies – Analyzing Fuel cell attraction in Iran

Year started – 2002
Year ended – 2004
Place – Tehran
Project description
Guiding committee of new energies organization has defined the feasibility studies – Fuel cell attraction and strategies for technological development in the country in order to respond to substance trap questions and strategic of Fuel cell technology area [5].
For this reason guiding committee of Fuel cell has separated into 3 substantial stages:
1. Knowing the Fuel cell technology and its related bases
2. Collection of technological development strategy of Fuel cell in the country.
3. Determination of Approaches of Fuel cell technological development strategy.
Project results
- Obtaining the suitable energy generator
- Developing Fuel cell Technology in transportation industries, power plants, and countries portable strategy
- Determination of Fuel cell Technology place for comparing with other competitors

5-4- Studies about saei peik power plants in the country by Fuel cell

Year started 2004
Year ended 2004
Place Tehran
Project Description
In this research the electricity of off – peak will produce by use electrolyzed and hydrogen.
Hydrogen will be kept in Hydrogen tank and during peak hour, this hydrogen will be converted by Fuel cell to electricity and enter the network [5].
Obtained results:
Application of Fuel cell for energy preservation during peak – off in power plants.

5-5 Marking planets of z – polar Thermoplastic polymer for polymeric Fuel cell
Year started 2005
Year ended 2006
Place: Esfahan
Project Description
Fuel cell is made is made of 2 – polar plates elements and the performance procedure in Fuel cell has a direct effects on efficiency and exist system. There are different ways to make 2-polars plate and based on the selection of certain way, different materials will be used [5].
In this project the aim is attain the technology of making Thermoplastic polymeric 2-polar plates.
In this procedure, thermoplastic polymer will mix with smoke particles and or Graphite and then in pressed molding device be molded to specific desired form.
Obtain results:
Attaining the Technology of making Thermoplastic polymeric z-polar plates for polymeric Fuel cell

5-6 Providing 25 KW Fuel cell
Year started 2006
Year ended 2007
Place: Taleghan site
The used Fuel cell system consists of 2 stack with capacity of 25 Kw, the durability of this system has estimated around 5000 hrs. The output electricity of these system is around 36 – 57 w DC and produced water in this system is 80 ml/min. figure 5 and 6 show the implements of this project [5].
Obtain results:
- To obtain experience of electricity to network.
- Exploiting and data gathering for studying the problems and finding the solution.
- Knowing the procedure of performance of Fuel cell system for applying in Fuel cell making.

Figure 5 Implements of 25 KW Fuel cell project

Figure 6 Implements of 25 KW Fuel cell project

5-7 Hydrogen – burn of peykan engine
Project Description
The application of Hydrogen gas different advantages such as, burning without co, coz and unburned hydrocarbons flam, low energy needed for flaming, high rate of flam high penetration speed, Approaching to Auto cycle suitable thermal value and thermal efficiency [5].
- In this project the following steps for hydrogenising paykan engine are considered:
1- Essential changes on Peykan Engine
2- Designing and making mixer of air and (H)
3- Improving sparkling system
4- Improving timing of
Obtain results
The transferring of technology of using hydrogen fuel in automobiles
Localized the referred technology

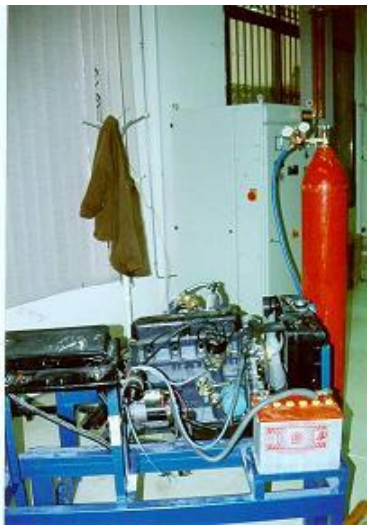

Figure 7 Implement used in 7 Hydrogen – burn of peykan engine project

6- Conclusion

According to the referred materials there is a serious effort in Iran to use fuel cell and hydrogen energy .and the policies for development and completion of plants are searched and under exploration and we hope in the coming future we witness a multilateral improvement in this field through hydrogen planets and fuel cell's in Iran.

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