

# Wind power applied to the Hydrogen generation

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## Abstract

The object of the presented communication is to show the applications of the use of the renewable energies, in particular the wind one, for the securing of Hydrogen, in the base of the tower of the wind power, as power supply of the fuel cell.

In the present moment, the technology based on the Hydrogen is constituted in a serious alternative to the use of the fossil fuels, being outlined as a new source of fuel based on renewable energies.

The electrical energy produced in wind powers is, principally, injected into the electrical networks, for his transport, distribution and consumption. The novel aspect that we try to exhibit in our communication is the storage of the wind energy in the shape of Hydrogen, which can serve to feed to fuel cells installed in automobiles. The produced electricity will feed the engines that will drive the automobile, without any type of pollutant taking place, since the residual element is the water.

## Key words

Wind power, fuel cells, Hydrogen, renewable energies, Environment.

## 1. Introduction

The gasoline and other products derived from the oil are excellent sources of energy, since they are compact and his supply in the planet is available, but it is limited. Also, the fuels derived from the oil present another serious problem as it is the Carbon. When a product of the oil is burned carbonic gases and other pollutants are expressed to the ambience. This is one of the causes of the smog in the cities and it is harmful, both for the health of the persons, and for the animals and the environment in general. The majority of the scientists believe that the combustion of these fuels provokes a global warming of the planet.

It remains clear that the resources of energy that we choose have notable impact on our life. With the current models, principally with the use of the fossil fuels, we see

some of the consequences of our decisions with regard to the type of energy used:

- 1) *Urban contaminated air (smog)*
- 2) *Acid rain*
- 3) *Global warming*
- 4) *Climatic change*

In addition to other questions related to the origin of the fuel:

- 1) *Dependency on politically unstable countries*
- 2) *Changeability of prices*

If we are capable of producing electrical energy from renewable energies and then we keep it, in order to use it in a fuel cell, we will be able to limit to a great extent the emission of carbonic gases to the ambience and also, to reduce the dependency on the petriferous supply.

The quality of the air, water and soil, and finally, the health of the planet, as well as ours and that of the future generations, they depend on our decisions on the used energy.

The communication that we present, tries to exhibit the storage of the wind energy in the shape of Hydrogen, which can serve to feed to fuel cells installed in automobiles. The current is still produced by the same ones it will feed the electrical engines that will drive the automobile. As consequence of the previous thing, it will create to themselves plants of storage and distribution of Hydrogen to service stations.

## 2. Description of the work

The work is structured of the following form:

- 1) *Generation of electrical energy*
- 2) *Hydrogen*
- 3) *Fuel cells*
- 4) *Applications*

### A. Generation of electrical energy

The use of the renewable energies for our electrical habitual needs presents different advantages, such as avoiding the consumption of natural resources, as well as the degradation of the environment, which turns out to be of the emission pollutants, you escape of oil and residual poisonous products.

So, in this paragraph it goes away to present the achievement of the necessary design to carry out the process of conversion of wind energy in electrical energy, from the spades of the wind power, happening for the box, generator and transformer, for his injection in the electrical network or, by means of electrolysis, to store it in the shape of Hydrogen, which, in turn, will serve to feed the fuel cells.



Fig. 1. General sight of the spades and the head

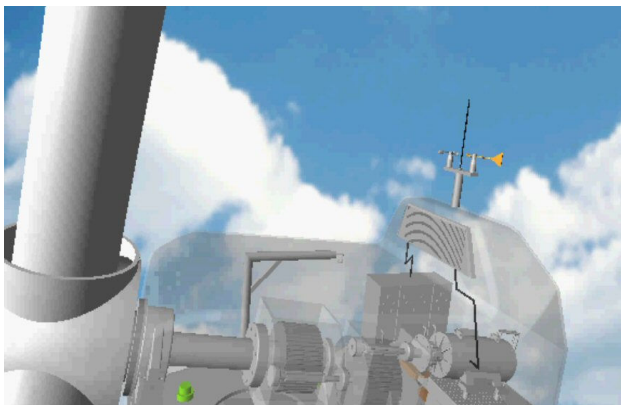


Fig. 2. Detail of the anemometer and the weathercock

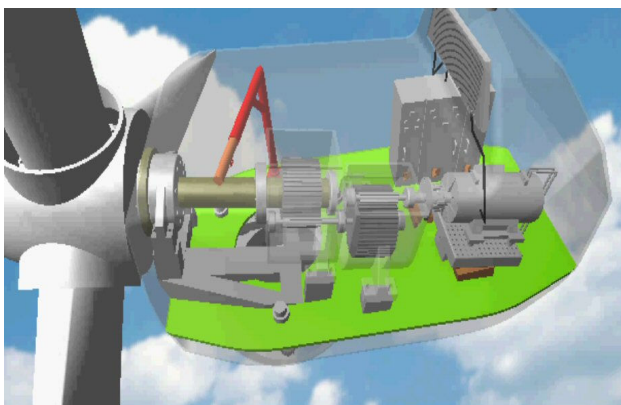


Fig. 3. Detail of the crane

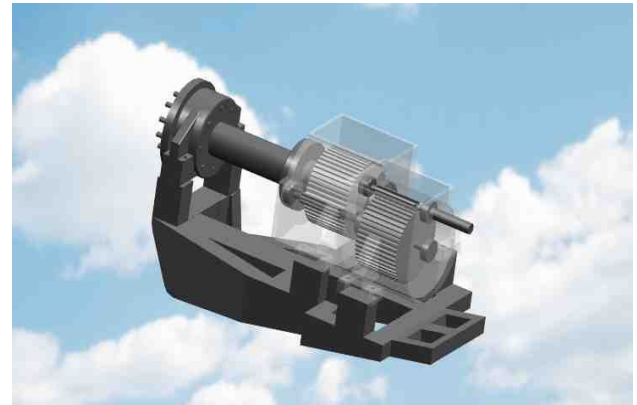


Fig. 4. Sight of the multiplier and principal axis



Fig. 5. System of braked of the spades

### B. Hydrogen

The Hydrogen has been for ages a fuel of confidence, being used as domestic gas in hearths more than one century ago, until the agent happened to be a propellant of the spatial rockets of nowadays.

This gas is a fuel much extended in the planet. It can be obtained from water, by means of electrolysis, using electrical current to separate the Hydrogen and the Oxygen that they compose the molecular structure of the water.

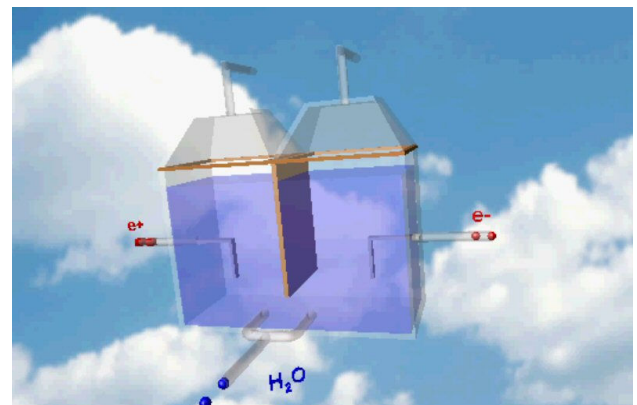


Fig. 6. Process of electrolysis. Dissociation of the water

The generation of the electricity necessary for this process, from the renewable energies, a fuel guarantees completely freely of emission pollutants, storable, of easy transport and available in the whole world. It constitutes for all this, one of the most promising routes for a more sustainable new energy model in average and long term.

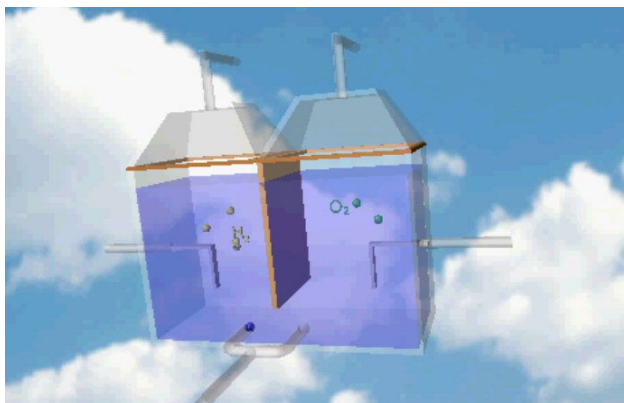


Fig. 7. Process of electrolysis. H<sub>2</sub> and O<sub>2</sub> separation

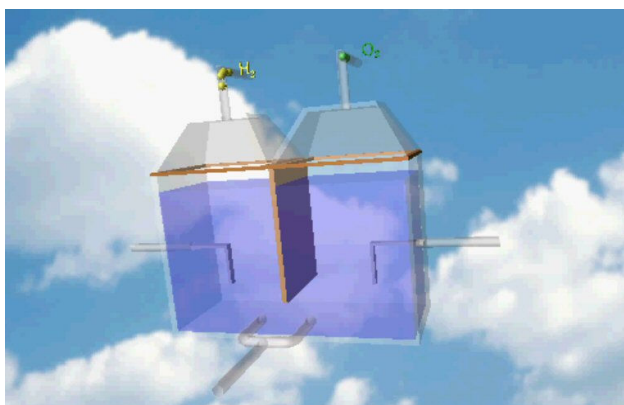


Fig. 8. Process of electrolysis. Securing of Hydrogen

To use the technology of the Hydrogen has diverse advantages:

- 1) *Does not consume natural resources.* The Hydrogen can be obtained of the water, by means of electrolysis.



Fig. 9. Transformer / Rectifier

- 2) *Does not produce contamination.* By means of a process of oxidation, in a fuel cell, the Hydrogen turns again into water.

Therefore it is an inexhaustible, renewable and clean resource



Fig. 10. Water tank

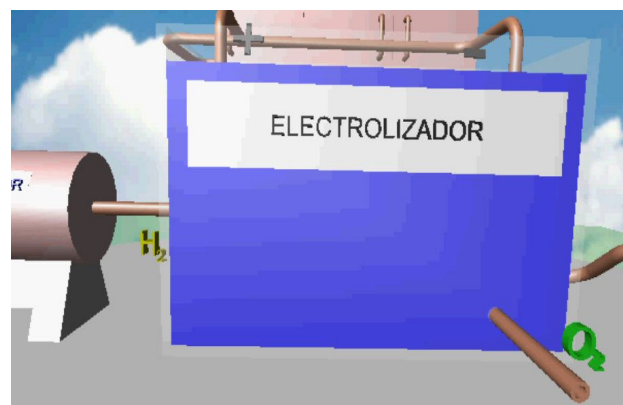


Fig. 11. Electrolyzed

- 3) *Security.* The systems based on the Hydrogen have demonstrated to have high reliability along the history. It is not poisonous and, in case of any escape takes place, it vanishes in the ambience with rapidity, staying in the top part of this one, where it is inert.

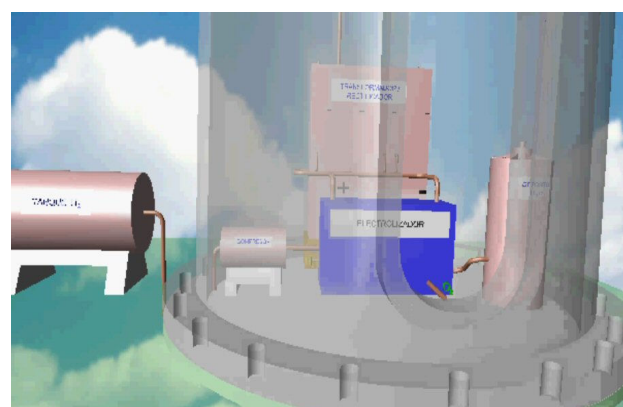


Fig. 12. Place with regard to the base



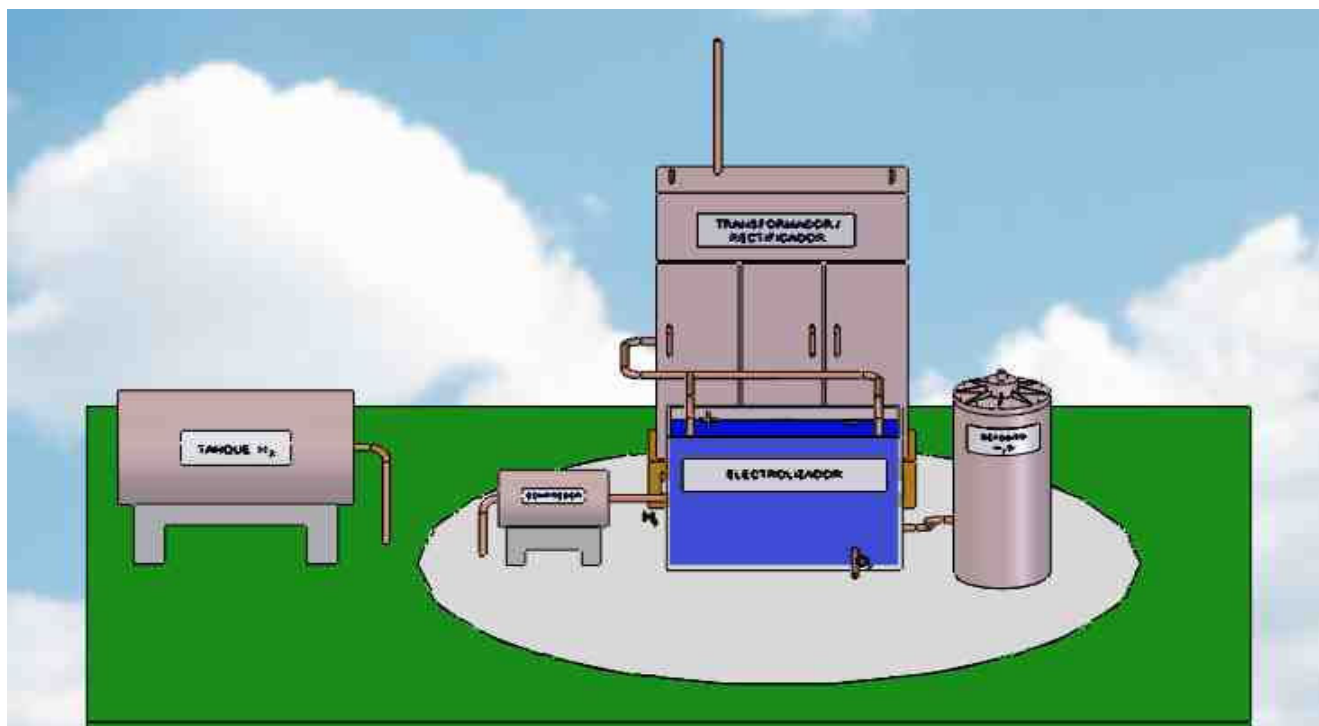


Fig. 13. General process of securing and storage of Hydrogen

### C. Fuel cells

Although the beginning of functioning of the fuel cells was discovered in the year 1839, for William Grove, it was not even 60s of last century, when it was applied in the spatial missions of the NASA, to give electrical energy and drinkable water. From then the Industry recognized them as a technical option, although in this moment they were facing technological barriers and high costs of production.

In the actuality, the most important companies of the world in the energy sector are employed at his investigation, development and determination of his potential applications, in order to make them more reliable and lasting, as well as, to reduce his cost, There is not doubts that this technology will revolutionize the world as in his moment the engine of internal combustion did it, having positive impacts, both in economic and environmental terms.

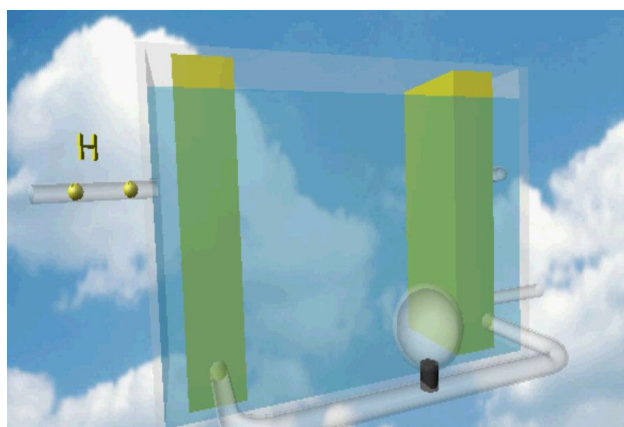


Fig. 14. Fuel cell

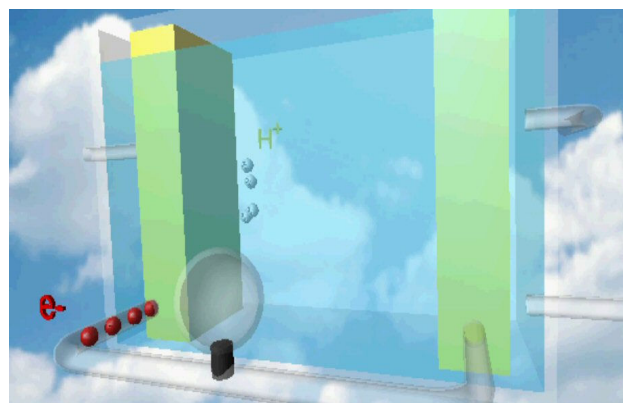


Fig. 15. Current generation

The fuel cells are generating systems, which are based on chemical processes to produce electrical energy from the Hydrogen and the Oxygen. The fuel, on having flown in the cell across the negative electrode, that propitiates the separation of the Hydrogen in ions that reach the positive electrode, on having combined with the Oxygen, they generate water. The electrons that they do not cross across the electrolyte flow for an electrical external circuit, with what there is generated a voltage, which, on having connected a load, produces an electrical current.

The engines of internal combustion, the batteries, and the fuel cells have in common that are devices transformers of energy. The first ones provide of energy to, practically, all the automobiles that circulate in the highways of the world. They generate noise caused by the explosions to high temperature of the process of combustion, transforming the chemical energy of the fuel in thermal and this one, simultaneously, in mechanics, and in occasions in electrical when a generator mates.

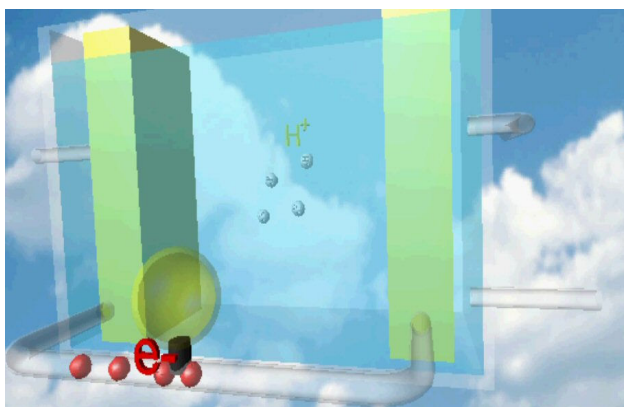


Fig. 16. Lighting of the lamp

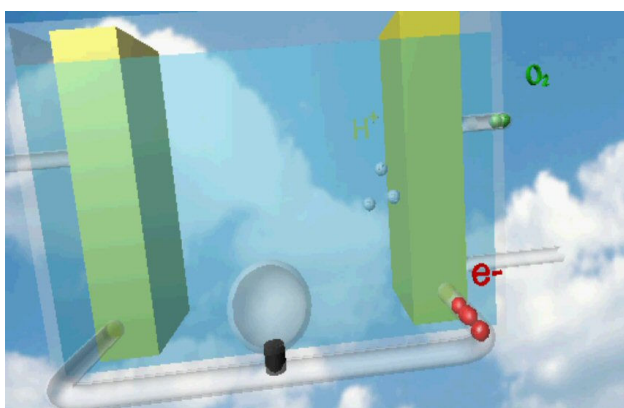


Fig. 17. H<sub>2</sub> and O<sub>2</sub> combination

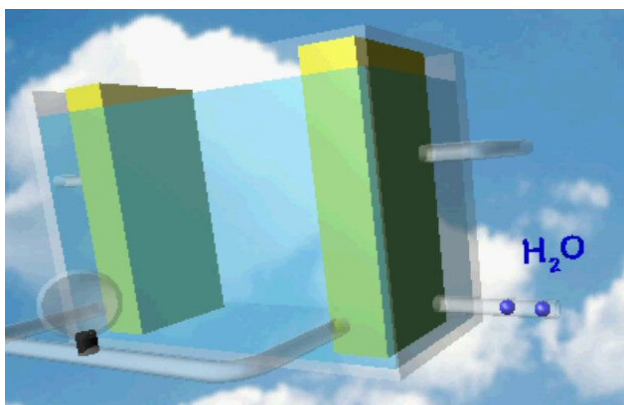


Fig. 18. Residual product of the fuel cell

The batteries and the fuel cells have similar operation and, for his nature, are more efficient than the engines of internal combustion, since they turn directly the chemical energy of the fuel, in electrical energy, whereas, on having involved the conversion of thermal energy, the engines of internal combustion limit themselves to the efficiency of the Cycle of Carnot.

Both devices can feed to the electrical current automobiles, with minimal requests of maintenance, on not having had mobile parts. Nevertheless, when the reagents are finished in the batteries, these have to be replaced or to recharge. In a fuel cell this does not happen, since the reagents are fed in form continues, as

which we will have availability of energy while we have reagents, and also, they present advantages such as minor weight and size, rapid supplying and major autonomy.

Like synthesis, to mention the advantages that present of fuel cells:

- 1) *High efficiency.* The cells transform directly the chemical energy into electrical energy, with major yield than no other system of energy. They have an approximate yield of 50 %, which is very high if we compare it with 15 % that can have the engines of internal combustion.
- 2) *Silent functioning.* In normal functioning, and since they do not have mobile components, the fuel cells do not produce any noise.
- 3) *They do not contaminate.* One of the biggest advantages of the use of the fuel cells is the low level of emission, being this one of the principal motives by what both his investigation and his development has been impelled. On having used Hydrogen, the only product of the reaction is a water steam.
- 4) *Long duration.* Although the fuel cells have not proved yet the extension of his useful life, since they are very recent, some cells go working several years and, according to the current information, it is foreseen that many could last more years.
- 5) *Modulability.* The cells can gather together some with others, allowing to have, from limited systems of energy, as to impel to a small vehicle, up to big systems, capable of generating energy for an entire population. Thanks to this characteristic, it is possible to increase (or to diminish) the energy of the systems as the change of the demand.

#### D. Applications

The applications can gather together in two categories: transport and fixed and mobile plants of generation.

The principal manufacturers of automobiles of the world are provided with programs of investigation and development of this technology.



Fig. 19. Hydrogen car



We find experiences in the NECAR 4 and the NEBUS developed by the company Daimler-Chrysler, the first one of them, from Mercedes Benz Clase A, fed by fuel cells that consume liquid Hydrogen and it is considered to be a "Vehicle of Zero Emission", reaching a maximum speed of 145 km/h, with an autonomy of 450 km. On the other hand, the NEBUS, despite being still in phase of prototype, already there has decided information of efficiencies of conversion of energy of up to 55 %, which is an almost 15 % more than an engine Diesel.

As for plants of generation, the applications are changed, being able to happen from small cells to feed cell phones or small electronic teams, up to units of 200 kW, to feed with electrical energy to industries or to inhabited zones. In the actuality there exist about 200 installations of this type distributed all over the world with favourable results.



Fig. 20. Fuel cell mobile



Fig. 21. Clean environment

### 3. Conclusion

The resources of energy that we choose have notable impact on our life. With the current models, principally with the use of the fossil fuels, we see some of the consequences of our decisions with regard to the type of energy used: urban contaminated air, acid rain, climatic change, etc.

In this work there has been exhibited the process of transformation of wind energy in electrical, his storage in the shape of Hydrogen and his use in the cell of fuel, as response to the problems derived from the use of the habitual fuels. Thus an energy respectful solution is exhibited with the environment.

On our decisions on the used energy they depend the quality of the air, water and soil, and finally, the health of the planet, as well as ours and that of the future generations. We all have the same ambition: to have a healthy and sure environment, for it the use of renewable energies will help us to obtain a cleaner world and to improve our quality of life.



Fig. 22. Respectful energy with the environment  
(Courtesy: TEXACO)

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