

HHO Generation & Its Application on Welding

Rajat Kesarwani¹ Mohd. Ariz² Naveen Kumar³

^{1,2}B.Tech Student ³Assistant Professor

^{1,2,3}Department of Mechanical Engineering

^{1,2,3}United College of Engineering & Research, Allahabad, India

Abstract— At the present time supply of fossil fuel is decreasing day by day whereas there is also an increment of carbon dioxide in the atmosphere, so the tendency towards increasing the use of renewable energy sources has increased. To achieve this purpose mostly all the countries are doing research in the development of renewable sources of energy. The tendency towards increasing the use of renewable energy sources has fueled the development of new sources of energy needed for fusion welding. To overcome these problems one of the relatively newer source of energy is the Hydrogen fuel or Oxy-hydrogen fuel obtained by electrolysis of water in the chamber with one output, a mix of one and two atomic hydrogen with oxygen. The mixture can burn with or without the presence of air, where in the obtained water vapor and heat required for welding. The effective temperature of the flame depends on the composition of the material's to be welded. As most of the conventional welding is done either using any gas or by direct electricity, so it very dangerous to work with them as there are various safety measures involved while working with them and handling them. And not to mention the heavy and bulky groups of equipment involved, which have to be transported to the place of work. So HHO Generator is an initiative towards a simpler, practical, cost effect and economical method for welding.

Key words: Electrolysis, Methods & Equipment, Results

I. INTRODUCTION

The welding technology as a source of heat, among others, is used and combustible gasses. Due to the light receiving, production and transportation, the most used fuel gasses based on carbon, or hydrocarbons. They combustion in a stream of air or oxygen gives the necessary heat for welding to form products of combustion: carbon monoxide (CO), carbon dioxide (CO₂) and water vapor (H₂O). However, as the heat source for welding can be used alone hydrogen as fuel gas. Hydrogen can be used as a pure molecular gas (H₂), which is burned in a stream of oxygen creating a flame temperature up to 2800°C. This procedure is called oxy hydrogen welding. If molecular hydrogen (H₂) we introduce the arc on the electric arc dissociates into atomic hydrogen subtracting the heat of an electric arc. When atomic hydrogen leaves the arc recombine into molecules releasing heat. When welding atomic hydrogen (atomic arc) flame reaches a temperature up to 4000°C. This procedure is called Oxy-Hydrogen Welding.

A. Water Electrolysis

Electrolysis of water is a process in which water is split into hydrogen and oxygen by the use of electrical energy, in water electrolysis, the total energy considerably exceeds with the increasing temperature, while the essential electrical energy decreases.

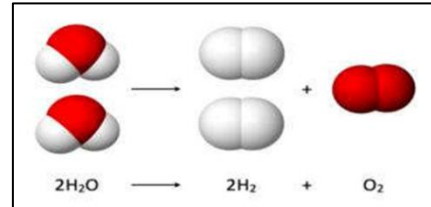
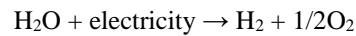


Fig. 1: Dissociation of water in H₂ & O₂

Following reactions occur in the cell when an electrolyte is mixed with water.

Electrolyte: $4\text{H}_2\text{O} \rightarrow 4\text{H}^+ + 4\text{OH}^-$

Cathode: $4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2$

Anode: $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$

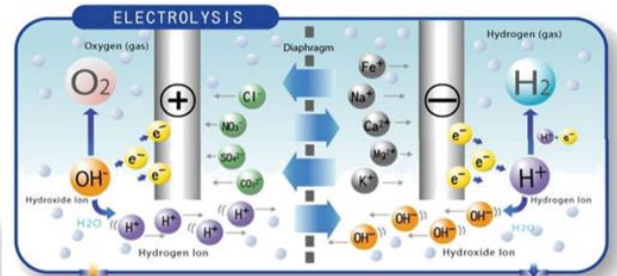
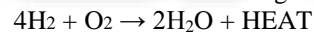


Fig. 2: Electrolysis of Water

During welding process due to combustion of hydrogen gas in presence of oxygen gas heat is produced as the reaction of combustion is exothermic in nature. During the combustion following reaction occur to give heat.



II. LITERATURE REVIEW

Saurabh et.al [2014] the historical background of hydrogen fuel cell begins in the nineteenth century, and the credit for the development of this tool goes to Sir William Robert Grove, a Welsh judge and beginner researcher, conceived in Swansea in 1796. In 1839, he found that blending of hydrogen and oxygen in the vicinity of an electrolyte handled power and water. The term —fuel cell for Grove's innovation was initially used in 1889 by Ludwig Mond and Charles Langer, who focused on creating a power module that uses mechanical coal gas and air as a source. The fundamental step they made was changing the fluid electrolyte with splashed up asbestos, the model to the strong electrolyte. In 1932 a designer at Cambridge University, Francis T. Bacon manufactured an energy component which was focused around a less destructive antacid electrolyte and made it conceivable to utilize minimal effort nickel as the impetus. In 1959, Bacon demonstrated a stack of forty cells, which could handle 5kw of electric force and was equivalent to current energy units. In 1959, the first energy component vehicle, a tractor, was made by Allis-Chalmers ranch gear firm in Milwaukee, Wisconsin. The principal Proton Exchange Membrane Fuel Cell (PEMFC) was made in 1954 in the USA by a physicist

William Thomas Grubb from General Electric. At the point when the USA and USSR, the two superpowers of the twentieth century, began the race for space, energy units turned into a matter of incredible enthusiasm as the need developed for minimized vitality transformation gadgets locally available rocket. In the 1950's, NASA chose to utilize energy units to supply power throughout space flight for their manned space missions. NASA supported in excess of 200 exploration ventures on power device engineering and thusly, energy components have given ready for and water to the Gemini, Apollo and Space Shuttle missions. In 1983 a group headed by Geoffrey Ballard from Canada accepted a Canadian government's solicitation to create a PEM energy component. Ballard is as of now a leading organization in the power device business and gives energy unit stacks and parts to numerous framework producers.

Bozickovic et al [2013] as for getting Brown's gas is water and the relatively small amount of direct current electricity, it is expected that this source of heat for welding in the future will be extensively used for welding and related techniques.

How has a neutral flame which does not use oxygen from the front passenger and does not produce harmful gasses, it can be used indoors without risk to welders. The process of the welding heat source is environmentally clean and has significant advantages over other sources of heat.

It is necessary to examine the applicability of the heat welding of specific materials. It should also prove technologically welding with Brown's gas.

Vashi et al [2016] water electrolysis is one of the cleanest, simple, and intuitive procedures to yield hydrogen. Such process, discovered by M. Faraday in 1820, consists of decomposing water into its constitutional components known as oxygen and hydrogen by means of electric current. The process of electrolysis works with an electrical power source that is connected to electrodes that are made out of typical metal (such as stainless steel, platinum or, titanium), which are submerged in water enhanced with electrolytes. Hydrogen will be produced at the negatively charged electrode (cathode), while oxygen will be produced at the positively charged electrode (anode). In past, similar such schemes were developed for power generation. As per literature survey, Invivo power generation using Micro solid oxide fuel cell stacks have been proposed. It consists of Hybrid self-sustaining system for power generation. It was initially used for powering IET Indian summit, Kolkata in 2013. There was an alternate technique called Oxygen Ion Transport to the electrolyte solid oxide fuel cell was implemented in ICRERA. This were some of the fuel cell techniques which were implemented in past. Also there was a Multi-fuel model of Oxygen and Ion transport fuel cell presented in 8th WSEAS International conference. This model was equipped with supplementary fuels like Traditional fuels, Biomass Fuels, Nano biomass fuels, Wasted Body Fluid Fuels etc. for Invivo support. Similarly literature also describes (Proton Exchange Membrane) PEM fuel cell technology based on the existing principle of HHO.

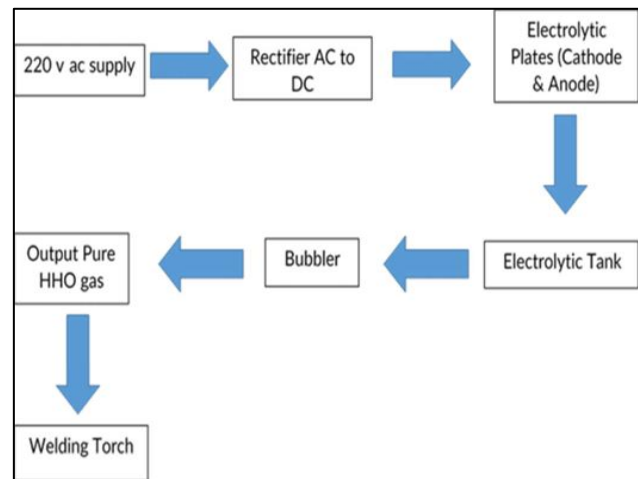


Fig. 3: Block Diagram

A. A.C. Power supply

A.C. single phase 220v, 50 Hz electric supply is used as initial power supply input for the setup.

B. A.C. to D.C. Convertor

An adapter is used for this purpose. The adapter converts 220 v AC current to 6 – 12 v dc current output.

C. Plate Assembly

A plate assembly is made using the 6 stainless steel sheets of 3"×12" in the following pattern as shown in the picture:



Fig. 4: Generator Plates

The connection and the terminals will be connected as following in the figure:

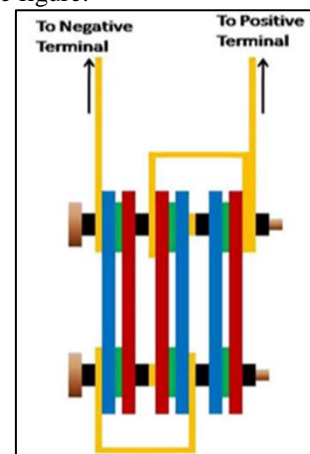


Fig. 5: Generator Plates setup

D. Electrolytic Tank

The capacity of the tank is roughly 5 liters and it is made of acrylic tubing.

The tank has 1 opening on the top and 2 holes for the terminals. Bottom of the tank is sealed. It is made by 4" outer diameter acrylic tube of 500 mm length.



Fig. 6: Electrolytic Tank

E. Bubbler

It is a very important tool in this project, it is made up of an acrylic tube of 3" dia. It has two nozzles for output and input. It consists of the flash port at the upper side of the bubbler. Basically, the bubbler has three main uses:

Stop any backflow of gas or water.

Remove any impurity from the mixture and give pure HHO gas. Stop any fire to move further in the case of any fire failure.



Fig. 7: Bubbler

F. Vinyl Tubing

A 1 m long vinyl tubing is used to transfer the generated gas from electrolytic tank to bubbler and then from bubbler to the torch.



Fig. 8: Vinyl Tube

G. Welding Torch

The welding torch is usually made up of brass for the welding purpose. It is made up brass with a single nozzle with a hole of 1mm; there is a pressure controller for control the pressure of hydrogen gas.



Fig. 9: Welding Torch



Fig.10: Actual setup of efficient welding torch by hydrogen fuel cell

III. RESULTS

A. Calculation for Hydrogen

To get maximum efficient output - conditions are: (2 - 2.2 Volt per plate) with 0.54 Amps per inch² active surface area of the plate. In the model by using the result: Plate size is: (7.5*7)" and circle diameter is 1.4 cm.

Rubber gasket is: 2*Net active surface area = (rectangle area) - (4*triangle area)

- (2*circle area)-(area exposed to H₂)

$$= (14 * 12.8) - (4 * 0.5 * 2.8 * 2.5) - (2 * 3.14 * 0.7 * 0.7) - (7.8 * 0.9 * 0.5)$$

$$= 158.62 \text{ cm}^2 = 24.58 \text{ inch}^2$$

Therefore, maximum current with its full efficiency can pass in the reactor is = 24.58 x 0.54 = 13.27 Amp

For supply of (220 Volt DC, 11Amps)

H₂ output is: 12.6 LPM

In an hour, output HHO = 756 liters

H₂ = 504 liters

O₂ = 252 liters

Energy density of H₂ 130MJ/kg

Density of H₂ = 0.085 gm/l at room temperature.

So, Energy output = 504*0.085*0.001*130 = 5.57 MJ/hr.

B. Energy Generation by Hydrogen

Consume energy is 220*11*3600 = 8.71 MJ/hr. (Clean Energy) Energy from the power plant is 8.71*3 = 26.13 MJ/hr.

Hydrogen generation is 12.6 LPM*0.66*0.085 gm/lit. = 0.706 gm/mil.

So the maximum efficiency of hydrogen gas we can get by this model is 12.6 LPM (liter per minute) by supplying the 220v at a pressure of 4 to 6 psi.

IV. CONCLUSION

In all the developing country all the research and development team is trying to focus on carbon free environment and to replace fossil fuel with renewable Sources of energy, like hydrogen gas, solar energy etc. India is also a developing country; many types of research are being made for the development of cheap and environment free sources of energy. Water electrolysis is a technology that deals with the production of hydrogen gas.

As for getting Oxyhydrogen fuel water and a relatively small amount of direct current electricity, it is expected that this source of heat for welding in the future will be extensively used for welding and related techniques. It has a neutral flame which does not use oxygen from an external source and does not produce harmful gasses, it can be used indoors without risk to welders. The process of the welding heat source is environmentally clean and has significant advantages over other sources of heat.

V. FUTURE SCOPE

The future scope of this project is using hydrogen fuel in place of fossil fuel, as the fossil fuel is lacking day by day and it creates too much carbon, whereas it (HHO Fuel) is carbon free and eco-friendly to the environment. It can be used for various purposes like cooking, welding, cutting etc. presently many companies are making use of it in vehicles like Hyundai and BMW have recently made such cars which can run on hydrogen fuel. Many developing countries have been researching on this project to use for electricity by the help of PEM (PROTON EXCHANGE MEMBRANE) it is a fuel cell used for making electricity by hydrogen fuel cell, so the basic scope of this project is to give larger efficiency at low cost.

REFERENCES

- [1] Research paper on Efficient Welding Torch by Hydrogen Fuel Cell by Suman Saurabh, P B L Chaurasia
- [2] Brown's Gas – Heat Source For Welding by Zdravko Božičković from <https://www.researchgate.net/publication/294260575>
- [3] Reduction Of Fuel Consumption In Engines Using Hho Gas by Harshal Vashi, G.T. Haldankar, Dr. Y. S. Rao
- [4] Electrolysis from? <https://en.wikipedia.org/wiki/Electrolysis>
- [5] Electrolysis of water from https://en.wikipedia.org/wiki/Electrolysis_of_water
- [6] Fuel Cell Explained - Power from Hydrogen!!! The Future!!! from - <https://www.youtube.com/watch?v=gcvs1QzrxrE&t=163s>
- [7] <https://www.youtube.com/watch?v=cqjn3mup1So>