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Homemade Oxygen Generator by Water Electrolysis Processes

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Abstract: Oxygen generators are frequently used to provide oxygen for the patient. In the current scenario, demand of oxygen is increased at domestic level as well as at organizational level since the pandemic. Most of the researchers have done research about oxygen extraction through electrochemical process using some advance materials and designs having benefits like no circulation of water but they are very expensive. In some of the papers, experimenters used very health hazardous materials like LDPE and HDPE plastic bottles for making concentrator cheaper. But our aim was to construct the oxygen concentrator with low cost, user friendly, portable as well as tough body. Basic methodology was based on electrolysis process of water in short breakdown of water. Water consists of H_2 ions and O ions, having positive and negative charge respectively. Thus, they can be separated easily using application current. We used two electrodes, filter bowls and a battery (12V, 5 Amp). Results obtained are production of oxygen in few hours. Results are acceptable according to cost and compactness of system, but comparatively low rate of production than mass producing oxygen extraction plants.

Keywords: Water electrolyzer, Electrical variables, H_2O and O_2 production.

I. INTRODUCTION

The procedure for creating molecular oxygen via a chemical reaction is known as an oxygen evolution reaction (OER). Because to its affordable and environmentally friendly attributes, scientists are now concentrating more on OER-based techniques for producing breathing oxygen for portable devices. In this post, we show how an electrochemical-based setup for oxygen evolution can be made with ease. Two holes were made at the top of a plastic 2-liter jar filled with 200g of sodium hydroxide (NaOH) aqueous solution so that a cathode electrode made of stainless steel and a power source-connected anode electrode. , could be submerged there. On a supply of 12V voltage and 4A current, the oxygen generation process began as bubbles formed. Through the plastic tube, the generated oxygen is gathered. Hydrogen is also produced, which can be stored separately. At first, 700 ml/min of oxygen was being produced per minute. An effective way to create hydrogen and oxygen is through water electrolysis (water splitting). Production efficiency is influenced by crucial design factors like electrical variables. The electrical parameters waveform, frequency, and amplitude of the AC and DC voltages were examined experimentally to determine their effects. between two flat plate-shaped electrodes separated by non-electrically conducting material and submerged in water, an electric current flows. Such as graphite, the electrolyser separates water into hydrogen and oxygen.

II. LITERATURE SURVEY

To start and complete any work or project, literature survey is very important because it gives knowledge of topic and help in deciding path to complete project successfully

For our project we have studied, the impact of electrical factors on the creation of hydrogen and oxygen (including Waveform, frequency, and amplitude of AC voltage), as well as DC voltage amplitude measured by water electrolysis from Paper [1].

Further [2] Oxygen Production through an Efficient Electrochemical Process

Research by [3] investigated electrochemical extraction of oxygen using Polymer Electrolyte Membrane (PEM) electrolysis technology.

Research by [4] developed solar spectrum management for efficient thermo-photovoltaic water electrolysis to produce hydrogen

Research by [5] designed optimal distance between electrodes for water electrolysis to produce hydrogen.

Research by [6] investigated Hydrogen production by water electrolysis.

Along with literature survey, references plays most important role in work or project. Because of referring many already existing project papers we get idea of design and patent work.

III. OBJECTIVE

1) To construct a portable device which can generate O2 for vulnerable conditions.
2) To generator O2 with affordable price and maintenance.
3) To study the reaction of water with electrolysis and understand the working of DC battery and different voltages.
4) To separate oxygen and hydrogen with the help of water electrolysis process.
5) To be able to calculate the amount of gas produced with respect to voltage provided.

IV. METHODOLOGY

1) Selection of material
2) Battery Selection
3) Assembly and Testing
4) Separate out Oxygen and Hydrogen
5) Result and Conclusion
6) Future Scope

V. MATERIAL SELECTION

1) Water purifier bowl (quantity=2) (material=PVC) (Bigger diameter=11.5 cm, length=26 cm, volume=1 litre each).
2) Connecting pipe (quantity=1) (material=plastic) (length= 10cm, diameter= 2.5cm).
3) Battery (quantity=1) (voltage= 12volt, ampere= 4).
4) Wires (quantity=2) (Length = 1 meter).
5) Electrodes (quantity=2) (material= graphite) (length= 15cm, diameter=2mm).

VI. FABRICATION OF DEVICES FOR OXYGEN PRODUCTION

A. Materials & Methods

A 2-liter plastic jar with a lid, stainless steel rods, electric wire, plastic tubes, DI water ,sealing fluid, and a power supply are also required.

B. Device Manufacturing

In the experiment, a 200gm aqueous solution of NaCl was poured into a 2-liter plastic container. On the jar's lid, two holes were drilled, and two pipes were inserted to divide the two electrodes. Two stainless rods were inserted in the middle of these pipes as shown in the schematic. An electrolytic reaction was carried out with the aid of a power source. The power supply's positive and negative terminals made separate connections to the Stainless Steel rods. The oxygen and hydrogen bubbles on the positive electrode could be observed almost to the electrodes when a voltage (12V) was applied. The produced gases were carried on and collected at outputs. A plastic tube connected the mouth of the outlet to the outlet. This tube can be utilized right away to use oxygen. But, hydrogen gas that has been created can be stored separately.
At first, it provides 700 milliliters of oxygen per minute.

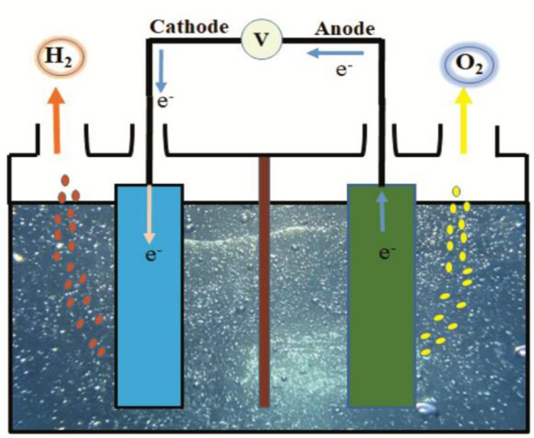

Fig.5.1: Electrochemical water splitting cell setup

C. Electrolyser Working Principle

The splitting of water molecules typically occurs during the electrolysis of water. This procedure needs electricity as an input and is carried out in the presence of an electrolyte, or alkaline solution. Water molecules are divided into hydrogen and oxygen in the electrolyser cell. Because the reaction is endothermic, as a fuel, electricity is required. The cathode, which is submerged in the electrolyte solution, and the anode make up a basic water electrolysis unit. The electrodes are connected to a DC power supply external to the system. When the device is powered by a DC power source, electrons travel from the negative terminal to the cathode. At the cathode, the protons and electrons from the hydrogen combine to generate H2. After that, hydroxide ions go in the direction of the anode while H2 ions move in the direction of the cathode. Figure 1 shows how oxygen and H2 gases originate at the cathode and anode, respectively.

2 H_2O(l) 2 H_2(g) + O_2 is the overall reaction (g)

Hence, more than twice as many hydrogen molecules as oxygen molecules are created. The volume of the hydrogen gas is twice that of the oxygen gas since both gases are produced at the same pressure and temperature.

Fig.5.2: Oxygen generated at anode

VII. CLASSIFICATION OF OXYGEN PRODUCTION METHODS

We concentrate on methods for producing oxygen that are chemically based. We are now going to talk about some chemically based methods of producing oxygen. According to Fig. 6.1, the most common ways for producing oxygen fall into three categories.

A. Chemical-based Oxygen Generator

Through a chemical reaction, oxygen is produced in this process; the oxygen source is frequently an inorganic compound like superoxide, chlorate, or perchlorate. The chemical reaction in this oxygen generator is typically exothermic, and a firing pin is used to start the process. In order to provide passengers with emergency oxygen, commercial aeroplanes often use chemical oxygen generators. The oxygen canisters and masks are fastened to the aircraft's top. The panels automatically open and the masks are taken off if there is any decompression. To acquire oxygen, the passengers depress the mask's trigger and draw down the mask.

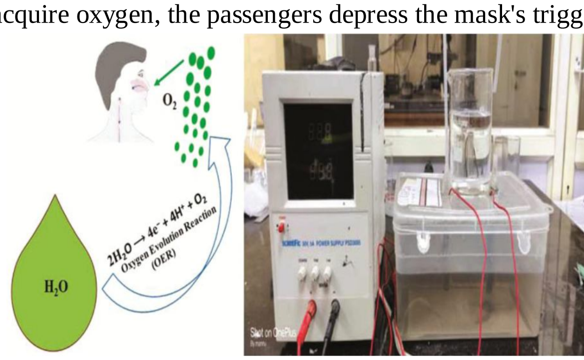

Fig. 6.1: Oxygen evolution reaction setup

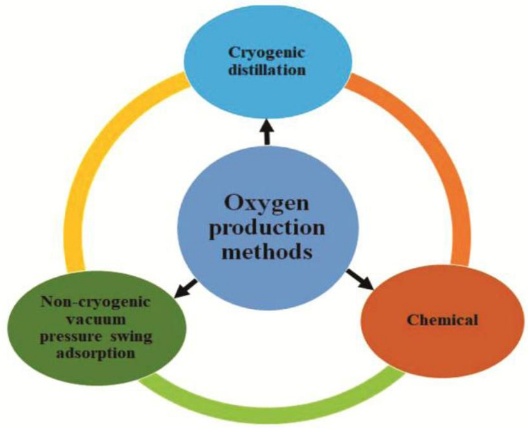

Fig.6.2: Types of oxygen production methods

VIII. DESIGN OF THE SYSTEM

A testing electrolyzing rig is constructed with the intention of examining the impact of the amplitude, waveform, frequency, and DC voltage of the AC voltage on the synthesis of hydrogen and oxygen. Figure 5.1 provides a schematic representation of the water electrolyzer employed in this research. The system is made up of a water electrolyzer, a bubbler, a power amplifier, a DC power generator, a pulse generator, and a device for measuring hydrogen and oxygen.
Following are the component of this system:

A. Pulse Generator

In this system, a pulse generator is used as the electrical power source.

B. Power Amplifier

The voltage produced at the pulse generator's output is amplified using a power amplifier.

C. DC Power Supply

DC voltage is produced using a regulated DC power supply.

D. Water Electrolyzer

A plastic cylinder container with a diameter of 12 cm is used in Figure 5.2, a height of 40 cm, and a capacity of 2 liters of water. The stainless steel 316 utilized for the electrodes is depicted in Figure 5.2. Each of the two electrodes is a flat plate measuring 6 cm in height and 5 cm in breadth. Each plate has a 1.5 millimeter thickness, and there is a 5 millimeter space between them. The resistive Teflon used to separate the flat plate electrodes acts as a non-electrical conductor.
Two electrodes are present in the electrolyzer, and each electrode is wired to a power source. When an electrical current produced by the power source or the pulse generator is passed between two electrodes, water is split into hydrogen and oxygen. while they are submerged in water.

Fig. 7.1: Water electrolyzing cell

E. Bubbler
For safe operation, the bubbler, a cylindrical device, must block the flow of oxygen and hydrogen in the opposing directions.

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IX. FUTURE SCOPE
A solar system that uses DC input voltage can increase the generation efficiency of hydrogen and oxygen.

X. RESULT AND DISCUSSION
It has been discussed how important developed electrochemical devices are for producing oxygen. This has been a quick explanation of the several sorts of oxygen production systems, along with its limitations and difficulties.

The initial step of oxygen production occurred at a rate of 700 ml/min.

A. Electrochemical Water Splitting
Producing oxygen and hydrogen from the breakdown of water is a quick and efficient process. The gases that are created can be used in a variety of ways, including as producing oxygen for breathing and hydrogen for fuel cells. In addition to being used for welding, oxygen-hydrogen gas is created when the two gases are combined. a water-splitting cell arrangement using electrochemistry. In order to produce oxygen and hydrogen gases on an industrial scale, Dmitry Lachinov first created an apparatus using water electrolysis. We have created a machine for producing oxygen right here. In the electrochemical process of water splitting, as indicated below, In an acidic and a basic medium, respectively, the oxygen evolution reaction (OER) takes place at the anode and the hydrogen evolution reaction (HER) at the cathode. a substance that is acidic 4e- + 4H+ (aq) 2H2 (g) 4H+ (aq) 2H2O (l) 4e- + O2 (g) In the Simple medium: 4e- + 4H2O(aq) 4-OH(aq) = 2H2O (l) + 4e+ O2 (g) 4-OH(aq) = 2H2(g)

B. Conclusion
The created electrochemical oxygen production apparatus is simple, inexpensive, and environmentally benign. Utilizing this technology, the construction of several assemblies can enable the production of oxygen on a huge scale, which is feasible given that people are currently seeking sustainable and economical oxygen production choices that meet their demands.

C. Acknowledgment
We sincerely thank everyone who helped us out and offered advice throughout the course of this endeavour. We would like to take this occasion to Pro.Dr.M.V.Walame, convey our sincere gratitude to who served as our dissertation advisor, for his invaluable advice, constant support, and helpful assistance.

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