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Electricity from Urine - A Review

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ABSTRACT

Since urine is locally produced in abundance this idea has an extra edge over many other renewable sources such as solar energy etc., which are cost effective only in certain areas. In this topic we generate electricity from urine. Urine majorly contains water in addition with other chemicals like ammonia, sulphate, uric acid, urea, etc. The urine is passed to the electrolytic cell from which hydrogen gas is evolved after electrolysis which is the main component for generation. Here urea is also a major component after water with the chemical formula CH_4N_2O, where the four hydrogen molecules is weakly bonded with the other components. Thus it is passed through various components and the purified gas is given to the generator to generate electricity.

Keywords: Renewable Sources, Electrolytic Cell.

1. INTRODUCTION

Global demand for energy has risen inexorably in the last 150 years in step with industrial development and population growth. Hunger for energy is predicted to continue to rise, by at least 50% by 2030 [1]. Developing countries are seeking a tremendous scarcity of electricity generation and it is of incredible importance to cope up with the overwhelming demand of electricity. So if we devise self-sustainable energy production via simple yet recyclable way that would be helpful to reduce the inevitable scarcity.

In all over world the fossil fuels are being exhaust continuously, due to which alternate sources such as solar, wind, biomass, etc., are being used as shown in fig.1. However these generations require a high capital cost hence there is ongoing research for low cost energy generation [2]. With around 1/7th of the world's population lacking access to electricity, scientists are eager to find solutions to generate power in more renewable and sustainable ways. We are constantly presented with better ways having a good implementation of technology, using very less input and in some cases achieving infinite output.

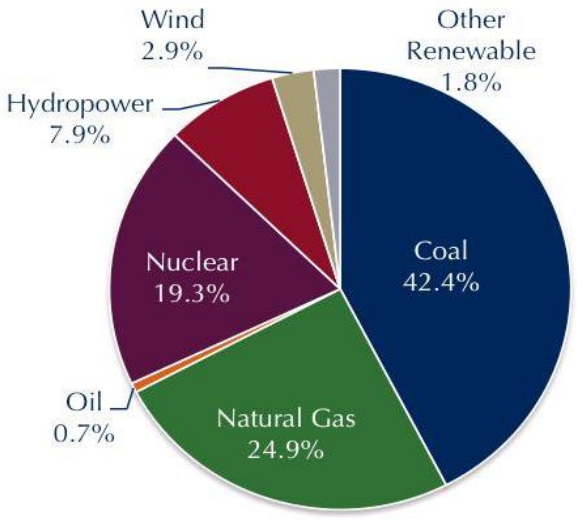

Fig.1. Production of electricity from different sources (Wikipedia)

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To make a decision on which of the aforementioned sources is to be used a careful consideration process takes place. This includes availability, extraction cost and feasibility, conversion cost, efficiency, sustainability, and economic implications. The most desirable would be the one that is non-pollutant available in abundance and can be harnessed at an acceptable cost in both small scale and large scale systems. In this context a constantly available resource that is, human urine has attracted the attention of energy enthusiasts as resource to generate energy.

2. LITERATURE REVIEW

Dr. S. S. Verma's article " Power from Urine**"** describes in detail the urine-powered generator, its technical potential, applications and drawbacks. In order to provide safer and growing access to electricity such newer forms of technologies are being developed by scientists and energy enthusiasts. Prior to this a firm in Ohio had patented a similar technology called the " Greenbox" to clean commercial and agricultural waste water to produce hydrogen energy [7].

Bryan K. Boggs et al., explains a new technology that accomplishes direct conversion of urine and urea to pure hydrogen via electrochemical oxidation with an inexpensive nickel catalyst. In the past, research pertaining to urea electrolysis exclusively involved the possibility of developing artificial kidneys for portable dialysis devices utilising platinum electrode in acidic buffer. There is a great interest in the scientific community for finding non-platinised catalyst alternatives such as Ni, for hydrogen production. This paper demonstrated the technology to be effective for urea and urine [5].

Wahidul Hasan et al., emphasizes on the generation of electricity using cow urine. The daily available fresh urine from a dairy farm could be a possible source of renewable energy. This system only requires replacement of old urine with fresh feed to activate it again. This technology was experimented with different terms such as, volume of urine, voltage, current and power with respect to time [6].

3. WORKING PRINCIPLE

It works mainly on the principle of electrolysis. Urine majorly comprises of urea which incorporates four hydrogen atom bonded weakly with the surrounding atoms. Electrolysis is used to break the molecule, To break the molecule down, a voltage of 0.37V needs to be applied across the cell – much less than the 1.23V needed to split water[3], developing an inexpensive new nickel-based electrode to selectively and efficiently oxidize the urea. During the process urea gets adsorbed on the nickel electrode surface, which passes the electrons required to break the molecule. Pure hydrogen is evolved at the cathode, while nitrogen with traces of hydrogen and oxygen is collected at the cathode.

3.1 Characteristics of Urine

1) Quantity: The quantity averages 1500 to 2000 ml in an adult man daily. It may vary with the amount of fluid taken. In fact it is linked with the protein metabolism higher is the protein intake higher will be the urinary output, the urea produced from the protein needs to be flushed out from the body. Higher is the urea production in the body, the higher is the volume of urine to excrete it.

2) Colour: The colour should be clear pale amber without any deposits. However, a light flocculent cloud of mucus may sometimes be seen floating in the normal urine.

3) Specific gravity: It varies from 1.010 to 1.025 specific gravity is determined with urinometer.

4) Odour: The odour is aromatic.

5) Reaction: The reaction of normal urine is slightly acidic with an average pH of 6.0.

3.2 Materials and Method

For the urine electrolysis, we use a voltage converter of 12V, a multimeter, two electrodes, wires, one timer, one container and two tubes graduated to measure the gas recovered inside.

This experiment will enable us to determine the voltage, the current and the length of time to determine the electric consumption of electrolysis. With this experiment, we will also be able to determine the quantity of dihydrogen produced by this system. The experimental setup for water electrolysis to compare it with urine electrolysis. For the water electrolysis, the materiel used was the same except that we replace urine with water.

3.3 Comparison between water electrolysis and urine electrolysis

the water electrolysis and urine electrolysis, we need to provide 0,25 Wh of energy to recover 15 cL of dihydrogen from water electrolysis. And we need 0.47 Wh of energy to recover 15 cL of dihydrogen from urine electrolysis. It means that to recover dihydrogen from urine electrolysis, we need twice as much as energy as from water electrolysis.

4. METHODOLOGY

Urine is mainly composed of water (96%), urea (2%), and other metabolic products (2%). Urea is one of the end products of protein metabolism and forms the major component for electrolysis reaction.

The main components required for the generation of electricity are:

1. Electrolytic cell
2. Water filter
3. Gas cylinder
4. Liquid borax cylinder
5. Generator

Electrolytic cell: It is an electrochemical cell that undergoes a red-ox reaction when electrical energy is applied. It is most often used for the decomposition of chemical compounds by a process called electrolysis. When electrical energy is added to the system, the chemical energy is increased. An electrolytic cell has three component parts: an electrolyte and two electrodes. Using this cell hydrogen gas is produced on application of electrical energy [4].

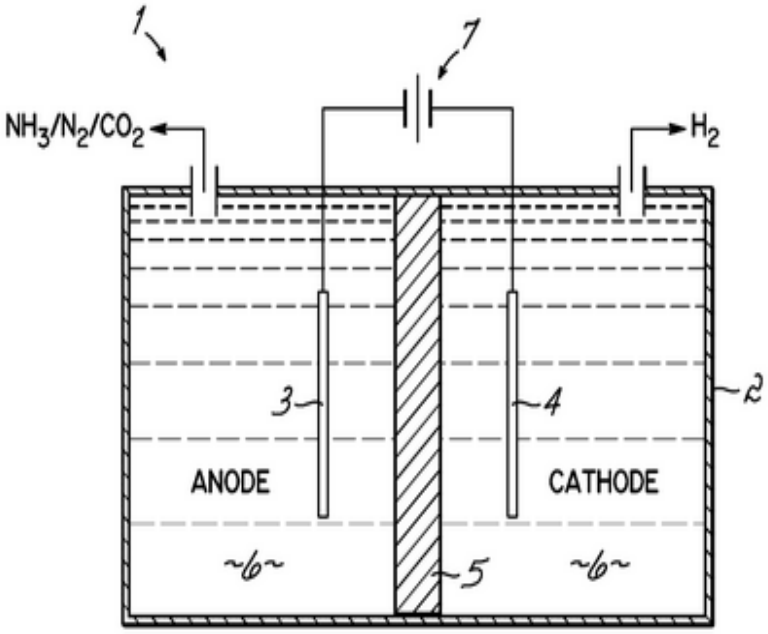

Fig 2: Scheme of urine electrolysis

1. gas that are being recovered
2. container
3. anode
4. cathode
5. electrolyte
6. urine
7. battery generator

Water filter: The hydrogen gas pushed into the water filter is purified and pure hydrogen gas is extracted.

Gas cylinder: The purified hydrogen gas is passed into the gas cylinder where it is stored in the form of liquid hydrogen at very low temperature and high pressures. From here it is input into the liquid borax cylinder.

Liquid borax cylinder: The moisture content that may be present in the hydrogen is completely removed and the gas is passed on to the generator.

Generator: The generator uses the hydrogen gas as fuel to produce electricity.

5. APPLICATIONS

1. Supplying electricity to households of rural areas, lacking other resources for the same[8].
2. In small scale, buildings such as public toilets, cinema halls, bus stops, and railway stations which may also be used as sources of fuel.

6. CONCLUSIONS

Nowadays, power generation from fossil fuels such as diesel, petrol and coal is decreasing day by day. Hence we need to produce electricity from other type of power plants. When compared to other power plants, urine-powered generators are less polluting and produce more electricity per unit volume of fuel. In the present generation this is one of the most sustainable methods for electricity generation

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