

Energy Potential Assessment Using Electrolysis from Animal Waste

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ABSTRACT: It is high time that everybody is looking for efficient and clean sources of power generation. Although we have quite a few efficient power sources but “clean” parameter is yet to be discovered for large scale generation of power. This paper throws some light on one of the ways of generating power keeping “clean” parameter in view. In this process, the supposedly most wasteful product of living beings is used as the power source. Although non conventional sources have been their but many of them exist with some or the other environmental limitations. But producing power from this waste has no environmental limitation. Here in this process the electrolysis of the liquid waste from animals is done to produce hydrogen gas which in turn is used to run a generator thereby producing electricity.

1. THEORY OF ENERGY:

The First Law of Thermodynamics also known as the Law of Conservation of Energy states that energy can neither be created nor be destroyed; it can only be transformed from one form to another.

“If you want to know the secrets of the universe, think in terms of energy, frequency and vibration.” – Nikola Tesla.

Quantum Physics says that “physical atoms are made up of vortices of energy that are constantly spinning and vibrating, each one radiating its own unique energy signature. The atom has no physical structure, we have no physical structure, and physical things really don’t have any physical structure! Atoms are made out of invisible energy, not tangible matter.”

These few quotes clearly state that everything in this universe is energy and as the first law goes, energy can be transformed from one to another form. Hence what we perceive as waste is not actually a waste but a matter confining a lot of energy which is left in that form. As humans what we are supposed to do to tap that energy is first to stop looking anything as waste and second to bring out the technology to suck the energy from every form of it.

According to Yogendra G. Nandagaoli et al [1] urine has hydrogen molecules in it. The amount of voltage it takes to break a urine molecule is less than the amount it takes to break the hydrogen molecule in water. thus urine electrolyzed, releasing hydrogen-oxygen gas mixture from it, if properly purification has done with hydrogen gas it can be used to drive engine.

One such technology which is evolving to convert supposedly ultimate waste, i.e., animal waste into usable form is being referred to in this paper. Many experiments have been done on this and are quite successful as well. This is important in today’s scenario because the world is facing a lot of scarcity of energy. Till date people are using the conventional sources such as coal, petroleum. According to EIA, i.e., US Energy Information Administration, the coal reserves left can serve the world for only around 250 years more depending upon the usage. According to the British Petroleum, the oil will last around 53.3 years at current production rates. These data alarmingly ask for new technology to evolve with newer sources of energy. Although non-conventional sources are being used but their usage has environmental barriers. Hence the waste from animals is the new source of energy, which if harnessed well, can revolutionize the world.

Out of many sources of energy, hydrogen is one of the biggest potential sources of energy but till date not much has been done to utilise this potential source. The reason may be because of its high flammability and explosive nature.

2. Hydrogen and its Uses:

Dr Gerardine Botte [2] studied on following parameter of hydrogen

Auto ignition temperature: 520 °C (968 °F)

Density: 0.08342 kg/m³

Diffusivity: 1.697 m²/hr

Flame temperature: 2318 °C (4202.4 °F)

Specific gravity: 0.6960 (air = 1)

Specific volume: 11.99 m³/kg(191.98 scf/lb) [2]

In a website, NASA has mentioned following main uses of Hydrogen -

- 1) For refining petroleum in industry.
- 2) Treating metals.
- 3) Producing fertilizers.
- 4) Processing foods.
- 5) As rocket fuel.
- 6) To produce electricity.
- 7) As vehicle fuel.

Out of these many uses of hydrogen, we are focusing on one use, i.e., produce electricity.

3. METHODOLOGY:

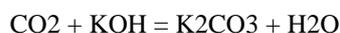
Wahidul Hasan et al [3] explain the methodology of electrolysis of urine. The methodology usually comprise of basically the 3 steps:

- 1) Electrolysis
- 2) Purification
- 3) Storing hydrogen

3.1 Electrolysis

In this process the animal urine (especially cow in the experiment) is put in the electrolytic cell and electrolysed. The main component of urine is urea which has four H-atoms per molecule which are loosely bonded as compared to the H-atoms in water. According to Bryan K. Boggs et al [4] for the electrolysis of urea we require an electrolytic cell potential of around 0.38 volts under standard conditions against 1.20 for water.

Figure No 3.1 shows the electrolysis of urine, releasing hydrogen during this process; carbon dioxide is also formed but is not collected at output because of the following reaction:



It reacts with potassium hydroxide to form potassium carbonate.

Also urea hydrolysis to ammonia and prevents the formation of ammonia gas, which is very hazardous to living beings.

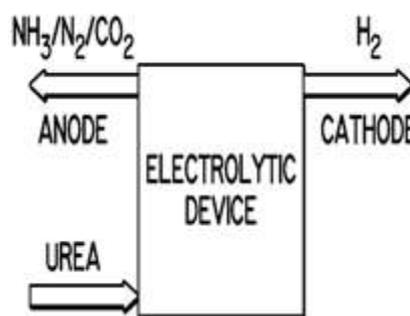
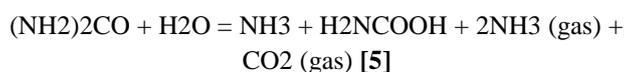


Figure: 3.1 Electrolysis of urine, releasing hydrogen.

3.2 Purification:

During this process the produced hydrogen is passed through liquid borax so as to remove any water vapour present in the hydrogen. This step is important for the safety of the generator so that not much of the moisture should enter it. Borax acts as a drying agent.

3.3 Storing Hydrogen:

Storing of hydrogen should be done very carefully because being a light gas it can escape out of the vessel or pipes easily as compared to other conventional fuels [6]. Hence to use hydrogen as a fuel either for transportation or to produce electricity, one must find cost-effective way to store it. According to R. Yadav et. al. [7] one of the effective ways of storing hydrogen is by compressing it and turning it into a liquid, basically a metal hydride.

Example- 1 gm of hydrogen almost occupies 11 litres of space under normal conditions of atmospheric pressure. Hence to compress it and store a usable quantity of hydrogen, it needs to be pressurised to several hundred atmospheres and store in pressure vessels.

Table No: 3.1 Storing of the Hydrogen

Material	H-atoms per cm ³ (x 10 ²²)	% of weight that is Hydrogen
H ₂ gas, 200 bar (2850 psi)	0.99	100
H ₂ liquid, 20 K (-253 °C)	4.2	100
H ₂ solid, 4.2 K (-269 °C)	5.3	100
MgH ₂	6.5	7.6
Mg ₂ NiH ₄	5.9	3.6
FeTiH ₂	6.0	1.89
LaNi ₅ H ₆	5.5	1.37

4. REVIEW OF RESEARCH WORK IN INDIA:

The research done in India has led to positive results from every perspective because this area of energy extraction is still untouched on a large scale.

The researchers in India have been able to create around 8.6 volts of potential difference from around 1.5 litres of urine. The calculated current is 63 mA which gives a power around 0.54 W. This battery is tested for 70 hours with and without load. This power can glow a LED for 3 days [8]. Researches also emphasise that though this power may not be too big to bring into industrial use but definitely can solve house hold problem of power cuts and of places where the power grids have not yet reached. To make this experiment successful, researchers used copper and zinc as electrodes and cow urine as an electrolyte. The main principle behind this experiment is to react the uric acid present in cow urine with the copper and zinc for the flow of electrons to start and hence get the current.

5. RESULT ANALYSIS:

Different researches in different countries by individual researchers have given individual results. Although a lot of work is still to be done to make this energy form usable on big scale but on smaller scale success has been achieved to bring out the electricity by electrolysis of urine. This has been proved with the help of experiments that as we increase the volume of urine, it increases the output of the current, voltage and power.

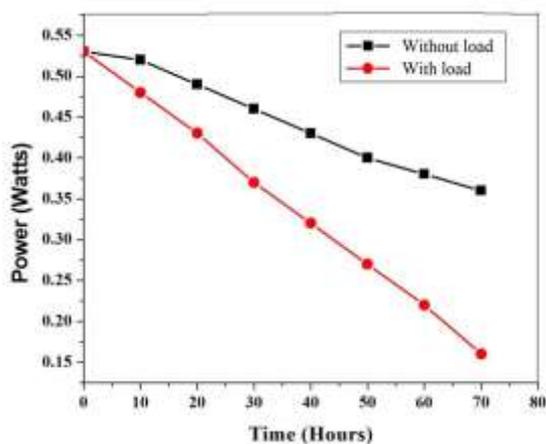


Figure:

5.1 Variation of power with time without and with load

6. CONCLUSION:

Electrolysis of urea requires 35% less energy and produces around 40% cheaper hydrogen as compare to electrolysis of water. Also unlike other conventional fuels it does not emit harmful gases such as carbon monoxide. As fuel it is easily and everywhere available. Not just animal but also human urine can be used here. Hence a new and effective source of

energy is available with us in the form of waste. The only thing is the way to utilise it to maximum.

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