Design of an Automated Power Generation By Using Urine

Bodigam Ganesh Reddy[1], Arun Mulimani[2], Voruganti Bharathkumar[3], Dr. P. Santosh Kumar Patra[4]

[1]*Assistant Professor, Department of Electrical and Electronics Engineering, St. Martin's Engineering College, Secunderabad, India*
[2]*Assistant Professor, Department of Electrical and Electronics Engineering, St. Martin's Engineering College, Secunderabad, India*
[3]*Assistant Professor, Department of Electrical and Electronics Engineering, St. Martin's Engineering College, Secunderabad, India*
[4]*Principal and Professor, Department of Computer Science and Engineering, St. Martin's Engineering College, Secunderabad, India*

Abstract—

The utilization of wastewater for useful fuel has been gathering recent attention due to society's need for alternative energy sources. The electro oxidation of urea found at high concentrations in wastewater simultaneously accomplishes fuel production and remediation of harmful nitrogen compounds that currently make their way into the atmosphere and groundwater. That waste water we using as a like fuel. By using the urine we get six hours of power produced continuously. Urine is the most abundant waste water on earth. The largest constituent of urine is urea, which is a significant organic source of H, C, O, and N. Despite the numerous benefits of using urea/urine for hydrogen production, there is not a single technology that directly converts urea to hydrogen.

Keywords—

Renewable energy, urine, hydrogen, Electrodes, Copperplates, Zinc plates, generator.

I. INTRODUCTION

Electrical energy is derived from electrical potential energy or kinetic energy and it is one of the highly consumed energies. It plays a crucial role in development of the nation and societal welfare largely depends on sufficient and continuous supply of electricity. It is observed that global industrial development in the past century relied heavily on fossil fuels which not only caused concerns on depletion of non-renewable sources but also caused global warming due to greenhouse gases. According to recent studies demand for energy will double globally by 2050. Since biomass is the largest potential source of renewable energy providing 10% of current world's primary energy supplies. As a result development of energy from biomass and bio-waste is urgently needed.

Average urine production in adult humans is around 1.4 L of urine per person per day with a normal range of 0.6 to 2.6 L per person per day, produced in around 6 to 8 urinations per day depending on state of hydration, activity level, environmental factors, weight, and the individual's health. Urine as a source does not produce methane gas, copper and zinc electrodes used in the system are cost effective. Also urine discarded from this process can be used as a fertilizer. Therefore, this system does not give out any waste and damages the environment, electricity obtained through this method is produced and consumed at minimum cost.

II. URINE COMPOSITION

Over 99 percent of urinary solutes are composed of only 68 chemicals which have a concentration of 10 mg/L or more. 42 compounds are actually involved. They may be classified as follows:

- Electrolytes such as sodium, potassium, calcium, magnesium and chloride
- Nitrogenous chemicals such as urea and creatinine
- Vitamins
- Hormones
- Organic acids such as uric acid
- Other organic compounds

The concentration of the following constituents in urine may be regarded a s a careful approximation:

Fig:1 Components in urine

- Urea: 9.3 g/dL
- Creatinine: 0.670 g/ L
- Sodium: 1.17 g/L
- Potassium: 0.750 g/L
- Chloride: 1.87 g/L

III. DESIGN LAYOUT

The main components required for the generation of electricity is as follows:

1. Electrolytic Cell
2. Generator
   IC Engine and Synchronous Motor

Urine
↓
Electrolytic cell
↓
(Hydrogen gas)
↓
Generator (IC Engine)
↓
Rotational Motion (Synchronous Motor)
↓
Electricity

A. Electrolytic Cell

An electrolytic cell is an electrochemical cell that under goes a redox reaction when electrical energy is applied. It is most often used to decompose chemical compounds, in a process called electrolysis. When electrical energy is added to the system, the chemical energy in increased. Similar to a galvanic cell, electrolytic cells usually consists of two half cells. An electrolytic cell has three component parts: an electrolyte and two electrodes (a cathode and an anode). In this the raw urine contains urea. The chemical formula of urea is CH4N2O. By this electrolytic cell we can produce the hydrogen gas by applying the electrical energy to the electrolytic cell.

B. Generator

Thus the hydrogen pushed out from the electrolytic cell is then given to generator that is in our project use generator as a combination of IC engine and synchronous motor. This generator uses the hydrogen gas as the fuel and it produces the electricity.

IV.UREA ELECTROLYSIS

Urea is the main component of human and livestock urine, as well as a key ingredient of fertilizers. There is, as a result, an abundance of urea-rich wastewater. If this wastewater is left untreated and then discharged into rivers, creeks, and lakes, the urea will naturally hydrolyze into pollutants such as ammonia and nitrates.

In the Center for Electrochemical Engineering Research (CEER), a novel technology has been developed to directly convert urea to hydrogen using electricity (please see below):

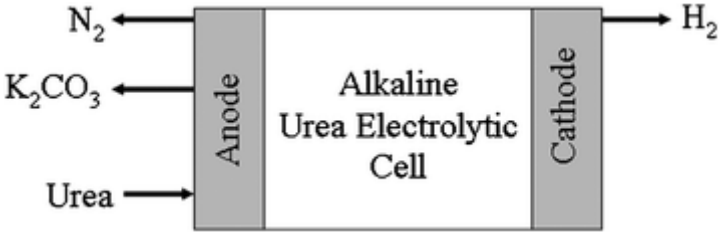

Fig. 2: Schematic representation of the direct urea to hydrogen process

Anode reaction:

$CO(NH_2)_2 + 6OH^- \text{----> } N_2 + 5H_2O + CO_2 + 6e^-$

Cathode reaction:

$6H_2O + 6e^- \text{-----> } 3H_2 + 6OH^-$

Overall reaction:

$CO(NH_2)_2 + H_2O \text{-----> } N_2 + 3H_2 + CO_2$

These reactions take place at room temperature and under normal pressure conditions. Theoretically, the cell voltage for the electrochemical conversion of urea to hydrogen is only 0.37 V, whereas water electrolysis, a popular electrochemical method to produce hydrogen, requires 1.23 V to split water into hydrogen and oxygen. Hydrogen gas produced from urea electrolysis does not require any further purification.

Fig. 3: Hardware Model

V. GENERATOR

A. Working Principle of IC Engine-

The principle of working of both SI and CI engines are almost the same, except the process of the fuel combustion that occurs in both engines. In SI engines, the burning of fuel occurs by the spark generated by the spark plug located in the cylinder head. The fuel is compressed to high pressures and its combustion takes place at a constant volume. In CI engines the burning of the fuel occurs due to compression of the fuel to excessively high pressures which does not require any spark to initiate the ignition of fuel. In this case the combustion of fuel occurs at constant pressure.

Both SI and CI engines can work either on two-stroke or four stroke cycle. Both the cycles have been described below:

1. *Four-stroke engine*: In the four-stroke engine the cycle of operations of the engine are completed in four strokes of the piston inside the cylinder. The four strokes of the 4-stroke engine are: suction of fuel, compression of fuel, expansion or power stroke, and exhaust stroke. In 4-stroke engines the power is produced when piston performs expansion stroke. During four strokes of the engine two revolutions of the engine's crankshaft are produced.

2. *Two-stroke engine*: In case of the 2-stroke, the suction and compression strokes occur at the same time. Similarly, the expansion and exhaust strokes occur at the same time. Power is produced during the expansion stroke. When two strokes of the piston are completed,

One revolution of the engine's crankshaft is produced. In 4-stroke engines the engine burns fuel once for two rotations of the wheel, while in 2-stroke engine the fuel is burnt once for one rotation of the wheel. Hence the efficiency of 4-stroke engines is greater than the 2-stroke engines. However, the power produced by the 2-stroke engines is more than the 4-strokeengines.

Fig. 4: SI and CI engine

1. Synchronous Motor

A synchronous electric machine can be either a motor or a generatordependingontheamountoftorquebeingappliedto thesynchronousmachine.Ifthetorqueexceedstheamountof power required to keep the synchronous machine spinning at rated frequency when connected to a grid supplying a load (motors, lights, computers, etc.) then the synchronous machine is a generator, converting the excess torque into amps which are being transmitted over wires to motors and the other types of loads (lights, computers,etc.).

Whentheamountoftorquebeingappliedtothesynchronous machine is less than amount required to keep the machine spinningatsynchronousspeedthenthesynchronousmachine becomes a motor, drawing amps from the grid to maintain speed and actually "driving" the prime mover (turbine, reciprocating engine, etc.)--which can be very damaging to the primemover.

Thereareverylargehydro-electricfacilitiescalled"pumped storage"facilitiesthatserveassynchronousgeneratorsduring the day allowing water to run "down" through the turbine driving the synchronous machine. Then at night, the synchronous machine is used as a motor to drive the turbine which becomes a pump and pumps the water back "up" to a storagelakewhereit'sreadytobeusedtodrivethemachineas a generator the next day. Some large heavy duty gas turbines employ the synchronous generator as a motor during starting and acceleration. There are many formulae that can be found at sites like wikipedia.org to describe how motors convert amps into torque and how generators convert torque into amps.

VI. RESULT ANALYSIS

Fig. 5 shows the variation of voltage generated from 930ml of cow urine over a period of 1 hour. It can be observed that the voltage remains almost constant with very negligible variation. The electrodes used were of small cross-sectional area.

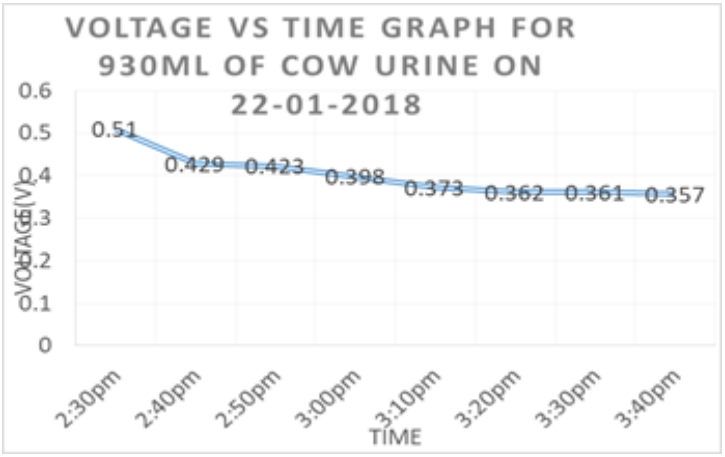

Fig. 5: Voltage variation for 930 ml urine

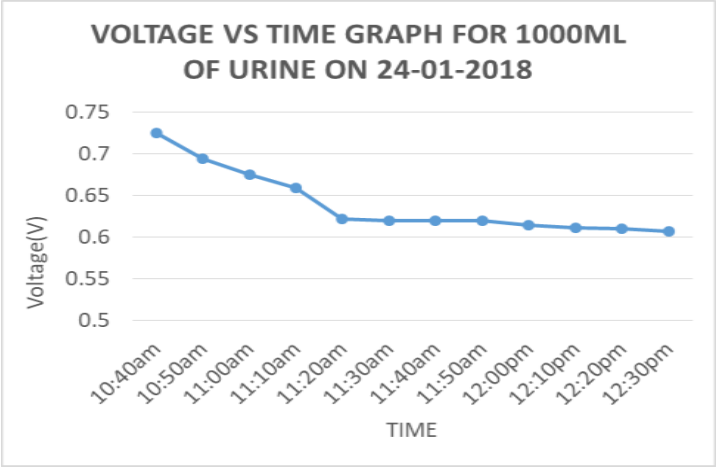

Fig. 6: Voltage variation for 1000 ml urine

VI. ADVANTAGES

1. There is no cost offuel.
2. There is no evolution of greenhousegases.
3. It is pollution freeequipment.
4. Maintenance cost is verylow
5. It is an ecofriendlyproduct.
6. It is non toxic with thenature.
7. It generates more electricity when compared to other generators by consuming less amount offuel.

VII. DISADVANTAGES

1. Themajordisadvantageishydrogenposses'explosiverisk.
2. The installation of this complete equipment is a little bit cost.
3. Before generation some external electricity is required for electrolysisprocess.

VIII. APPLICATIONS

1. In the public toilets.
2. In the College, cinema halls, commercial areas.

IX. CONCLUSION

Now a days the power generation from diesel, petrol, coal, water decreases day by day so we need to produce electricity from other type of power plants. When compared with the other generators it is pollution less and it does not affect the environment. It produces much electricity compared with othertypesofpowerplantsandmainlythewasteUreaisused (it is cost less). In present generation this is the best way to produce power from this type of pee poweredgenerator.

REFERENCES

1. WahidulHasan, Hafiz Ahmed, and Khosru M. Salim, "Generation of Electricity Using Cow Urine," International Journal of Innovation and Applied Studies, vol. 9, no. 4, pp. 1465–1471, December2014.
2. PratyushBisen, RajnarayanChoudhary, Samir Khule, "Cow Urine Generated System", International Journal of Advance Research in Science and Engineering, Vol. No.4, Special Issue No. (1), December 2015.
3. Gomutra, Wikipedia. H. B. H. Cooper, I. Spencer and W. Herbert, *Methods for the production of ammonia from urea and/or biuret, and uses for $NO_x$and/orparticulatematterremoval*,*U.S.Pat*.,607749 1,2000.
4. Cow Manure" (2003) Thermal efficiency and environmental performances of a biogas-diesel stationary engine. Environ. Technol. vol. 24(9):pp.1165-1173.
5. Elliot, H. H., Klass, D., Energy from Biomass and Wastes VIII/Symposium.1984.
6. Delaney,G.M.,Bennetto,H.P.,Mason,J.R.,Roller,S.D., Stirling,
7. J. L. and Thurston, C. F. "Cow Manure adds to Arsenic Epidemic" (1984) Performance of fuel-cells containing selected microorganism mediator substrate combinations. J. Chem. Technol. Biotechnol. B- Biotechnology vol. 34(1):pp.13-2
8. Ali Abul, Jun Zhang, "MFC: Design,Control oriented Modelling", Michigan State Universityinpartialfulfillmentoftherequirementsfor the degree of Mechanical Engineering - Master of Science2015.
9. Mahyudin Abdul Rachman, "Electricity from Biowaste based Gas Hydrogen as a Source of Renewable Energy", 3rd International Conference On Informatics, Electronics & Vision 2014.
10. Research on Applied Bioelectrochemistry, *Quarterly Progress ReportNo.2*, Magna Corporation Contract NASw-623,1963.