₹ 200 ISSN - 2249-555X

Volume : 1 Issue : 8 May 2012

Indian Journal Of Applied Research

Journal for All Subjects

www.ijar.in

Listed in International ISSN Directory, Paris.

ISSN - 2249-555X

Indian Journal of Applied Research

Journal for All Subjects

Advertisement Details

Position	B/W (Single Color)	Fore Color
Full Inside Cover	₹ 6000	₹ 12500
Full Page (Inside)	₹ 5000	-

Subscription Details

Period	Rate	Discount	Amount Payable
One Year (12 Issues)	₹ 2400	Nil	₹ 2400
Two Year (24 issues)	₹ 4800	₹ 200	₹ 4600
Three Year (36 issues)	₹ 7200	₹ 300	₹ 6900
Five Year (60 issues)	₹ 12000	₹ 600	₹ 11400

You can download the Advertisement / Subscription Form from website www.ijar.in. You will require to print the form. Please fill the form completely and send it to the **Editor, INDIAN JOURNAL OF APPLIED RESEARCH** along with the payment in the form of Demand Draft/Cheque at Par drawn in favour of **INDIAN JOURNAL OF APPLIED RESEARCH** payable at Ahmedabad.

1. Thoughts, language vision and example in published research paper are entirely of author of research paper. It is not necessary that both editor and editorial board are satisfied by the research paper. The responsibility of the matter of research paper/article is entirely of author.
2. Editing of the Indian Journal of Applied Research is processed without any remittance. The selection and publication is done after recommendations of atleast two subject expert referees.
3. In any condition if any National/International University denies accepting the research paper published in IJAR, then it is not the responsibility of Editor, Publisher and Management.
4. Only the first author is entitle to receive the copies of all co-authors
5. Before re-use of published research paper in any manner, it is compulsory to take written permission from the Editor-IJAR, unless it will be assumed as disobedience of copyright rules.
5. All the legal undertaking related to Indian Journal of Applied Research is subject to Ahmedabad Jurisdiction.
7. The research journal will be send by normal post. If the journal is not received by the author of research papers then it will not be the responsibility of the Editor and publisher. The amount for registered post should be borne by author of the research paper in case of second copy of the journal.

Editor,
Indian Journal Of Applied Research
8-A, Banans, Opp. SLU Girls College, New Congres Bhavan, Paldi,
Ahmedabad-380006, Gujarat, INDIA
Contact.: +91-9824097643 E-mail : editor@ijar.in

INDEX

Volume : 1 | Issue : 7 | May 2012 ISSN - 2249-555X

Research Paper Biotechnology

Generation of Bioelectricty from Waste water and Cow's urine

* H.Vignesh ** Hema Kalai Rani

*,** : Department of Biotechnology, Adhiyamaan College of Engineering, Hosur

ABSTRACT

Microbial fuel cells (MFCs) are devices that can use bacterial metabolism to produce an electrical current from a wide range of organic substrates. Microbial fuel cells (MFCs) represent a completely new long term, affordable, accessible and ecofriendly approach to waste water treatment with production of sustainable energy. The open circuit potential was determined and the maximum voltage was estimated. We got a highest value of 1.4mA, 0.70V and 1.20mA, 0.24V by using Waste water with mediator and without mediator respectively and 0.53mA, 0.878V and 20mA, 1.35V by using Cow's urine with salt bridge and without salt bridge respectively, using this technology primary treatment of wastewater was also done and the tests revealed the reduction of BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand). We are also successful in isolating the electrogenic Pseudomonas aeruginosa.

Keywords : Microbial fuel cell, waste water treatment, BOD and COD

Introduction

Recently considerable attention is being paid to alternative renewable sources of energy throughout the world. Harnessing of biohydrogen (H2) by anaerobic fermentation (Das & Veziroglu 2001, Logan 2004, Yang, Shao, Lub, Shena, Wang, Xub &Yuan 2006, Venkata Mohan, Veer Raghavulu, Srikanth & Sarma 2007) are gaining importance due to their clean, efficient, and renewable nature. Although, fermentative H2 production is considered as a viable alternative energy source of the future, its storage, purification, low-production rates and conversion to energy (electricity) by fuel cells are some of the inherent limitations. Alternatively, MFCs facilitate in situ conversion of organic substrate to energy (bioelectricity).

MFC is a biochemical-catalyzed system which generates electrical energy through the oxidation of organic matter in the presence of fermentative bacteria under mild reaction conditions (ambient temperature and pressure). The potential developed between the bacterial metabolic activity [reduction reaction generating electrons (e−) and protons (H+) and electron acceptor] conditions separated by a membrane leads to generation of bioelectricity. Exploiting wastewater as a viable substrate to harness electricity is considered as sustainable approach and is presently in the early stages of research (Balat 2010, Daniel & Derek 2003, Debabov 2008, Gregory, Shigeki Mori, Ryuhei Nakamura, Kazuhito Hashimoto & Kazuya Watanabe 2009).

Therefore, the present work aims to study the feasibility of bioelectricity generation in single chambered MFC (mediator less (anode); air (cathode)), using glass wool as proton exchange membrane (PEM) and wastewater as substrate employing selectively enriched acidogenic mixed consortia as anodic inoculum.

Materials

- Plastic containers (1.5litre)
- Electrodes (carbon, zinc)
- Nacl (15gms)
- Agar (2%)
- Substrate (Sucrose, bits of waste newspaper) (1gm/1.5litre)
- Waste water (1.1 litre)
- Cow's urine (1.1 litre)
- Electrolytic Solution
- Aerator
- Wires
- Multimeter
- Gloves

Collection of the samples

Different samples were collected from following sources

- Sample1- Waste water (Kempambudhi Lake)
- Sample2- Cow's urine (Male)

Table-1 Isolation of Pseudomonas aeruginosa

Ingredients	Gram/ litre
Gelatine peptone	20
Magnesium Chloride	1.4
Potassium Sulphate	10
Glycerol	10 ml/l
Cetrimide	0.3
Agar	13
Final pH (at 37˚C) 7.2 ± 0.2	

Methods

Isolation of microorganisms

The organisms were isolated from different samples (Waste water & Cow's urine). The different samples were inoculated on Nutrient agar media and incubated for 48hrs. After incubation, colonies were observed. Later these colonies were subcultured to get pure cultures. The organisms was Pseudomonas aeruginosa.

Construction of Anode

A Plastic anaerobic container of 1.5 litre capacity was used. It was holed to insert a Salt bridge. The container was filled with different samples. In our apparatus, we have used sucrose, dextrose in concentration of 1gm/1.5litre solution.

Construction of Cathode

A Plastic aerobic container of 1.5 litre capacity was used. It was holed at the side to insert a Salt bridge. The chamber was filled with electrolytic solution. The electrolytic solution was exposed to air for reduction reaction to occur (Zhao, Harnisch & Schroder 2006).

Agar salt bridge

Composition of Medium
Sodium chloride 15g; Agar 2%; Water 150 ml,

Other Components - PVC Pipe (2 inches), Epoxy resin.

Assembling of electrodes
Carbon, Zinc rod and Copper sheets, graphite Rods were used to make the electrodes. These were fitted smoothly into the neck opening of the lid in anodic chamber and left suspended in cathode solution. A hole big enough for the wire to pass through was punched in the lid and electrode was connected to the wire and other end of wire was left freely to connect to the external circuit. The hole was sealed by epoxy resins to avoid passage of air into anode chamber. For the cathode, different approach was used. Air was supplied to the cathode assembly by an aerator pipe which is fitted through the lid or the lid was kept open for air passage (Zhao et al. 2006).

Preparation of the salt bridge
To create the salt bridge, we used common salt, agar and water. Initially 150ml of water is boiled in a beaker, 3gms of agar and 15gms of salt was added to the boiling water. The mixture was boiled till the agar got completely dissolved. Simultaneously, firmly a plastic wrap was placed on one end of the coupler (PVC pipe). The agar mixture prepared earlier was poured into the open end of the coupler. The set up was allowed to stand for a few minutes till it got solidified.

MFC operation
The anode chamber was 3/4 filled with a sample of interest. The beaker filled with warm saturated salt solution was allowed to completely cool and poured into the cathode chamber until only the salt slurry was retained. The external wiring of anode and cathode was connected to a multimeter to complete circuit.

Figure-1 Waste water sample

Figure-2 Cow's urine sample

Results
Figure-3 Isolation of Pseudomonas aeruginosa

Table-2 Measurement of Electricity using waste water with Mediator

Apparatus	Date/time	Voltage(V)	Current(mA)
Waste water (with mediator)	**1st day** 11.00 am	0.5	0.51
	12.00 pm	0.49	0.6
	1.00pm	0.38	**1.4**
	4th day 8.00am	0.41	0.95
	9.00am	0.40	0.87
	10.00am	0.42	0.55
	11.00pm	0.36	0.74
	12.00pm	0.39	0.52
	1.00pm	0.41	0.58
	5th day 9.00am	0.64	0.63
	10.00am	0.431	0.63
	11.00am	0.425	0.69
	12.00pm	0.419	0.58
	6th day 9.00am	0.5	0.73
	10.00am	0.56	0.77
	11.00am	0.61	0.71
	12.00pm	0.66	0.71
	1.00pm	**0.70**	0.82

Figure-4 Peaks showing electricity measurement using waste water with Mediator

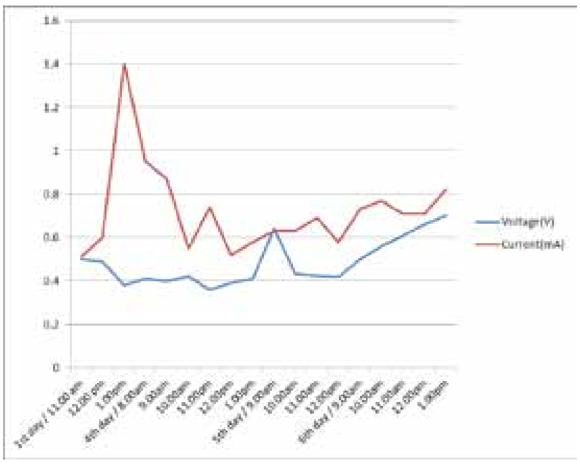

Table-3 Measurement of Electricity using waste water without Mediator

Apparatus	Date/time	Voltage(V)	Current(mA)
Waste water (without mediator)	1st day 8.00am	0.26	0.83
	10.00am	0.29	1.01
	12.00pm	**0.42**	**1.20**
	2.00pm	0.36	0.81
	4.00pm	0.27	0.65
	2nd day 8.00am	0.24	0.53
	10.00am	0.22	0.29
	12.00am	0.22	0.40
	2.00pm	0.21	0.51
	4.00pm	0.19	0.93
	6.00pm	0.23	0.85

Figure-5 Peaks showing electricity measurement using waste water without Mediator

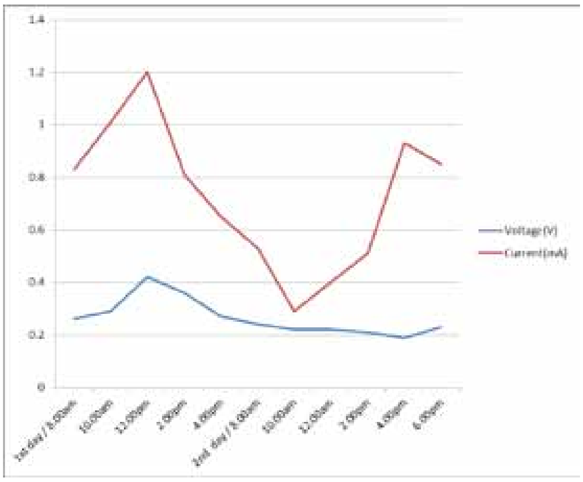

Table-4 Measurement of Electricity using cow's urine with salt bridge

Apparatus	Date/time	Voltage(V)	Current(mA)
Cow's urine (with salt bridge)	1st day 11.00 am	0.85	0.5
	12.00 pm	0.72	0.46
	1.00pm	0.74	**0.53**
	2.00pm	0.82	3.7
	3.00pm	0.83	3.5
	4.00pm	0.83	3.1
	5.00pm	0.85	3.1
	2nd day 9.00am	0.86	3.2
	10.00am	0.868	3.45
	11.00am	**0.878**	3.34
	12.00pm	0.69	3.4
	1.00pm	0.82	3.22
	2.00pm	0.86	3.49

Figure-6 Peaks showing electricity measurement using cow's urine with salt bridge

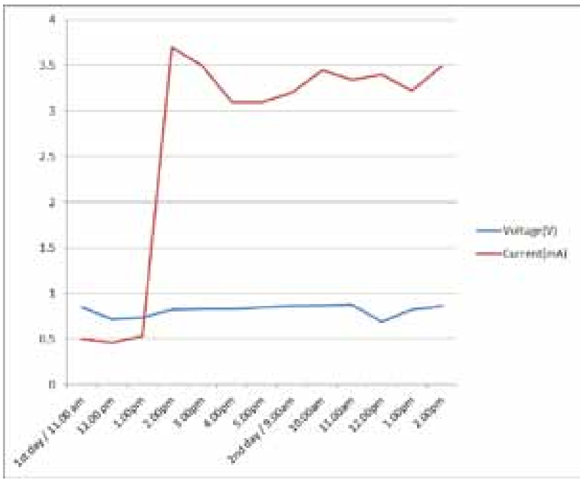

Table-5 Measurement of Electricity using cow's urine without salt bridge

Apparatus	Date/time	Voltage(V)	Current(mA)
Cow's urine (without salt bridge)	1st day 8.00am	0.82	18
	9.00am	0.97	18.51
	10.00am	1.04	19.2
	11.00am	1.14	**20**
	12.00pm	1.18	17
	1.00pm	1.21	10.2
	2.00pm	1.33	5.9
	3.00pm	**1.35**	2.7

Figure-7 Peaks showing electricity measurement using cow's urine without salt bridge

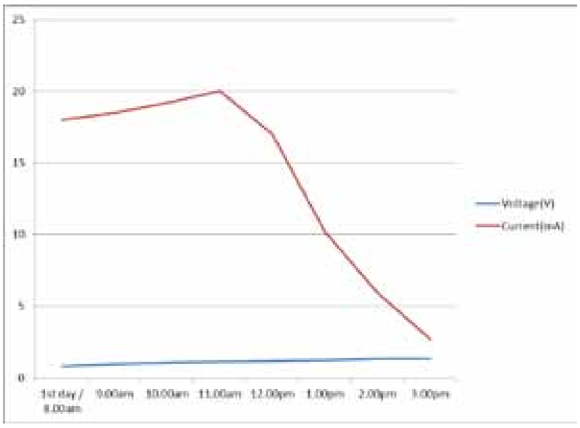

Table-6 COD test for different samples

Sample	Before(mg/l)	After(mg/l)
Waste water	6358	3186
Cow's urine	625	384

Waste water
By waste water with mediator we gained a highest value of 1.4mA current at 1.00pm on 1st day and 0.70V voltage at 1.00pm on 6th day (Table 2).

By waste water without mediator we gained a highest value of 1.20mA current and 0.42V voltage at 12.00pm on 1st day (Table 3).

Cow's urine
By Cow's urine with salt bridge we gained a highest value of 0.53mA current at 1.00pm on 1st day and 0.878V voltage at 11.00am on 2nd day (Table 4).

By Cow's urine without salt bridge we gained a highest value of 20mA current at 11.00am and 1.35V voltage at 3.00pm on 1st day (Table 5).

Applications
Electricity Generation
A MFC generates electricity directly from electron donors through the microbial activity.

Wastewater Treatment
Wastewater treatment using an MFC is promising since this process converts the major part of the chemical energy of the contaminants to electricity, thereby reducing the generation of excess sludge. Geobacter species have shown to be important in the anaerobic degradation of petroleum components and landfill leachate contaminants in ground water.

Biohydrogen
The MFCs can be readily modified to generate hydrogen instead of electricity (Oh & Logan 2005) using an anaerobic cathode and a small applied voltage to reduce protons in the cathode chamber.

BOD-Sensing
Another potential application of the MFC technology is to use it as a sensor for pollutant analysis and in situ process monitoring and control.

Body fluid batteries
In the future the amount of low-power devices implanted in the human body will significantly expand. To provide this power, a MFC can be used. Two possibilities exist, enzymatic and microbial fuel cells.

Powering underwater monitoring devices
Sensors distributed in the natural environment require power for operation. MFCs can possibly be used to power such devices, particularly in river and deep-water environments where it is difficult to routinely access the system to replace batteries.

Sediment electricity
MFCs can be used to generate electricity based on the potential difference generated by bacteria between sediment and the aqueous phase above.

Conclusion
In this work, with the help of MFC we have successfully generated a power of 0.8 – 1.4 V which is sufficient to light a LED by using waste water and cow's urine. MFC represent a biotechnological solution to generate electricity and it is a promising technology for generating electricity from organic material and wastes. Microbial fuel cells do hold promise towards sustainable energy generation in future. In addition to having very high fuel efficiency, microbial fuel cells produce very little pollution. They are inexpensive compared to a full metal combustion engine and they pose no explosion hazards such as the hydrogen fuel cell systems.

REFERENCES

1. Balat, M. (2010) . Energy Sources part A: Microbial Fuel Cells as an Alternative Energy Option. 2. Daniel R. Bond & Derek R. Lovley (2003). Electricity Production by Geobacter sulfurreducens attached to Electrodes, Applied and environmental microbiology: (69), 1548–1555. 3. Das, D., & Veziroglu, T.N. (2001). Hydrogen Energy, Int. J.: (26), 13–28. 4. Debabov, V. G. (2008). Pleiades Publishing Ltd.: Electricity from Microorganisms, (77), 123–131. 5. Gregory J. Newton, Shigeki Mori, Ryuhei Nakamura, Kazuhito Hashimoto & Kazuya Watanabe1 (2009). Journal of Zhejiang University-Science B (Biomedicine & Biotechnology): Analyses of Current Generating Mechanisms of Shewanella loihica PV-4 and Shewanella oneidensis MR-1 in Microbial Fuel Cells, American Society for Microbiology, 7674–7681. 6. Logan, B. E. 2004. Environ. Sci. Technol.: performance as a factor in electricity generation in microbial fuel cells, (38), 160–167. 7. Oh S. E., & Logan, B.E. (2005). Hydrogen and electricity production from a food processing waste water using fermentation and microbial fuel cell technologies, Water Res.: 39 4673–4682. 8. Venkata Mohan, Veer Raghavulu, S., Srikanth, S., & Sarma, P. N. (2007), Current Science: Bioelectricity production by mediatorless microbial fuel cell under acidophilic condition using wastewater as substrate, Influence of substrate loading rate, 92 (12), 1720–1726. 9. Yang, H., Shao, P., Lub, T., Shena, J.,Wang, D., Xub, Z., & Yuan, X. 2006. Int. J.: Hydrogen Energy, (31), 1306–1313. 10. Zhao, F., Harnisch, F., & Schroder, U. (2006). Env Sc Tech: Challenges and constraints of using oxygen cathodes in microbial fuel cells, (40), 5193-5199.

Sara Publishing Academy
Indian Journal Of Applied Research
Journal for All Subjects

Editor,
Indian Journal Of Applied Research
8-A, Banans, Opp. SLU Girls College,
New Congres Bhavan, Paldi, Ahmedabad-380006.
Contact.: +91-9824097643 E-mail : editor@ijar.in

Printed at Unique Offset, Novatsing Rupam Estate, Opp. Abhay Estate, Tavdipura, Shahibaug, Ahmedabad