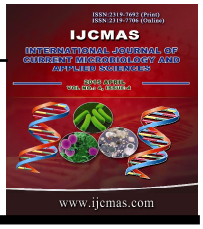
Int.J.Curr.Microbiol.App.Sci (2015) 4(4): 118-122

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 4 Number 4 (2015) pp. 118-122**
http://www.ijcmas.com



Original Research Article

Studies on Sewage Treatment of Industrial and Municipal Wastewater by Electrogens Isolated from Microbial Fuel Cell

S. G. Chaudhari* and A. M. Deshmukh

Department of Microbiology, Dr. Babasaheb Ambedkar Marathwada University, Sub campus, Osmanabad-413501 (M.S.) India
**Corresponding author*

Keywords

Waste water, COD removal, Electrogens

A B S T R A C T

Three waste water samples, Agro waste water; Dairy waste water, Distillery waste water from nearby area of Osmanabad district (M.S.) and Municipal waste from Osmanabad (M.S.) were used as substrate in Microbial Fuel Cells (MFCs) to generate electricity. Along with electricity generation the MFCs can successfully helps in treating same sewage samples. The parameters like pH, TS, TSS, TDS, BOD and COD were analyzed for all the four samples. The COD removal efficiency of the MFCs was analyzed using standard reflux method. All the MFCs were efficient in COD removal. 55%, 70%, 99% COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with municipal waste as substrate. 50%, 75% 99% COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with Dairy waste as substrate, 40%, 60%, 99% COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with Agro waste as substrate, 35% 54%, 70%COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with Distillery waste as substrate.

Introduction

Environmental pollution is high risk problem today. To meet growing population demand there is industrialization urbanization which is major contributor of the pollution. Untreated industrial waste is hazardous to population at site of disposal whether it is human, animal, plant or microbial population every one suffers pollution hazards. It disturbs food web which leads to imbalance of environment creating pollution problem. Every country having its own legal criteria for waste water treatment and disposal. Industrial waste treatment before disposal of it is necessary as it is hazardous to environment. Waste treatment in the view of industries is economic task with respect to both money and electricity Current research provides novel microbial solution to this problem (Mali *et al.,* 2012; Venkata Mohan *et al.,* 2008; Chonde 2014; Yifeng Zhang, 2012; Du *et al.,* 2007).

Recirculation of the waste to minimize pollution hazards along with electricity generation can be the great resolution

(Ghangrekar and Shinde, 2009). It is Microbial Fuel Cell that involves waste recirculation for the purpose of electricity generation. Microbial fuel cells are devices that generate electricity by live micro organism that is electrogens which utilize organic waste as substrate. The electricity generation is achieved by utilization of substrate by anaerobic digestion phenomenon (Hampannavar and Shivayogimath, 2010) during which there is removal of COD of waste samples with same organism that are involved in electricity generation. Thus by using MFCs reactor two aims that is electricity generation and waste water treatment can be achieved at a time by minimizing pollution hazards with power generation by ecofriendly mean.

Materials and Methods

Collection of waste samples

Three industrial waste samples namely Dairy waste, Distillery waste, Agro waste from nearby l industrial area of Osmanabad city and a single Municipal waste sample from nearby area of Ayurvedic campus Osmanabad city were collected aseptically and kept into the refrigerator for further research purpose.

Construction and operation of MFCs

Four double chambered MFCs were constructed with salt bridge as mean for proton transfer and operated using four different waste water as substrate to generate electricity (Pethkar *et al.,* 2012).

Physical analysis of waste samples

All the waste samples collected were analyzed physically with the parameters, pH, TS, TSS, TDS, BOD (Byung *et al.,* 2006) and COD.

COD removal of waste samples during the electricity generation experiment by MFCs

Four waste samples mentioned above were fed batch wise for electricity generation in four separate MFCs constructed during research work. Power generation measured in terms of voltage after every 24h. All the samples were analyzed for COD removal efficiency by standard reflux method.COD measurement were carried out after 5^{th}, 10^{th} and 20^{th} day. COD removal efficiency can be calculated using formula

$$E_{COD} = [COD_{in}\text{-}COD_{out} / COD_{in}] \times 100\%$$

Result and Discussion

Physical analysis of sewage is carried analyzing various parameters pH, TS, TSS, TDS, BOD and COD (Table 1). Minor change in pH of waste was observed during operation of MFCs with waste. There is slight reduction in pH of Agro, Dairy and Municipal waste water while there is increase in pH of Distillery waste. About TSS there is great reduction in TSS after treatment the appearance and color also changed during treatment .TDS values are observed to be increased it may be due to increase in number of microorganism during treatment BOD values are monitored by conventional method by samples after 5 days of incubation in MFCs proving the fact that MFCs can be good BOD sensor (Kim *et al* 2006).The COD removal efficiency (Moon *et al* 2005) of the MFCs was analyzed using standard reflux method (Table 2). All the MFCs were efficient in COD removal. 55%, 70%, 99% COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with municipal waste as substrate.

Table.1 Characterization of waste before and after incubation of 10 Days in MFCs

Sr. No.	Waste water samples	pH		TSS mg/l		TDS mg/l		TS mg/l		BOD mg/l
		Before	After	Before	After	Before	After	Before	After	
1	Agro waste	8.5	8.0	6100	800	80000	120000	86100	120800	200
2	Dairy waste	8.5	7.1	7600	3500	86000	112000	93600	115500	270
3	Distillery waste	4.8	6.5	24400	11700	606000	718000	630400	729700	420
4	Municipal waste	7.5	7.3	13000	9900	140000	324000	153000	333900	140

Table.2 COD removal ability of MFCs For different wastes

Sr. No.	Waste water samples	COD (%) removal efficiency after			Maximum power generation after
		5 Days	10 Days	20 Days	10 Days
1	Agro waste	40%	60%	99%	589 mv
2	Dairy waste	55%	75%	99%	700 mv
3	Distillery waste	35%	54%	70%	647 mv
4	Municipal waste	55%	70%	99%	667 mv

Figure.1 Power generation using Dairy waste

Figure.2 MFCs setup during research work

50%, 75% 99% COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with Dairy waste as substrate, 40%, 60%, 99% COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with Agro waste as substrate, 35% 54%, 70% COD removal was observed after 5, 10, 20 days respectively of operation of MFCs with Distillery waste as substrate. During current research goal of recirculation of waste to minimize pollution hazards can be achieved along with power generation by novel microorganism in MFCs. Figures 1 and 2 show the MFCs set up constructed during current research successful COD removal (Table 2) of all the four waste samples were observed while operating MFCs for electricity generation.

Maximum 75% COD removal and maximum electricity generation of 700 mv (Table 3) were observed during operation of MFCs as compare to other waste recirculation.

Local area waste samples were applied for isolating electrogenic bacteria and the most occurring strains are traced out for COD removal as well as electricity generation efficiencies of isolates (Mathuriya and Sharma, 2009). During the operation of double chambered MFCs the current research successful in generation of electricity as well as COD removal similar type goal can be achieved by various researchers using single chambered MFCs (Pandey *et al.,* 2011) Domestic wastewater treatment using single chambered MFCs were carrying out by (Liu *et al.,* 2004) the results are 50% to 70% COD removal efficiency. Current research successfully progressing toward goal of achieving good electricity generation using mediator less MFCs which confirms the fact that the bacteria did not require soluble mediators (Bond and Lovley, 2003), but can donate electrons directly by adhesion to the electrode surface (Liu and Logan 2004) perform the work operating the MFCs with a proton exchange membrane and the results are 55% COD removal while 75% COD removal operating the MFCs without a proton exchange membrane.

During the current research three industrial wastes and a municipal waste water sample from nearby area of Osmanabad district were analyzed for electricity generation and COD removal efficiency successfully. 75% maximum COD removal was achieved after 10 days by utilizing Dairy waste as substrate for MFCs constructed during current research. So it is concluded that the electrogens isolated from MFCs reactors are successful mean for waste water treatment along with generation of electricity.

Acknowledgement

The authors would like to thank the authorities and the members of microbiology department of Dr. B.A.M.U. Sub Campus Osmanabad.

References

Aishwarya D. Dalvi, Neha Mohandas, Omkar A. Shinde, Pallavi T. Kininge, 2011. Microbial for production of bioelectricity from whey and biological waste treatment. *J. Adv. Biotechnol. Res.*, 2(2): 263–268.

Bond, D.R., Lovley, D.R. 2003. Electricity production by Geobacter suljiurreducens attached to electrodes. *Appl. Environ. Microbiol.,* 69(3): 1548–1555.

Byung Hong Kim, In Seop Chang, Hyunsoo Moon, 2006. Microbial Fuel Cell-Type Biochemical Oxygen Demand Sensor Bioelectrochemistry Laboratory, Water Environment & Remediation Research Center, Korea Institute of Science and Technology, Hawolgok-dong, Sungpook-ku, Seoul, Korea

Chonde, S.G. 2014. Microbial fuel cell: a new approach of wastewater treatment with power generation. *Int. J. Chem. Environ. Pharm. Res.*, 5(1): 8–12.

Du, Z., Li, H., Gu, T. 2007. A state of the art review on microbial fuel cells: A promising technology for wastewater treatment and bioenergy, *Nat. Biotechnol.*, 25: 464–482.

Ghangrekar, M.M. Shinde, V.B. 2009. Mfcs a new approach of waste water treatment with power generation. *Bioresour. Technol.,* 100(18): 4171–4175.

Hampannavar, U.S., Shivayogimath, C.B. 2010. Anaerobic treatment of sugar industry wastewater by up flow anaerobic sludge blanket reactor at ambient temperature. *Int. J. Env. Sci.*, 1(4): 631–639.

Hyunsoo Moon, In Seop Chang, Jae Kyung Jang, Byung Hong Kim, 2005. Residence time distribution in microbial fuel cell and its influence on COD removal with electricity generation. *Biochem. Eng. J.*, 27: 59–65.

Liu H and Logan B. E.,(2004). Electricity generation using an air cathode single chamber microbial fuel cell in the presence and absence of a proton exchange membrane. *Environ. Sci. Technol.*, 38: 4040–4046.

Liu, H., Ramnarayanan, R., Logan, B.E. 2004. Production of electricity during wastewater treatment using a single chamber microbial fuel cell, Environmental Science and Technology, 38, pp 22812285.

Mali, B.M., Gavimath, C.C., Hooli, V.R., Patil, A.B., Gaddi, D.P., Ternikar, C.R., Ravishankera, B.E. 2012. Generation of bioelectricity using waste water. *Int. J. Adv. Biotechnol. Res.*, 3(1): 537–540 .

Mathuriya, A.S., Sharma, V.N. 2009. Bioelectricity production from various wastewaters through microbial fuel cell technology. *J. Biochem. Tech.*, 2(1): 133–137.

Pandey, B.K., Mishra, V., Agrawal, S. **2**011. Production of bio-electricity during wastewater treatment using a single chamber microbial fuel cell. *Int. J. Eng. Sci. Technol.*, 3(4): 42–47.

Pethkar, A.V., Kalyani Kale, Priyanka Belgaonkar, Vaishali Bagul, Kale, V.S., Sucheta N. Patil, 2012. A microbiological process for combined bioelectricity production and waste water treatment using *Staphylococcus* Sp. *J. Environ. Res. Dev.*, 6: No. 3A.

Venkata Mohan, S., Mohanakrishna, G., Purushotham Reddy, B., Saravanan, R., Sarma, P.N. 2008. Bioelectricity generation from chemical wastewater treatment in mediator less (anode) microbial fuel cell (MFC) using selectively enriched hydrogen producing mixed culture under acidophilic microenvironment. *Biochem. Eng. J.*, 39: 121–130.

Yifeng Zhang, 2012. Energy recovery from waste streams with microbial fuel cell (MFC)-based technologies, PhD Thesis, Department of Environmental Engineering**,** Technical University of Denmark.