

MFC, energy saving?

Maria Manzano Ramírez, Microbiology grade

Goals:

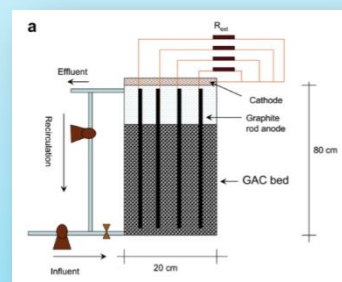
- Check out if a microbial fuel cell (MFC) can save energy in a 7200 people village (Gelida)
- Check out if a MFC can save energy in a 5 people house
- If all of this is possible, how can they should be built

Data used

	Wastewater production	Energy consumption
Gelida	1440 m ³ /day 525600m ³ /year	113KWH/day /person 813600KWH/year
5 people house	0,2 m ³ /day 73 m ³ /year	9922 KWH/year

Multi anode –cathode MFC:

- Residence time = 24h
- Multiple anodes were installed in the cylinder chamber, comprising multiple graphite rods mounted on a plastic frame to collect electrons in the granular activated carbon bed



Calculations

Gelida

$$\frac{1440000L}{day} * \frac{0,281 g}{L} * \frac{14,7KJ}{g-COD} * \frac{1kWh}{3600kJ} = 1652,28 \frac{KWH}{dia} * 365 \frac{days}{year} = 603082,2 \frac{KWH}{year}$$

5-people house

$$\frac{200L}{day} * \frac{0,281 g}{L} * \frac{24,45KJ}{g-COD} * \frac{1kWh}{3600kJ} = 0,2295 \frac{KWh}{dia} * 365 \frac{days}{year} = 83,76 \frac{KWH}{any}$$

Money saved in a year:

	€ saved
Gelida	86.482€
5-people house	12€

Architecture:

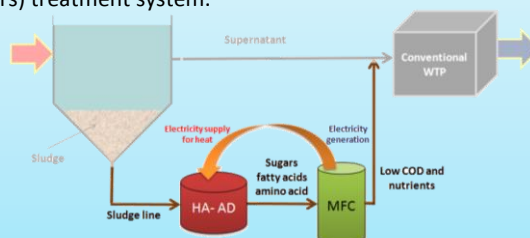
$\pi * r^2 * h = total\ volume$
h has to be 8 times larger than 2r
(Jiang et al⁶)

Dimensions calculated

Gelida	Diameter = 7,7 m Height = 30,8112 m
5-people house	Diameter = 0,4 m Height = 1,6 m

WWTP distribution in our case

MFC would replace the AS (Activated sludge) or TF (Trickling filters) treatment system.



Conclusions:

- The installation of an MFC in a 5-peolpe house is not economically viable.
- Gelida WWTP can have an MFC because no much space is needed and benefits are high.
- If Gelida installed an MFC, architectural changes would be required to adapt to the selected tank and materials.
- More research is needed to build profitable MFCs for 5-people houses.

1. Min, B., Cheng, S. and Logan B. E. (2005). Electricity generation using membrane and salt bridge microbial fuel cells, Water Research, 39 (9), pp1675–86 // 2. ACA (Agència Catalana de l'Aigua) - http://aca-web.gencat.cat/aca/documents/ca/depuradores_servei/dgel_edar_gelida.pdf//3. Organizacion de Consumidores y Usuarios - <http://www.ocu.org/vivienda-y-energia/gas-luz/noticias/cuanta-energia-consume-una-casa-571584> // 4. Logan BE, Aelterman P, Hamelers P, Rozendal R, Schroeder U, Keller J, et al. Microbial fuel cells: methodology and technology. Environmental Science and Technology 2006;40 (17):5181e92. // 5. Keller J and Rabaey K. Experiences from MFC pilot plant operations. Microbial fuel cells-first International symposium. Pennsylvania, US; 27e29 May 2008. // 6. Jiang D, Li X, Raymond D, Mooradain J, Li B. Power recovery with multi-anode/cathode microbial fuel cells suitable for future large-scale applications. International Journal of Hydrogen Energy 2010;35(16):8683e9. // 7. Jiang, D., Curtis, M., Troop, E., Scheible, K., McGrath, J., Hu, B., ... Li, B. (2011). A pilot-scale study on utilizing multi-anode/cathode microbial fuel cells (MAC MFCs) to enhance the power production in wastewater treatment. International Journal of Hydrogen Energy, 36(1), 876–884. doi:10.1016/j.ijhydene.2010.08.074 // 8. Mahdi Mardandpour, M., Nasr Esfahany, M., Behzad, T., & Sedaqatvand, R. (2012). Single chamber microbial fuel cell with spiral anode for dairy wastewater treatment. Biosensors and Bioelectronics, 38(1), 264–269. doi:10.1016/j.bios.2012.05.046 // 9. Endesa - <http://www.endesaonline.com//> 10. Bruce E. Logan, Microbial fuel cells. Ed. Wiley // 11. Logan, B., Cheng, S., Watson, V., & Estadt, G. (2007). Graphite fiber brush anodes for increased power production in air-cathode microbial fuel cells. Environmental Science & Technology, 41(9), 3341–6. // 12. Zuo, Y., & Logan, B. E. (2011). Power generation in MFCs with architectures based on tubular cathodes or fully tubular reactors. Water Science and Technology: A Journal of the International Association on Water Pollution Research, 64(11), 2253–8. doi:10.2166/wst.2011.429