

GCC Domestic Wastewater Treatment and Microbial Fuel Cells

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Situation

- The water resources are scarce across the gulf region, however water consumption is very high compared to other countries across the world.

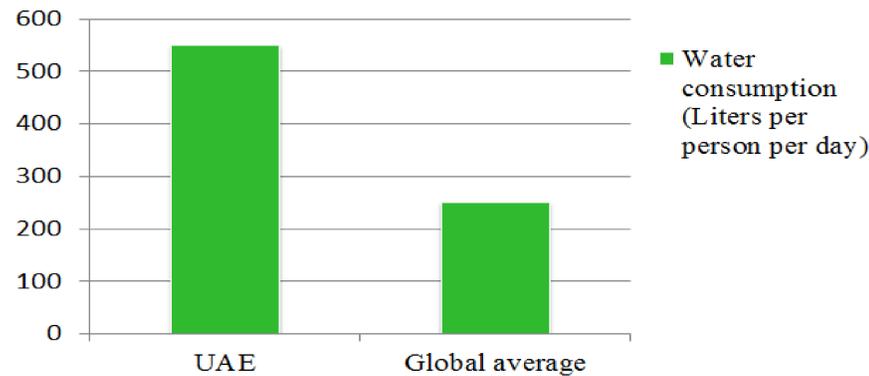


Fig. 1 Water Consumption Of UAE Versus The World [1]

- The wastewater production rate is increasing with the increasing water consumption which concerns many environmental institutions in the region.

Problems

There are two main problems:

- Many countries dump untreated wastewater in water bodies because it is cheaper than treating it.

➔ The environmental institution Al Muharraq Council in Bahrain warns about this act, because the wastewater contains harmful bacteria and gases such as methane gas which eventually will destroy the marine life and could also risk people's lives [2].

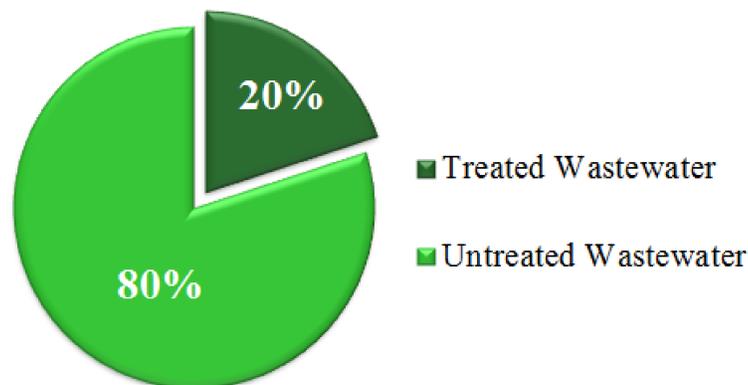


Fig. 2 Percentage of wastewater treated worldwide [3]

- The energy consumption of treating wastewater is very high. This translates into a high cost of operation, which makes the current wastewater treatment methods uneconomical. The current methods need external power supply, while the proposed solution generates the electricity needed to operate the wastewater treatment plant.

Solution

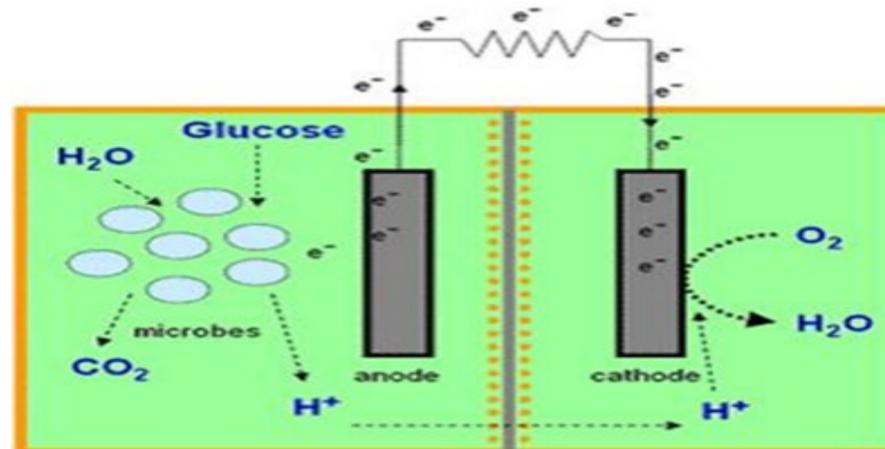
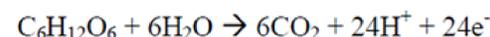


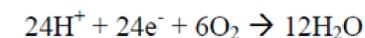
Fig. 3 Microbial fuel cell schematic diagram [4]

- A cost effective and environmentally friendly solution is to use the microbial fuel cells (MFCs) to generate electricity in order to operate the wastewater treatment plant.
- MFCs are devices that generate electrical energy from bacteria in organic wastes. The devices keep the water that contains the bacteria in a chamber isolated from oxygen, and glucose is added. The bacteria will absorb the glucose and produce electrons. These electrons will be used in the process of electrolysis to generate the electricity [5].

Oxidation half reaction:



Reduction half reaction:



Overall oxidation/reduction reaction:

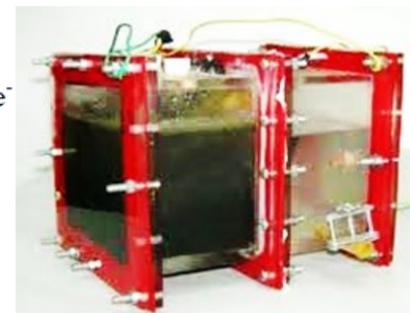
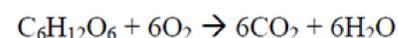


Fig. 4 A microbial fuel cell [6]

- The wastewater treatment process that we will utilize in our project is the activated sludge method which consists of multiple stages that are shown in Fig 2.

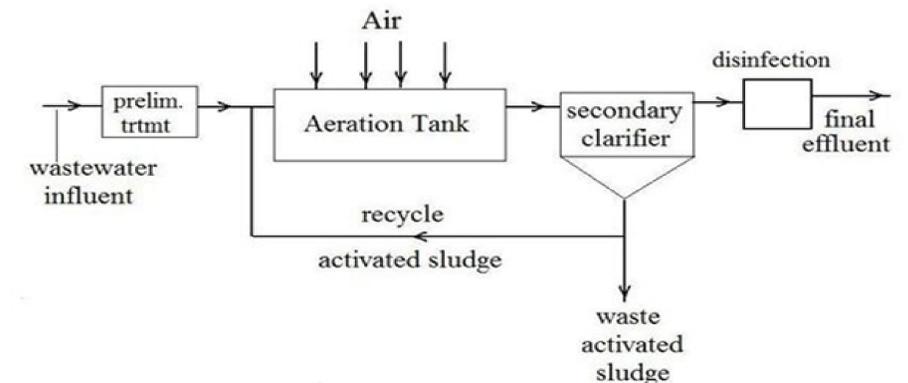


Fig. 5 Activated Sludge flow diagram [x]

Evaluation

Advantages

- Cost will be reduced with respect to the power generation of the wastewater treatment plant [7].
- Having a cost effective method of treating water available in the market will encourage many countries that do not treat their water, but instead dump it in the sea or in pits, to start treating their water [7].
- Electricity generated by the MFCs is considered a clean and renewable source of energy [7].

Limitations

- MFCs are not very efficient since this technology is new and not much research has been done on it. Therefore, a series of MFCs should be used.
- The wastewater used in the treatment should be very rich in organic material which is not always the case with domestic wastewater.

References

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