# EXPERIMENTAL INVESTIGATION ON STRENGTH OF WASTEWATER AND ENERGY PRODUCTION USING MFC TECHNOLOGY

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**Abstract:** The need for alternative fuel is increasing rapidly with the depletion of non-renewable energy resources. Microbial fuel cell$_s$ (MFCs) represent a new form of renewable energy, which converts organic matter into electricity with the help of bacteria present in wastewater, while simultaneously treating the wastewater. These MFC$_S$ performed well for BOD,DS and TS removal from the wastewater treatment, demonstrating the effectiveness of this device for wastewater treatment with BOD,DS and TS removal efficiency about 75%,62% and 66% respectively. Using graphite electrodes, the electricity generation in these MFC$_S$ was observed under different MFC configuration. The maximum current production is 0.86mA and 0.89V of voltage with duration of 35days.

***Keywords:*** Microbial Fuel Cell, Bioelectricity, Wastewater, Salt bridge, Electrodes.

## 1. Introduction

Energy calamity in India is rising each year, as there is a constant activity in the price of fuels and also due to depletion of fossil fuels to a larger level. The demand for an alternating fuel has erupted extensive research in discovering a potential, economical and reusable source for energy manufacture[1]. Rapid urbanization and industrialization in the developing countries like India pose severe problems in collection, treatment and disposal of effluents. This situation leads to serious public health problems. For constructing a sustainable world, we require to minimize the expenditure of fossil fuels as well as the pollution generated. These two aims can be accomplished all together by treating the wastewater (From disposing waste to using it)[1]. Industrial waste, agricultural waste and household waste are ideal substrates for energy productions as they are rich in organic contents.

Textile wastewater is still remained as one of the most complicated wastewaters to treat because of the complex pollutants that it is composed of. Textile wastewater contains very high concentration of colour, COD, suspended solids and others pollutants[2]. Being a complex kind, Textile wastewater requires most sophisticated and thus expensive treatment methods which are not affordable to Textile industries in developing worlds. Moreover, Textile industries are one of the most important and rapidly growing industrial sectors in many developing countries like Bangladesh, China, India, Pakistan, Turkey, Vietnam and many more. Due to growing concern of pollution caused by Textile wastewater and updated environmental regulations, Textile mills need to control and treat their produced wastewaters before discharging to water bodies.

## 2.Materials and Methodology:

### 2.1 Wastewater collection

Textile wastewater is collected from Sholapur, Maharashtra which is very famous city for Textile industries and there are many power loom and cotton mills in Sholapur district. The city lies in the border of Karnataka and is well connected from all the neighboring districts. Sholapur is bordered by Gulbarga district on the southeast and south, Bijapur district on the south and southwest[3].


Various materials are used for the construction of MFCs were as follows:

- AGAR AGAR BACTO: is used to prepare agar salt bridge, proton exchange membrane for keeping the anode & cathode liquid separate.
- Graphite RODS: are used as anode & cathode materials.
- COPPER WIRE: is used to connect the electrodes to the multimeter which form external circuit.
- PVC PIPE: holds the agar salt mixture, which is called as agar salt bridge.
- PLASTIC BOXES: used to prepare anode & cathode chambers. The anode chamber is having 10 litres capacity with a working volume of 7.5 litres and holds the wastewater and the cathode chamber holds a conductive salt solution.
- DIGITAL MULTIMETER: is used to measure the current and voltage.

## 2.2 METHODOLOGY

Double chambered, Microbial fuel cells will be fabricated for the treatment of Textile industry wastewater and electricity production.

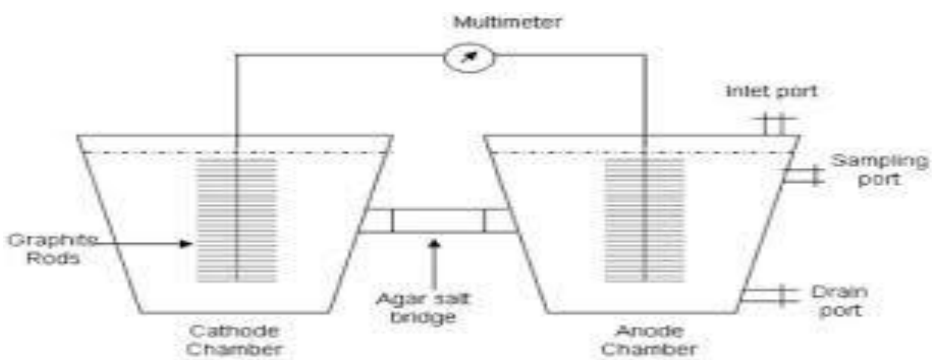



Fig1 : Schematic diagram of Double chambered MFC

### 2.2.1 Selection of anode and cathode chambers:

Non-reactive, non-conductive and non-biodegradable plastic boxes are selected as anode and cathode chambers.

### 2.2.2 Assembling Of Electrodes

The graphite rods from battery cells are extracted & used as anode and cathode materials. The arrangement of electrodes is done on a plastic pipe in such a way that it looks like a graphite brush as shown in fig 2. This arrangement of graphite allowed to increase the surface area and to come in contact with substrate.

Fig 2: Schematic diagram of arrangement of graphite rod

### 2.2.3 OPERATING CONDITIONS

The whole study was conducted under ambient environmental conditions. The microorganisms present in Textile wastewater acted as the substrate for MFCs. The Textile wastewater samples were kept in refrigerator at 4 $^{0}$ C before use.

### 2.2.4 MFC Operation

The anode chambers of MFC-1 were ¾ filled with Textile wastewater with different wastewater strengths as substrate for both the MFCs and 3ml sewage. In the cathode chamber of MFC-1, 1 M KCL solution was added as catholyte. The internal wiring of anode and cathode were connected to a multimeter to complete the circuit. The entire setup was left for 4 days for stabilization and the initial reading was noted down. The wastewater parameters were analyzed weakly and the current & voltage readings using multimeter were monitored every 24 hrs interval. As for the standard value of BOD removal efficiency is 38%,60% and 75%. The Maximum current production is 0.86mA and 0.89V of voltage with duration of 35days[4].

## 2. Results and discussion:

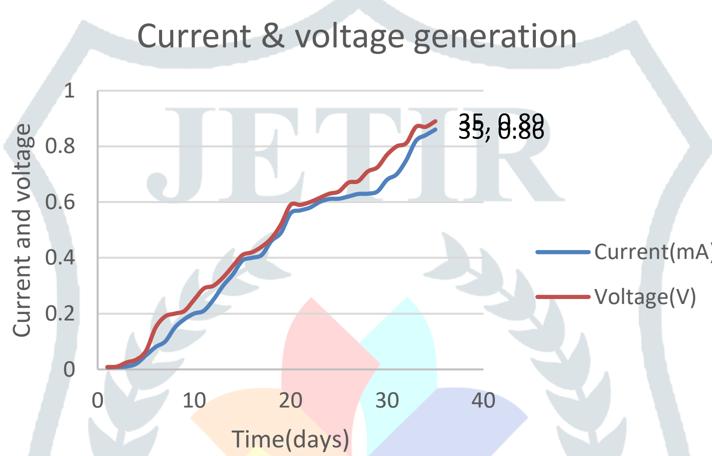
**Table 1: General characteristics of Textile industry wastewater**

| **Properties** | **Range of value** |
|---|---|
| pH | **7.17** |
| $BOD_5$ (mg/L) | **994** |
| **Colour** | **Dark greenish** |

| | blue |
|---|---|
| **Suspended Solids(mg/L)** | **1140** |
| **Dissolved Solids(mg/L)** | **4580** |
| **Total Solids** | **5720** |

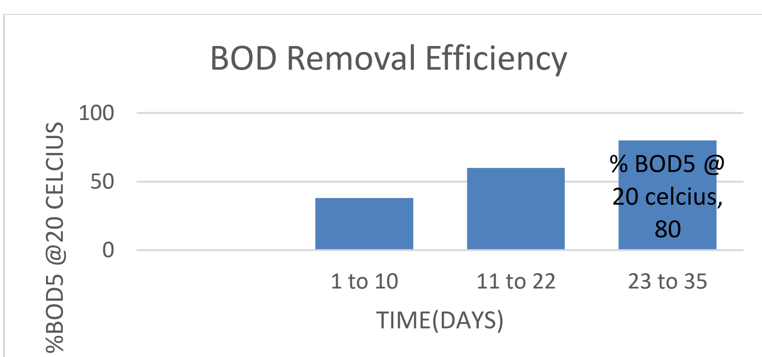
## 2.1 Current and voltage generation using various concentrations of textile mill wastewater:

After inoculation and feed application in continuous mode, slow increase in current was observed in MFC with duration of operation. The MFC took two weeks to get acclimatized with necessary microbial culture development to produce steady current. The maximum current production is 0.86Ma and 0.89V of voltage with duration of 35 days. Lower external resistance the current production is higher and vice versa.



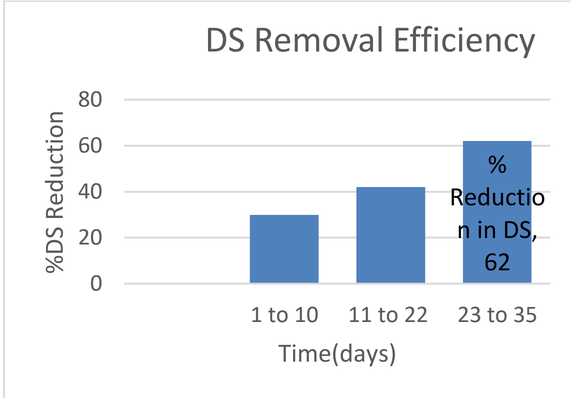

## 3.2 BOD REMOVAL EFFICIENCY:

During operation, all MFCs were continuously monitored for waste (as BOD) removal to enumerate the potential of fuel cell to act as wastewater treatment unit. The textile waste water showed its potential for BOD removal indicating the function of microbes, present in waste waters in metabolizing the carbon source as electron donors. It is evident from experimental data that current generation and BOD removal showed relative compatibility. The effect of wastewater concentration on BOD removal of textile waste water. The BOD removal efficiency using textile waste water is 1 to 10 ,11 to 22 and 23 to 35 days waste water concentration were 38%, 60% and 75% respectively. Below table and graph shows the BOD Removal Efficiency of textile wastewater under various organic loading rates.



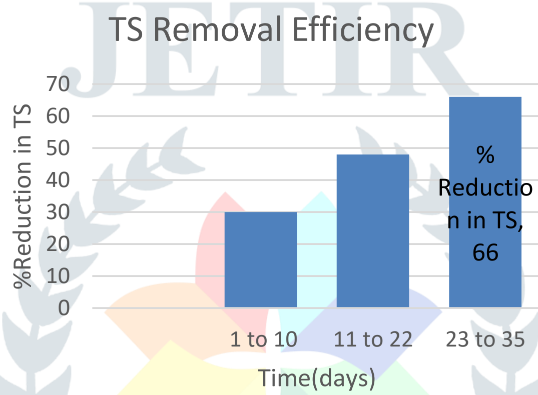

## 3.3 DISSOLVED SOLIDS REMOVAL EFFICIENCY:

The below table and graph shows its potential for dissolved solids removal. The effect of waste water concentration on dissolved solids removal of textile waste water experimental data indicated that dissolved solids removal efficiency increases 30%,42% and 62% increase in waste water concentration of 250mg/L,500mg/L and 750mg/L from were 30%, 42%, and 62%.




### 3.4 TOTAL SOLIDS REMOVAL EFFICIENCY:

Graph shows the TS Removal Efficiency of textile wastewater under various organic loading rates.




## 4.CONCLUSIONS:

1. Maximum current production= 0.86mA &Voltage =0.89V
2. BOD Removal efficiency is 38%, 60% and 80% for Con of 250mg/L, 500mg/L, and 750mg/L respectively.
3. Dissolved solids removal efficiency is 30%,42% and 62% for Con of 250mg/L, 500mg/L, and 750mg/L respectively.
4. Total solids removal efficiency is 30%, 48% and 66% for Con of 250mg/L, 500mg/L, and 750mg/L respectively.

Thus, the combination of wastewater treatment along with electricity production may help in saving money as well as helps in creating sustainable environment.

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