SUMMARY AND CONCLUSION
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The present study was conducted to enhance the electrical conductance and remediation of various microbial cultures. Three different pure cultures (E. cloacae, E. aerogene and E. coli) have been chosen with different density (0.5 and 1 O.D) using glucose or sodium acetate or sucrose at 0.4% concentration. Optimization of culture density and substrate concentration was done to enhance the electrical conductance using dual chambered MFC. Different water samples were also selected with sucrose at pH 5.5 to generate electrical conductance and remediation purpose using same dual chambered MFC. Optimization has been done using changing pH and substrate to compare the electrical conductance and remediation improvement. Textile waste water was also used with adding inoculum of E. cloacae using sodium acetate as substrate at pH 5.5. Overall results of the present study can be summarized as follows.

As described in the results and discussion E. cloacae and E. aerogene at 0.5 and 1 O.D using 0.4% sucrose and sodium acetate showed that 0.5 O.D. of E. cloacae with sodium acetate produced maximum voltage of 1100 mV and CE value of 92.1% compare to other concentration of same culture and E. aerogene at both densities. Optimization of culture density was done using 0.125 and 0.25 O.D. E. cloacae showed that electrical conductance parameters and CE value were lower compared to 0.5 O.D. of E. cloacae. Further optimization of substrate concentration was performed using 0.2 and 0.6% sodium acetate which gave 222 and 786 mV voltage which were generated that were lower compare to produced by 0.4% sodium acetate (1100 mV). CE values produced were 55.7 and 81.4% for 0.2 and 0.6% sodium acetate respectively which were also lower compared to 0.4 % sodium acetate (92.1%). The results from this section showed that 0.4% sodium acetate was most suitable substrate for 0.5 O.D. of E. cloacae. The results demonstrate the optimization requirements of specific substrate and biocatalyst mandatory for optimal and stable electrical conductance in a mediator less dual chambered aerated membrane MFC.

Pure culture of E. coli gave 660, 783 and 592 mV voltage using 0.5 O.D. with 0.4% sucrose, sodium acetate and glucose respectively while CE value produced by them were 85.2, 86.5 and 66.35% respectively. Voltages produced at 1 O.D. were 779, 688 and 701 mV for sucrose, sodium acetate and glucose respectively while CE values were 69.45, 78.2 and 74.54% for the respective substrates. It has been demonstrated that three different substrates have been
used with 0.5 and 1 O.D. culture density and sodium acetate gave better results compared to other two substrates. The results using *E. coli* at different density and various substrates confirmed that sodium acetate was best suitable substrate for *E. coli* at 0.5 O.D. culture density. The voltage and power generated for each individual batch was increased with some fluctuations that resulted high coulombic efficiency and showed COD removal rate using dual chambered MFC. The graphs obtained with *E. coli* were unlike that observed with *Enterobacter* spp specific MFC where the eventual formation of a biofilm was indicated.

Remediation efficiency of the dual chambered MFC was observed using various water samples. Six water samples (four inland and two waste waters) samples were collected to compare the electrical conductance and CE values. Sucrose of 0.4% concentration was used with all the water samples at pH 5.5 and was observed that pond water gave maximum voltage of 724 mV and 74.97% CE while maximum CE value was obtained with sangam water sample (76.96%) that was slight higher but voltage value was much lower (285 mV).

Waste water sample (primary treated municipal waste water) produced maximum voltage of 705 mV with 73.6% CE value that was slight less compare to pond water sample. Pond and canal (from inland water) and waste water samples at pH 4.5 had lower voltage and CE values compared to pH 5.5. Least voltage producing water samples (sangam and yamuna) were used with 0.4% glucose at 5.5 pH and observed that glucose produced less voltage and CE compare to sucrose when used with same samples. While using different water samples, it was observed that water samples like municipal waste water or pond water showed better electrical potential than water samples like sangam or yamuna that showed that water at flowing condition has less microbes and organic matter that plays vital role in current generation. Since it was clear from the pure microbial cultures that sodium acetate was better substrate then sucrose so sodium acetate was used with maximum voltage producing water sample (pond) and observed that voltage and CE values were 804.63 mV and 77.07% respectively. The results from the present study confirmed that sodium acetate was the best suitable substrate for water samples which gave increased electrical conductance and CE value.

Electrical conductance and remediation efficiency of textile waste water was observed by adding varying size pellets of overnight culture of *E. cloacaes*. The results from the present study showed that *Enterobacter cloacaes* when added to textile waste water increase the remediation efficiency of the MFC. CE values of textile waste water alone were lower than when
*Enterobacter cloacae* culture pellets were added. Similarly the power density generation for TW+100 was 233.44 mW/cm² was higher than TW+0 i.e. 91.57 mW/cm². Optimization of *Enterobacter cloacae* as biocatalyst additive in the textile water showed power density of TW+0, TW+50p, TW+200p and TW+300 was lower compare to TW+100p indicative of the bacterial density optimization for maximum electrical conductance. Conversely all CE values were higher for the textile water sample with *Enterobacter cloacae* as additive with the maximum CE of 80.1% obtained with TW+100. The increase in power generation and CE values confirms the efficiency of *Enterobacter cloacae* as a biocatalyst additive for increased remediation efficiency of waste water when using a mediator less dual chambered membrane cathode aerated MFC.

From the present study it can be concluded that an *Enterobacter cloaca* was best suited bacterial culture for MFC when used with 0.4% sodium acetate at pH 5.5. Remediation and electrical conductance increased with different water samples using also with 0.4% sodium acetate at pH 5.5. Efficiency of *E.cloaca* was estimated by adding different inoculum size in textile waste water. *E.cloaca* increases electrical conductance and CE values of textile waste water samples the resulting in improved remediation.

As described in review of literature, there are several other parameters that influence electrical conductance and remediation like bridge size, membrane size, MFC design, different electrode materials, and electrode size can be optimized in further studies to achieve higher electrical conductance and remediation using different microbial populations.

There is much exciting work to be done on better understanding the bacteria that function as an electrogenic source and that help us to harvest electricity from MFCs. The ultimate achievement of MFCs will be when they can be used solely as a method of renewable energy production. Presently, the high cost of materials for MFCs and the relatively cheap price of fossil fuels make it unlikely that electricity production can be competitive with existing energy production materials and methods. Much work remains to be done, but there is a bright and promising future for a wide range of MFC technologies that can form the foundation of a new generation of electrogenic reactor systems.