DIRECT MEMBRANE FILTRATION OF DOMESTIC WASTE WATER: IMPLICATION FOR COUPLING WITH MEMBRANE BIOTREACTOR (DF-AnMBR) FOR WASTE WATER.

Amrinder Singh, Nishma Chadda
Uttaranchal Institute Of Technology,Uttranchaluniversity,Dehradun,Uttrakhand-248001
Assistant Professor, Uttranchal University, Dehradun, Uttrakhand

ABSTRACT

This paper enlists the research work done in direction of finding alternative methods of treatment of waste water. Use of different types of membranes is still being done to treat the water to enhance the performance of water filtration by membranes.In DF as the name suggests, there is a direct filtration of raw water, without any prior treatment. The filter being exposed to the raw water directly, due to direct exposure of raw fed water the performance of filter being affected and the pores of the filter may get blocked. Testing with pore size of 0.03 micrometer ultrafiltration method (Polyvinylidene fluoride) showed by using this technique. A high quality effluent is produced while sustaining a high membrane flux simultaneously. By filtration through this method, a highly concentrated fraction of waste water is obtained which is reduced in volume but has high amount of solids and organic strength which then has to be treated by other methods.Thus to overcome this problem we propose coupling of direct membrane filtered with an anaerobic membrane bioreactor which can deal with high amount of solids and organic strengths being produced in waste.An MBRs are used in treatment of industrial strength waste water which is high in COD. This method may not be completely suitable with domestic waste water which is the generally low in COD. But if we couple DF with An MBR, the low strength domestic waste water can be treated efficiently. By coupling DF and An MBR we can deal with liquid fraction of waste water by DF and highly concentrated organic part of waste by An MBR, thus improving the efficiency and energy profile of An MBR.So during the research we have to deal with various flow and mass equations according to which best suitable design can be chosen.due to highly concentrated solid waste being generated in this method there are chances of membrane fouling over few weeks and months. Due to absence of any systematic method, that may determine how the process changes may affect the performance the performance of method. Due to this occurring problem, there was a desire to determine fouling propensity. MPI (Modified Propensity Index) that was previously used in sea water. RO dissemination is now being applied to this method to find out fouling propensity.This method to find out fouling propensity will be applied to raw domestic waste water,

concentrated domestic waste water and the liquid fraction obtained during filtration. Adsorption can also effectively reduce fouling during this method. So the effect of PAC (Powdered Activated Carbon) on fouling propensity is also to be determined.

KEYWORD

COD, AnMBR, Fouling propensity,ultrafiltration ,DF(direct filtration)

INTRODUCTION

Till date these conventional treatment methods were considered to be fully effective but as the technology is advancing these days these methods are having a limited approach or some limitations in the treatment of waste water. These methods have various disadvantages like they produce a low quality effluent , a very large volume of sludge is formed, they work on a very large foot print. Seeing these disadvantages alternative method for treatment of waste water was proposed . One of the most effective method of treatment is using MBR i.e membrane bioreactor. The main purpose or role of a membrane is to act as selective barrier or passage from which certain selected particles or material can pass and the rest of it can be retained on the membrane. Depending on the pore size and the capability of the membrane to exclude the particles from the liquid the membranes can be classified as microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis(RO).Based on their configuration they are also classified as spiral wound membrane,hollow fibre membrane and tubular membrane. The treatment through DF systems can be improved by addition of coagulants, by increasing the efficiency of DF system we can reduce various problems, reducing maintenance and operating cost , low fouling index , increase life of membrane and can operate at lower transverse membrane pressure. Anaerobic membrane bioreactors are non-conventional treatment facilities that use combination of biological treatment methods with ultra on micro-filtration. a high quality efficient is being generated that can be reused. The bioreactor that is being used in AnMBRs consist microorganism that breakdown the organic matter being found in raw domestic feedwater on the micro and ultra-filtration to treat the raw feed water. The performance of AnMBR depends on various parameters, that are to be considered while operation. The system should operate at lower energy maintaining the flux in the system.

MATERIALS AND METHOD

The AnMBR technique deals with treatment of waste water collected by the students and the staff members with the help of collection system that disposes of waste water into septic tank. The two stage AnMBR is designed to obtain waste water at an ambient temperature. Each stage blanket(UASB) ,where as the second is completely stirred tank reactor(CSTR). The tabular PVDF membranes modules, with total membrane area of 0.0415 m^2 and average pore size of 0.03 micrometer, then filters the bioreactor content from second reactor and sends the left out concentrate to the bioreactor. Pervade from AnMBR and effluent from FW digester provides nutrient source for the hydroponic system as well as the APBR. Because the wastewater changes from day to day, sample of the wastewater must be characterized for each experiment. PAC was obtained from such that it had an average particle diameter of 0.16 mm. This PAC was used in furthers tests to be conducted. The samples obtained from all of the experiments were measured with the following parameters based on each test (DO, total nitrogen, total phosphorus ,

turbidity ,total solids(TS) ,total volatile solids(TVS), total suspended solids(TSS) and volatile suspended solids(VSS), pathogens via E-Coli testing ,color and yellowness.

COD- The cod test in our case was able to measure the concentration of COD from 30-1500 mg/l. Another method to determine COD is by using hach COD reactor. But in case of higher expected values of COD , the samples are heated at150 degree celcius for 2 hours.

TURBIDITY- Turbidity can be measured by using turbidity rod, Jackson and Baylis turbidity meter.it can also be measured using Hach 2100 P portable turbidity meter

TS AND VS-TS and VS were first measured using EPA METHOD 1684 and TSS and VSS were determined using EPA METHOD 3402. Whatman glass microfilter was used in TSS and VSS sample, having diameter of 47 mm and pore size of 1.5 micrometer

TOTAL NITROGEN- Total nitrogen can be determined either by determining kjeldahl nitrogen i.e sum of organic nitrogen and ammonia nitrogen. It is determined by decomposing the organic matter by addition of H2 SO4 and heating up the sample. After this the sample is distilled by adding some amount of NaOH to convert ammonium salt to ammonia. It canm also be determined by usind spectrometer using a colourimetric test kit(hach) method.

AMMONIA- Ammonia can be determined by simple colorimetric method in ppm. Indophenols blue color is produced in alkaline borate medium using phenol and hypoclorite as reagents and then color is matched.

TOTAL PHOSPHORUS- Total phosphorus is determined in aqueous solutions as phosphorus is being chamged to phosphate form precipitated with hydrated iron (iii) oxide ,it is bound by activated charcoal and measured using EDXRF.TP can also be measured utilizing Hach total phosphorus by the molybdovandate test ‘N tube method Hacg method 10127 mg/l PO4 .

Then these all tests were performed by addition of PAC to the filter. In phase 2 ,tests were done to find out the performance of the system by finding out the flux and trans membrane pressure by using transducers across the membrane.

RESULTS

Phase 1

COD (initial)=480 mg/l

Soluble COD=155mg/l

Permeate COD=120mg/l

COD after addition of PAC

0.5 g/l of PAC added—COD=62 mg/l

1 g/l of PAC added-----COD=58mg/l

1.5 g/l of PAC added-COD=52mg/l

Nitrogen(initial)=110 mg/l ,80 percent is soluble

Ammonia-102 mg/l (no impact of PAC)

Total phosphorus=35 mg/l ,30 percent is soluble(increases with increase in PAC)

Phase 2

Flux reduced to 60 percent

Transmembrane pressure increased by 0.06 bar

COD(Initial)=210 mg/l , 20 percent is soluble (C.F=4.6)

COD(final)=2800 mg/l

Solids(total)=700 mg/l

Turbidity= 2-3 NTU

Transmembrane pressure stablised at0.82 bar

Flux reduced from 58 LMH and stablised at 26 LMH.

CONCLUSION

From this research we could find out the performance of the DF-AnMBR and find out the quality of effluent generated by the system. We found out the concentration of different solids ,COD, various nutrient with and without usage of PAC to find out the effect of addition of PAC on different concentrations. We also found out the fouling potential which can further be helpful in removal of this major problem of fouling in the system.

- A model of DF-AnMBR was proposed that gave a very good quality of effluent.
- The system was successful in treatment of domestic waste water even though it has lesser concentrations of COD.
- There was an improvement in the performance of the system on addition of PAC.
- A stable flux was maintained with proper HRT , even in conditions the OLR was low.
- The results found from the testing were satisfactory and some where near the expected results. These tests were successfull in removal of turbidity upto 2-4 NTU. The transmembrane pressure was stablised around 0.91 bar and the flux was reduced to a value of 26 LMH. The values of COD and solids were lower than the expected. As there was no backwashing or other cleaning method used in the process the flux could be even lower as it is in the case of AnMBR.

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AUTHOR

Mr Amrinder Singh, student of Mtech Environment Engineering, Uttranchal University,Dehradun-248001