

Study of MBR technology for treatment of municipal wastewater at 5hrs HRT with infinite SRT

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Abstract

MBR is an advanced wastewater treatment, in which physical separation is carried out by filtering the biomass through membranes. The efficiency of MBR can be increased by altering sludge retention time (SRT) & hydraulic retention time (HRT). To implement this, Membrane bioreactor (MBR) plant operated at infinite SRT with 5 hr HRT. The main advantage of low HRT and high SRT is, it can treat more quantity of wastewater and less sludge production. This paper include MBR startup process results with startup specifications. The experimental work at 5 hr HRT with infinite SRT shows that MBR can operated at this specific HRT with SRT.

Keywords: Membrane bioreactor, startup, HRT, SRT

Introduction

Membrane Bioreactor is an advance wastewater technology. It is a combination of biological process with physical separation. Now a day, because of government's stringent discharge standard, it is necessary to switch to advance wastewater treatment from conventional wastewater treatment. MBR can treat different types of wastewater like sewage, different industrial effluents etc. and convert into water which can be used for water reclamation purpose, domestic purpose. This paper mainly focus on treatment of sewage using membrane bioreactor. Many factors affects performance of MBR such as Hydraulic retention time

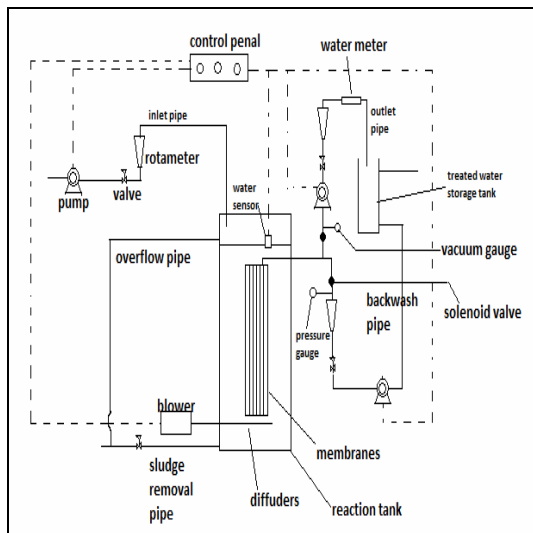
(HRT), Sludge retention time(SRT), Mixed liquor suspended solids(MLSS), aeration, pH, biomass properties, DO (dissolved oxygen), trans membrane pressure (TMP), food to microbe ratio (F/M ratio). From all that factors, SRT and HRT are directly affect the performance of membrane operation and permeate quality. This are the main parameters which can reduce the capital and maintenance cost of MBR. The main advantage of low HRT and high SRT is, it can treat more quantity of wastewater, less sludge production. So to reduce the problem of capital cost by decrease the MBR required area for installation and maintenance cost by decrease the sludge production rate and increase the membrane performance, this study is conducted by considering HRT and SRT

as experimental parameters. MBR generally operated at 6-8 hr HRT with 20-30 days SRT. But in this experimental work, MBR was operated at 5 hr with infinite SRT.

The advantage of using MBR technology is, it gives high quality effluent with effective removal of solids, nutrients, organics, microbial contaminants etc. with uses very less space footprint and less sludge production. On the contrary it has high capital cost, high cost of membrane replacement, high energy cost and fouling problem .

Methodology

The plant is installed at STP 180MLD, pirana for treatment of municipal wastewater. The schematic diagram of pilot plant is shown below.



Schematic diagram of pilot plant

Table below shows the specifications of pilot plant:

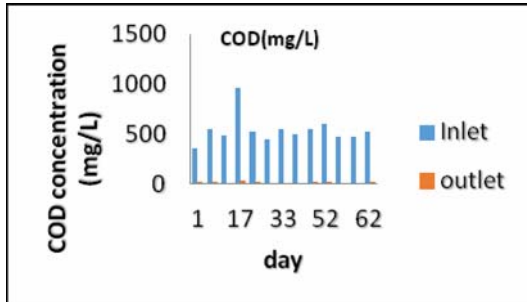
Sr no.	Parameters	Specifications
1	Size of the reactor	1m X 1m X 1m
2	Volume of the reactor	1000L
3	Material of the reactor	High Density Polyethylene (HDPE)
4	Membrane module	Hollow fibre membrane
5	Membrane material	Polyvinylidene difluoride (PVDF)
6	Pore size of the membrane	0.1 μm
7	Effective surface area of membrane	10 m^2
8	Feed pump capacity	5000 L/H
9	Backwash pump and permeate pump	0.5 HP
10	Blower capacity	450 L/min
11	Aeration type	Intermittent
11	Rotameter	0-1000 L/H
12	Pipe material	PVC
13	MBR operation	Continuous 24 X 7
14	Bacteria	Bacillus

Results

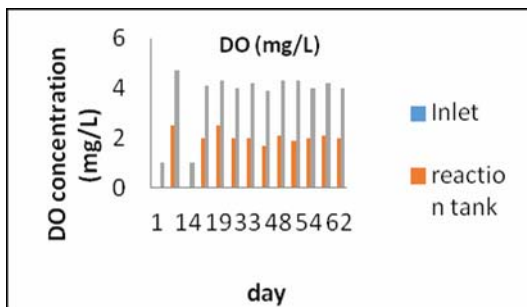
Startup

After the leakage test, equipment test, municipal wastewater is fill in the reactor with addition of inoculam. At time of startup , pilot plant was maintained at 20 hr HRT and 0.1 d^{-1} F/M ratio. The MBR is called acclimatized when all the outlet parameters and reaction rank parameters are going to be constant. At time of startup , for check that whether plant maintained properly or not, tests should be done i.e. BOD, COD, DO, pH, MLSS, TSS, TDS at inlet, in the reaction tank and outlet. Measure the TMP by using vacuum gauge meter at permeateline.

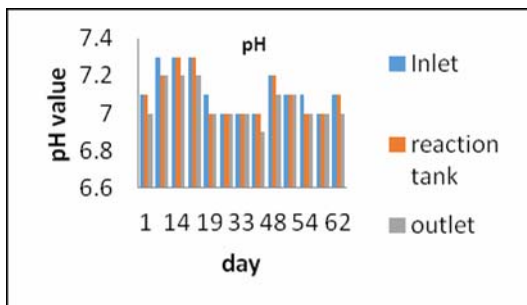
All the tests are measured as per standard methods for examination of water and wastewater “APHA”. Fig below shows the results at time of startup.



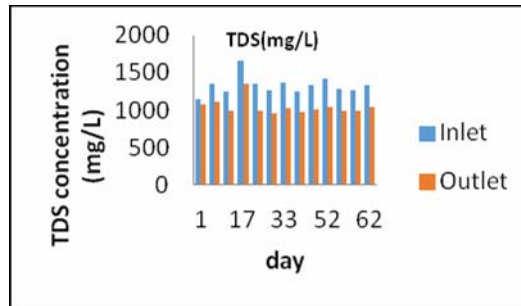
Results of COD at time of startup



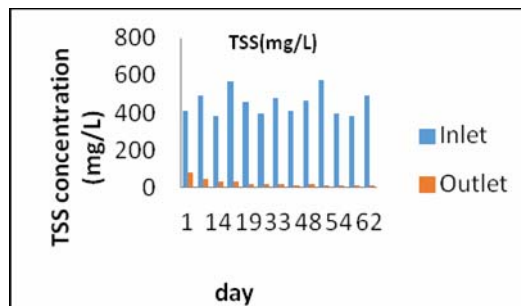
Results of DO at time of startup



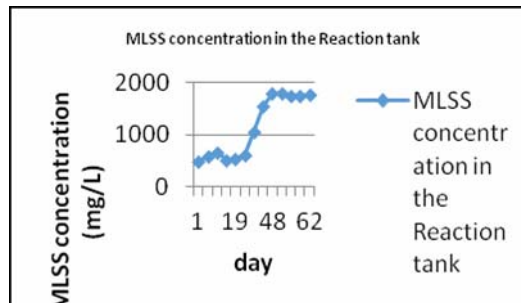
Results of DO at time of startup



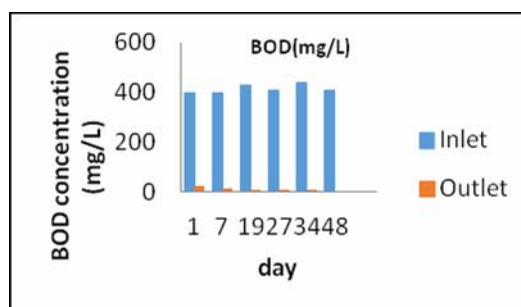
Results of TDS at time of startup



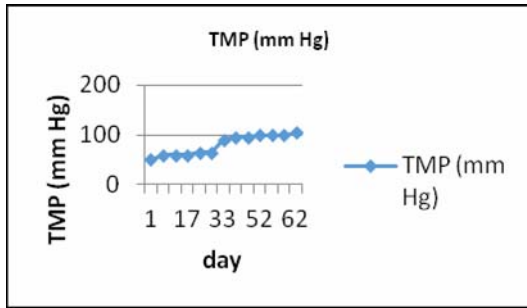
Results of TSS at time of startup



Results of MLSS concentration at time of startup



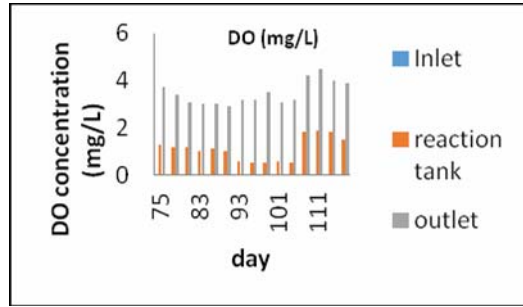
Results of BOD at time of startup



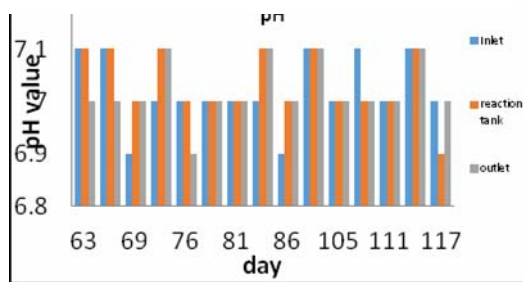
Results of TMP at time of startup

Experimental phase : 5 hr HRT with infinite SRT

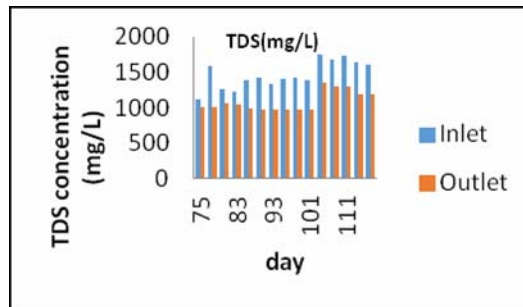
After startup, experimental work was take place. Pilot plant was maintained at 5 hr HRT and 0.1 d⁻¹ F/M ratio in the experimental phase.. At time of experiment, for check that whether plant maintained properly or not, tests should be done i.e. BOD, COD, DO, pH, MLSS, TSS, TDS at inlet, in the reaction tank and outlet. We measure the TMP by using vacuum gauge meter at permeate line. All the tests are measured as per standard methods for examination of water and wastewater “APHA”. Fig below shows the data at time of 5 hr experimental work.



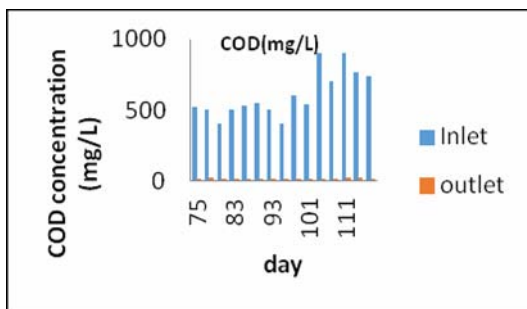
Results of DO at time of 5 hr HRT



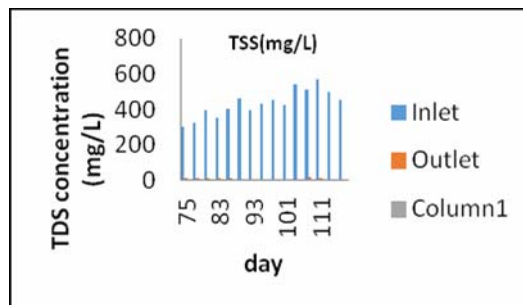
Results of pH at time of 5 hr HRT



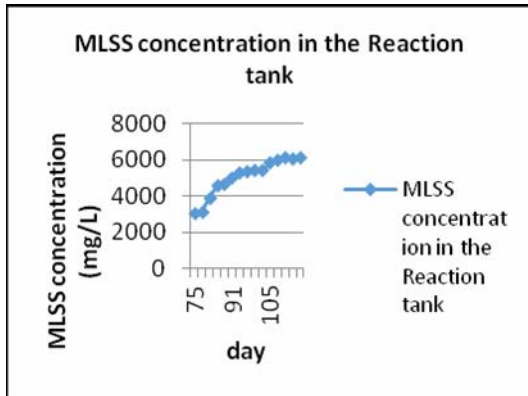
Results of TDS at time of 5 hr HRT



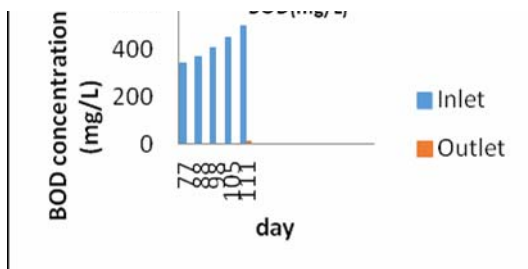
Results of COD at time of 5 hr HRT



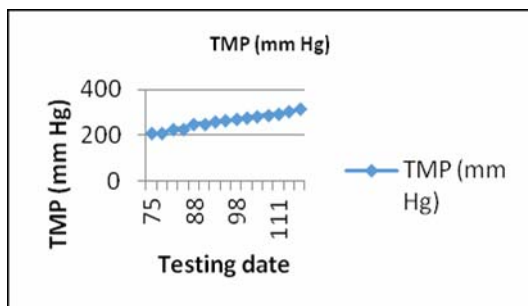
Results of TSS at time of 5 hr HRT



Results of MLSS concentration at time of 5 hr HRT



Results of BOD at time of 5 hr HRT



Results of TMP at time of 5 hr HRT

From the experimental work using MBR as pilot plant including startup process, the conclusion is as because of MBR is a combination of biological process with physical separation process, it is required to monitor continuously, specially at time of MLSS development in startup process. MBR required around 2 months for complete the startup process.

In the experimental work, we conclude that MBR can operated at 5 hr HRT with infinite SRT. In the experimental phase,

the treated water quality parameters are within the limit of effluent quality standard and no requirement of cleaning of membrane and disposed of sludge.

Conclusion

As MBR include biological process, continuous monitoring is required and it is possible to operate it at 5 hr HRT with infinite SRT. At 5 hr HRT with infinite SRT, MBR can achieve 95-98% COD removal, 98-99 % TSS removal, 10-15% TDS removal, 99% BOD removal. At the time of experimental phase, MBR operated at 6000-6500 mg/L MLSS concentration and the pH of treated water is 6.9-7.1

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