TREATMENT OF TOILET WASTEWATER BY MEMBRANE BIO REACTOR TECHNOLOGY

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Abstract

Recent evidence indicates that india is heading towards major sanitation crisis in the coming years. 65% of the population is not having toilet facilities. for example , nearly half of India's 1.2 billion people have no toilet at home. Accocrding to report of the WHO/UNICEF's joint monitoring programme on sanitation for the Millenium Development Goals on 6th March, 2012, has also indicated that 59% Indians still do not have access to toilets.

Over this half of the homes not having toilet because of the lack of water supply facilities in their area.36% of homes have to fetch water from a source located within 500 meters in rural area and 100 meters in urban area. Defence Research and Development Organisation (DRDO) has introduced bio toilet to reduce the water problem in toilet flushing. they built Bio digester facility for toilet water treatment .which is a part of "Swachh Bharat Abhiyan". They have facilities to treat the water by bio digester but the treated water can not be reused but using morden technology we can use treated water for benificial purpose with efficient wastewater treatment. For the reuse of water from toilet we can use the morden technologies,MBR is an efficient process which gives the proper solution to wastewater that it can be use for flushing which can solve the problem of use of water in toilet.The membrane component of the MBR process eliminates the need for a clarifier and is performed using membranes such as microfiltration (MF) or ultrafiltration (UF). MBR technology offers several advantages to conventional wastewater treatment including reduced footprint, consistent and superior effluent water quality and ease of operation. For many areas, it is necessary to further treat the sewage making it useable for irrigation, industrial, and some other beneficial uses

Key words: *Membrane bio reactor ,toilet water,recycling and reuse*

Introduction

Our world is surrounded by a great amount of natural and synthetic products. These products leave their impact on human beings, animals (all living creatures) and non-living things during their journey from "cradle to grave". All these led to contamination of Earth's environment with materials that impede people from enjoying their life.

Various types of pollution that our world is facing are Air, Water, Land and Noise Pollution. As on today, one of the most pressing concerns is "**Water pollution"**.

The wastewater of the toilet contains mainly urine, faeces and toilet paper. Wastewater dilution takes place only via toilet flushing, which results in high BOD, nutrients and salt concentrations. Because the treated waste water is recycled as flushing water and water for sinks, salts and refractory organic compounds accumulate in the system. Phosphate and inert COD increase when the usage is maximum. The daily wastewater flow depends strongly on the number of people using the toilet and varies between 0 to 2 m^3 / d, which is equivalent to a maximum of 500 toilet flushes per day. When the toilet is not in use the flow will be minimum and there will be a reduction in salts and nutrients content.

Toilet wastewater is treated by septic tank while others from various facilities are treated by biological treatment plants. This report comprises of the classification of waste water into black water and grey water.

Blackwater is the wastewater generated from the restrooms and contains urine and faeces.

Greywater is the wastewater generated from restaurants, coffee shops, convenience stores and food court and contains washing food and dishware.

Toilet wastewater contains high BOD, COD and nutrients. Other wastewaters are high in BOD and COD but low in nutrients content.

Treatment technology

introduction

MBR (Membrane bioreactor) technology is an excellent modern wastewater treatment technology, having the several advantages over conventional activated sludge processes. Membrane bioreactor technology is membrane separation technology and biological treatment combination of new wastewater treatment technology.Wastewaters from the toilets, when released into water bodies, are extremely harmful to the aquatic environment because they have high concentrations of suspended solids, uncountable number of microorganisms (including fecal bacteria, pathogenic bacteria, and even viruses) and large quantities of ammonia and organic pollutants . Use of Membrane biotechnology for treatment of toilet waste can prove an efficient treatment for toilet waste and we can use treated water for beneficial use.

Membrane bio technology is the technology for treating the toilet waste which gives the sufficient result to reuse the toilet water for the beneficial purpose. Membrane bioreactor (MBR) technology, which combines activated sludge process (ASP) and membrane filtration, have became more popular, abundant and accepted in recent years for treatment

The treatment of toilet water is very important and many technologies for the treatment were applied like ASP, membrane separation and biodegradation.

Advantages of MBR system

- BOD < 5 mg/L, COD < 20 mg/L
- Suspended Solids ~ not detectable
- Color : Clean & Transparent
- Free of bacteria in effluent
- Small Footprint - Save up to 50% of space
- Can be directly reused for the beneficial purposes
- Reuse valuable resource & Save money on water expense

For this reason we can reuse the toilet water by MBR technology.

- **Membrane Technology**

A membrane technology has been modified in several water treatment, drinking water and wastewater treatment plants. The membrane is used for particular removal and colloidal matter from a liquid mixtures phase. Membrane as a selective barrier to filtrate the differentiation of substances such as organic matters, nutrients, color, turbidity, microorganisms, inorganics and others, and allows clear water permeate through.

Membrane classifications

Membrane filtration, which is classified into microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) is a pressure driven process. The membrane removal efficiency depends on the pore size of the membrane that presents the different membrane categories. The membrane categories can be followed as:

- **Microfiltration (MF**); there is the pore size as 0.1 – 0.5 µm. The MF can remove colloidal matter, microorganism, total suspended solid, viruses and turbidity.

- **Ultrafiltration (UF**); there is the pore size as 0.005 – 0.1 µm. UF can remove viruses, macro-colloids, bacteria and proteins.

- **Nanofiltration (NF**); there is the pore size as 0.001 – 0.01 µm. The NF can apply to color, hardness and virus removal, ions and chemical interactions.

- **Reverse osmosis (RO)**; there is a pore size as 0.0001 – 0.001µm. The RO is used for ions, small molecules, color, hardness sulfate, small ions removal, dilute solution etc.

As MF and UF have been applied to remove turbidity, suspended residual solid and sludge flocs in treated wastewater, it can be modified for retaining biomass in bioreactor. Moreover, NF can also be applied to MBR process

EXPERIMENTAL PROCEDURE

Description of the model

The model consisted of a biological reactor of 6 L volume in which a submerged hollow fibre membrane was installed. The complete plant lay out is represented in fig 7. The influent waste water was taken from the municipal waste water treatment plant from 180 MLD pirana, Ahmedabad, which operates with conventional activated sludge technology. The wastewater enters the pilot plant and gets treated with the biomass developed in the bioreactor for the designed HRT .Continuous aeration is provided with the porous disk situated beneath the membrane which serves two purposes : provides aeration and reduces fouling on the membrane surface. After getting treated for the designed period, the permeate was extracted by imposing negative pressure on the outlet probe using pedestrian pump.

Acclimatization of bacteria

Bacterial seeding is often used to jumpstart the biological system. Usually there are two approaches are involved.

- Dry seeding (using bacterial culture in powder form)
- Wet seeding (sludge obtained from the existing treatment plant)

Running the plant on glucose water

Glucose was added as per theoretical oxygen demand. Therefore, 192 g O_2 is required to degrade 180 g of $C_6H_{12}O_6$ .Thus, 1.07 g of oxygen is required to degrade 1 g of glucose. So a solution of 1000 ppm COD can be prepared by adding 0.974 g glucose in 1 liter water .

Quality Guidelines of Water Reuse (United States Environmental Protection Agency, 2012)

parameters	Requirements for reusing
BOD	≤10mg/l
COD	≤30mg/l
NITROGEN	≤10mg/l
PH	6-9
DO	≥1mg/l
ODOR	No bad smell
COLOUR	Transparent

Referance:GB50336-2002 (Code of Design for Building Reclaimed Water System, PRC China)

Feed water characteristics : Sample collected from pirhana 180 MLD plant ,Narol and synthetic black water made from the references by sewage wastewater.

Parameters	value	Analytical method	referent
pH	7	Electrometric	APHA (2005), Method 4500-H+ B
COD	857mg/l	Closed reflux method	APHA (2005), Method 5220 B
BOD	332mg/l	Dilution method	APHA (2005), Method 5210 B
TSS	875mg/l	Gravimetric method	APHA (2005), Method 2540 DT
Ammonical Nitrogen	55mg/l	Titrimetric method	APHA (2005), 4500-NH3 C
DO	2mg/l	DO meter	APHA (2005), Method 4500-O G
MLSS	2000mg/l	Gravimetric method	APHA (2005), Method 2540 DT

MBR reactor figure

Outlet characteristics of permeate

parameters	value	Analytical method	referent
pH	7	Electrometric	APHA (2005), Method 4500-H+ B
COD	67mg/l	Closed reflux method	APHA (2005), Method 5220 B
BOD	119mg/l	Dilution method	APHA (2005), Method 5210 B
TSS	14mg/l	Gravimetric method	APHA (2005), Method 2540 DT
Ammonical Nitrogen	9.2mg/l	Titrimetric method	APHA (2005), 4500-NH3 C
DO	2mg/l	DO meter	APHA (2005), Method 4500-O G
MLSS	4000mg/l	Gravimetric method	APHA (2005), Method 2540 DT

Conclusion:

It is clear from above study that by MBR technology we can surely reuse the toilet wastewater removal.efficiency of COD, BOD and Nitrogen removal are 92%,78% and 55%.

REFERENCES:

Abegglen, C. and Siegrist, H. (2006) Domestic wastewater treatment with a small-scale membrane bioreactor. Wat. Sci. Tech. 53(3), 69-78.

Boehler, M., Buetzer, S., Joss, A., Ziranke, M., Siegrist, H., Holzapfel, M. and Mooser, H. (2006) Decentralized treatment and Re-use of Toilet wastewater in Alpine Areas, Final report, not published, Eawag, Duebendorf, Switzerland

Buetzer, S., Joss, A. and Siegrist, H. (2006) Diploma thesis, Modeling of a decentralized toilet wastewater treatment plant with closed water circulation, not published, Eawag, Duebendorf, Switzerland