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Grey Water Treatment and Pipeline Network for Flushing System

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Abstract: *Water related problems like water source, reuse of water, treatment of water etc, are rising over time. India is facing a critical problem of water scarcity. So that water treatment has become an area of significant consideration especially in metropolitan cities like Surat. This situation necessitates the need for water conservation and substitution of fresh water with suitable alternatives. Project focus on planning of the pipeline network for residential buildings by reuse of grey water for domestic purposes. Sustainable use of water is the ultimate way to store energy. Grey water recycling is a viable option to minimize the deficit demand and supply in cities. In that case treated grey water used for non-portable purposes in multi storey building, hotel, commercial building etc. but we mainly focused on multi storey building.*

Keyword: Grey water treatment, Pipeline network

1. Introduction

1.1General

Water is turning into an uncommon asset on the planet. In this manner, it is basic to decrease surface and groundwater use in all divisions of utilization, to substitute new water with elective water assets and upgrade water use proficiency through reuse alternatives. These alternative resources include rain water harvesting and grey water treatment. Grey water is specially wash-water. Grey water free of garbage residues. Scientists around the globe are working on the new way of conserving water. It is a helpful chance to pull together on one of the procedures to reuse water through the reuse of greywater by conservative way. Grey water is non-industrial waste water generated from domestic processes such as washing dishes, washbasin, laundry and bathing. Grey water is the water which is somewhat tainted by human exercises and might be reused after appropriate treatment. Grey water recycling is a valuable alternative source of water for non-potable use. Therefore, wastewater recycling is considered as part of a green building system. If we consider all sources of greywater, it is found that grey water from the wash basin is the least polluting grey water. The grey water reuse is a viable option that can be very useful in water arid and semi-arid areas. Grey water is available in abundance in highly populated areas since its generation escalates Multifood in these areas. Grey water constitutes about 70% of household water consumption with lower concentration of organic matter and fewer pathogens as compared to domestic wastewater. Grey water gets its name from its shady appearance and from its status as being neither new nor vigorously dirtied. Grey water may be treated and reused much more easily than composite domestic waste water for the point of treatment technologies applied and relevant costs. Most advanced technologies used widely in recent years are “Membrane Bioreactors (MBRS)” and “Sequential Batch reactors (SBRS)”. In the case of application of sequential batch reactors for treatment of domestic grey water, the removal efficiency of organic matter increases with increase in cycle time. Membrane bioreactor gave removal efficiencies as high as 85%, 94% and 63% can be achieved for COD, BOD and TKN respectively by treating grey water. Population growth usually increases demand for water in all sectors of economy agricultural, industrial, and domestic .In Surat city water demand is currently around 1500 MLD and this value reached up to approximate 2367 MLD in 2041 due to rapid population growth, unplanned urbanization, surface water pollution and continuous ground water extraction and also reduce rainfall .In this case demand of water is more due to various factors but source of water supply is less so that we tried to planed reuse of greywater system in residential buildings.

1.2 Type of Waste Water

Black water is wastewater that originates from toilet fixtures, dishwashers and food preparation sinks. It is made up of all the things that you can imagine going down the toilets, bath and sin drains.

They include poop, urine, toilet paper and wipes; body cleaning liquids, anal cleansing water and so on. They are known to be highly contaminated with dissolved chemicals, particulates matter and are very pathogenic.

Grey water is wastewater that originates from non-toilet and food fixtures such as bathroom sinks, laundry machines, spas, bathtubs and so on. Technically it is sewage that does not contain poop or urine. Greywater is treated very differently from blackwater and usually suitable for reuse.

Yellow water is basically urine collected with specific channels and not contaminated with either black water or greywater.

1.3 Aim

- Grey water reuses system
- Reuse of treated greywater in flushing system of toilet

1.4 Objective

- To qualification of grey water of multi-storey building.
- To proposed planning for pipeline network or membrane filter system for multi-storey building.

2. Methodology and Work

In building generally two pipeline networks are available. One for domestic use of clean water and another for sewerage. Underground large tank in buildings is available to store clean water coming from the municipality. Another tank is available on the rooftop of the building. Water is pumped out from ground tank to rooftop tank by means of mechanical pump. Another tank on the rooftop is available for fire purposes. Domestic water tank's water is used for daily operation. Such as in washing, in cleaning, in flushing etc. Generally the capacity of the domestic water tank is 18000 liters. While the capacity of a fire water tank is 20000 liters for 11 storey buildings. In daily operation, the diameter of a pipe coming out of a domestic water tank is 75 mm.

The water will be used in flushing, gardening by reusing greywater using the building's pipeline network. In our project there are two types of pipelines used in the pipeline network. One for domestic water and the other for flushing water. There are two types of sewage pipelines provided in this pipeline network. One for Greywater and the other for Black Water. Underground two tanks will be provided. One of these will be used as domestic water storage and the other tank will be used to store treated greywater. And three tanks will be built on the terrace. These include a domestic water tank, another flushing water tank, and a third fire water tank. Greywater means bathing, kitchen, laundry, washbasin that drains wastewater. Purify the greywater collected from the greywater pipeline with help of the MBR system and then storing it in an underground greywater tank. Emptying treated water in a flushing water tank by pumping treated greywater. Flushing water tank will be used only in gardening, flushing water, etc. Domestic water tank's water will be used in bathing, kitchen, laundry, wash basin, etc.

We compared sand filter and Membrane bio reactor for greywater treatment.

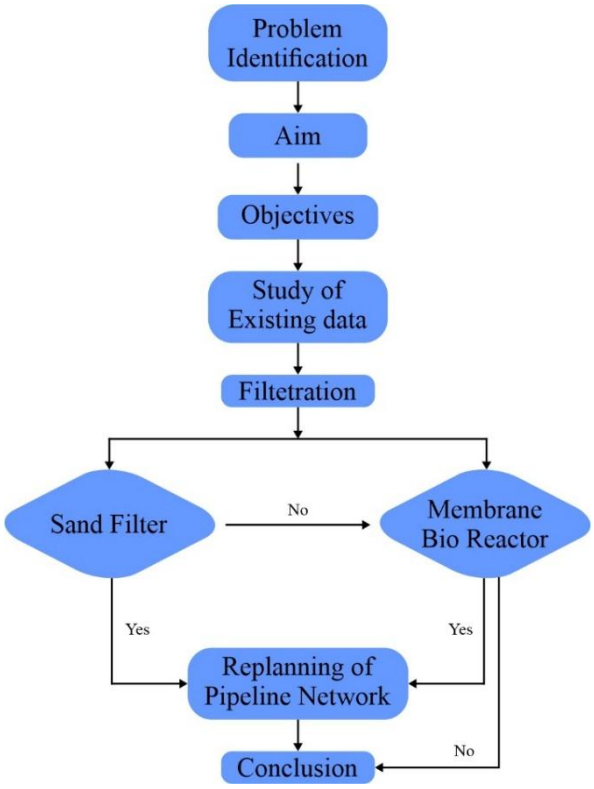

Fig 1: Methodology

3. Water Treatment Process

Type of treatment

- Sand Filter
- Membrane Bio-reactor

3.1 Sand Filter

Sand filters are used as a step in the water treatment process of water purification. There are three main types; Rapid (gravity) sand filters, Upward flow (Pressure) sand filters and Slow sand filters. All three methods are used extensively in the water industry throughout the world. The first two require the use of flocculent chemicals to work effectively while slow sand filters can produce very high quality water with pathogens removal from 90% to >99% (depending on the strains), taste and odour without the need for chemical aids. Sand filters can, apart from being used in water treatment plants, be used for water purification in singular households as they use materials which are available for most people.

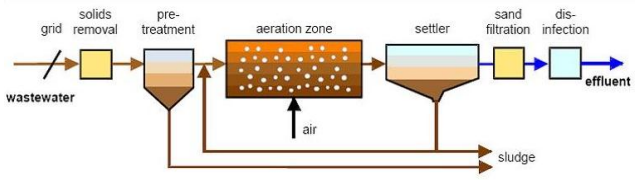

Fig 2: Process of Sand Filter

3.2 Membrane Bio reactor

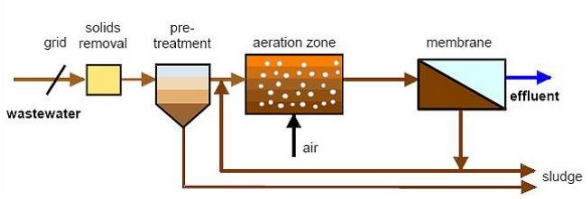

Fig 3: Process of Membrane Bio Reactor

What are membrane bio reactors?

Membrane bioreactor' (MBR) is generally a term used to define wastewater treatment processes where a perm-selective membrane, e.g. microfiltration or ultrafiltration, is integrated with a biological process –specifically a suspended growth bioreactor. MBR processes can produce effluent of high quality enough to be discharged to coastal , discard in creek , surface or brackish waterways or to be reclaimed for urban irrigation or flushing uses. Membrane bioreactors can be used to reduce the footprint of an activated sludge sewage treatment system by removing some of the liquid component. This leaves a concentrated waste product that is then treated using the activated sludge process.

Pore size of membrane

The flat sheet membranes used in this process were polymeric and pore sizes ranging from 0.003 to 0.01 µm. Separation ranges for those membranes are as follows: 100 to 1000 nm for MF, 5 to 100 nm for UF, 1 to 5 nm for NF and 0.1 to 1 nm for RO. For more than the last 10 years MBRs have emerged as an effective secondary treatment technology by using membranes in the range of MF (micro filtration) and UF (ultra filtration).

In general MBRs have three distinct membrane configurations

A) Flat sheet (FS)

B) Hollow fibre (HF)

C) Multi tube (MT)

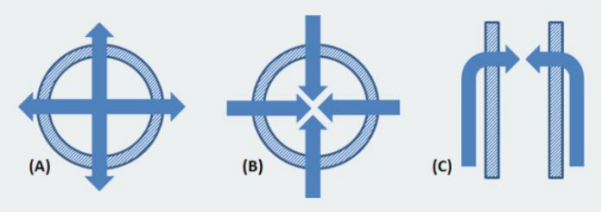

Fig 4: Membrane Configuration

Classification of membrane bio reactor

MBR systems can be classified into two major categories according to the location of the membrane component: External membrane MBR configuration which typically involves the use of polymeric organic or inorganic membranes located external to the bioreactor and internal bioreactor.

Process of membrane bio reactors.

In the MBR process, raw sewage from equalisation or holding tank first passes through fine screens to remove substances that may clog or scratch the membrane before going into the MBR facilities. The membrane bioreactor facility consists of aerobic tank and anoxic tank. Membrane modules are immersed inside the aerobic tank where organic contents (BOD) in the sewage will be biologically degraded by activated sludge. The MLSS (Mixed Liquor Suspended Solid) concentration in the MBR System is 10 to 20 g/L compared to 3 to 4 g/L in conventional activated sludge systems, thus the retention time required is only 30% of conventional system. The membranes also separate suspended solids from liquid through the filtration process. As the pore size of the membrane is 0.1 micron, not only suspended solids but also bacteria such as coliform bacteria are also removed. The immersed membrane filtration process also eliminates the requirement for gravity sedimentation tank or clarifier required by conventional activated sludge systems. Through recirculation of MLSS from aerobic tank to anoxic tank, nitrate content is removed. Additional coagulant and flocculent dosing also can be incorporated for phosphorous removal.

Advantages and disadvantages of MBR

Advantages:

Independent control of Hydraulic retention time and solid retention time

High quality effluent

Small footprint

Improved bio-treatment.

Independent control of Hydraulic retention time and solid retention time

Disadvantages:

Membrane fouling

Membrane clogging

4. Water Characteristic

Characteristic of Grey Water Treated by Sand filter And Membrane Bio Reactors

Sr. No	Parameters	Unit	Grey water result	Sand filter result	MBRS result
1	pH	-	7.23	7.24	6.5-7.5
2	Turbidity	NTU	18.27	7.28	<1
3	TSS	mg/L	65	41	Up to 100%
4	TDS	mg/L	1856	1824	-
5	Nitrate	mg/L	1.23	3.14	6-72%
6	Total Nitrogen	mg/L	6.25	7.92	52-63%
7	Phosphate	mg/L	12.57	9.96	Up to 19%
8	COD	mg/L	923	543	<50
9	BOD	mg/L	295	175	<100
10	Sodium	mg/L	387	353	-
11	Potassium	mg/L	8.046	4.79	<1
12	Calcium	mg/L	31.2	28.8	-
13	Electric Conductivity	mmho /cm	2.642	2.632	-
14	Magnesium	mg/L	28.8	27.3	-

Table 1 Characteristic of treated grey water

5. Designed Pipeline Network

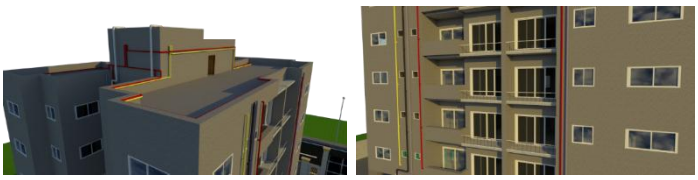

Fig 5: Designed Pipeline Network

6. Conclusion

Research papers and related information helps to conclude that proper method such as membrane bio reactor and sand filter. Reuse of grey water coming from kitchen, laundry, wash basin, bathrooms. Decided to which treatment beneficially for surrounding environment. The benefits founds are low energy demand , less operating and maintenance cost lower load on fresh water , effective purification and sustain of water. Separation of sewage water into grey water and black water reduces the area of the waste water treatment plant in consequently, reduce the cost.

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