STUDY AND TREATMENT OF DOMESTIC WASTE WATER

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Abstract:

A water treatment plant is quite necessary to receive the domestic waste water and removes the materials which pose harm for general public. Its objective is to produce an environmentally safe fluid waste stream suitable for disposal or reuse. The growing environmental pollution needs de-contaminating waste water result in the study of characterization of waste water, especially domestic water. In the past, domestic waste water treatment was mainly confined to organic carbon removal. Recently, increasing pollution in the waste water leads to developing and implementing new treatment techniques to control nitrogen and other pollutants. Waste water treatment consists of different processes which protect the environment and human through cleansing the water pollutant. In history people used different methods of treatment for purification of water which get advance by advancement in the technological world.

1.0 INTRODUCTION

Water is considered as the most important and priceless commodity on planet Earth. Water on earth moves continually through the water cycle of evaporation and transpiration, condensation, precipitation and runoff, usually reaching the sea. It is one of the most essential things that are required for every living being. In order to develop a healthy and hygienic environment, water quality should be monitored such that it lies within the respective standards.

Wastewater is liquid waste discharged by domestic residences, commercial properties, industry, agriculture, which often contains some contaminants that result from the mixing of wastewater from different sources. Wastewater obtained from various sources need to be treated very effectively in order to create a hygienic environment. If proper arrangements for collection, treatment and disposal of all the waste produce from city or town are not made, they will go on accumulating and create a foul condition that the safety of the structures such that building, roads will be damaged due to accumulation of wastewater in the foundations. In addition to this, disease causing bacteria will breed up in the stagnant water and the health of the public will be in danger.

The principal aim of wastewater treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. Therefore, in the interest of the community of the town or city it is most essential to collect, treat and dispose of all the wastewater of the city in such a way that it may not cause harm to the people residing in the town. The extent and the type of treatment required, however depends on the character and quality of both sewage and sources of disposal available. Domestic wastewater, also known as sewage or sewage water, refers to the wastewater generated from households and other residential sources. It typically includes a mixture of water from various domestic activities.

SOURCES OF POLLUTANTS IN DOMESTIC WASTEWATER

Domestic wastewater is the combination of 2 major waste streams:

- Greywater water from the kitchen sink, laundry, bath .
- Blackwater, water from discharged from toilets.

Fig :1 Waste Water

2.0 LITERATURE REVIEW

1.Manar Elsayed Abdel-Raouetal Studies (2019)

Problem of the fresh water scarcity affects people all over the world. Increase population, combined with numerous human activities, has resulted in a severe and ongoing scarcity of freshwater resources. This conundrum prompted scientists to seek out radical and low-cost solution. One of possible solution for this issue is for purifies industrials wastewaters so that it can be used in agriculture by eliminating harmful contaminants**.**

2. Jayashree Dhoteetal Studies (2019)

Today numerous waters resources are pollute by the anthropogenic source including the agricultural and household waste as well as industrial process. Public concerns over environmental impacts of waste water pollution increased. To eliminate the pollutants, many traditional wastewater treatments strategies, such as activated sludge, chemical coagulation and adsorption, have used; however, there're still few limitations, particularly in terms of high operating costs. Because of its low operating and maintenance cost, aerobics waste water treatment as reductive medium is gaining popularity.

3. Avloppsrening med mikroalger (2016)

Microalgae can be used for tertiary treatment of wastewater due to their capacity to assimilate nutrients. The pH increases which is mediated by the growing algae also induces phosphorus precipitation and ammonia stripping to the air, and may in addition act disinfecting on the wastewater. Domestic wastewater is ideal for algal growth since it contains high concentrations of all necessary nutrients. The growth limiting factor is rather light, especially at higher latitudes. The most important operational factors for successful wastewater treatment with microalgae are depth, turbulence and hydraulic retention time.

4. Suad Jaffer Al-Lawatietal Studies (2016

Wastewater treatments and sludge production occur in a variety of economic, social, and technological contexts, necessitating a variety of approaches and solutions. In the most cases, routine as well as environmentally friendly wastewater treatments and sludge management necessitate developments of the practical and enforceable legislation and treatment systems tailored to local conditions. Their paper's main goal is to provide valuable information about Oman's existing wastewater and sludge treatments, managements, legislation, and analysis.

5. Zahra Aghalarietal (2018):

Collected data according by the exclusion and inclusion criteria as well as by the searching the related keywords in papers publish during years (2008 to 2018) through focus on effectiveness of waste water treatment system in the eliminating bacterial agent. Qualitative figures was collect by using preferred reporting item for the systematic evaluations and Meta analyzes (PRISMA) standards checklists. After verifying papers' accuracy, information such as the first author's name and the year the report was published, types of analysis, numbers of the sample, purification method, types of the microbial agent, and rates of microbial agent removal was entered into the checklist. Also, the removal rate of the microbial agent mention in study was compare with the United States environmental protections agencies (USEPA) standard.

3.0 METHODOLOGY

Even though more than 75% of the earth is covered by water the availability of pure water is short. There are places in India where people are having difficulty in finding pure water for their daily needs. So, it is essential to use what we have carefully. The conventional method of treating wastewater helps in reducing the adverse environmental and health problem created by them, but the quality of treated water is not up to the standards of pure water. Also, various human activities have created new contaminants in wastewater called emerging pollutants.

Conventional Wastewater Treatment Methods

Traditional wastewater treatment uses physical, chemical, and biological methods to remove solids, organic matter and, nutrients from wastewater. The different stages include preliminary, primary, secondary and tertiary.

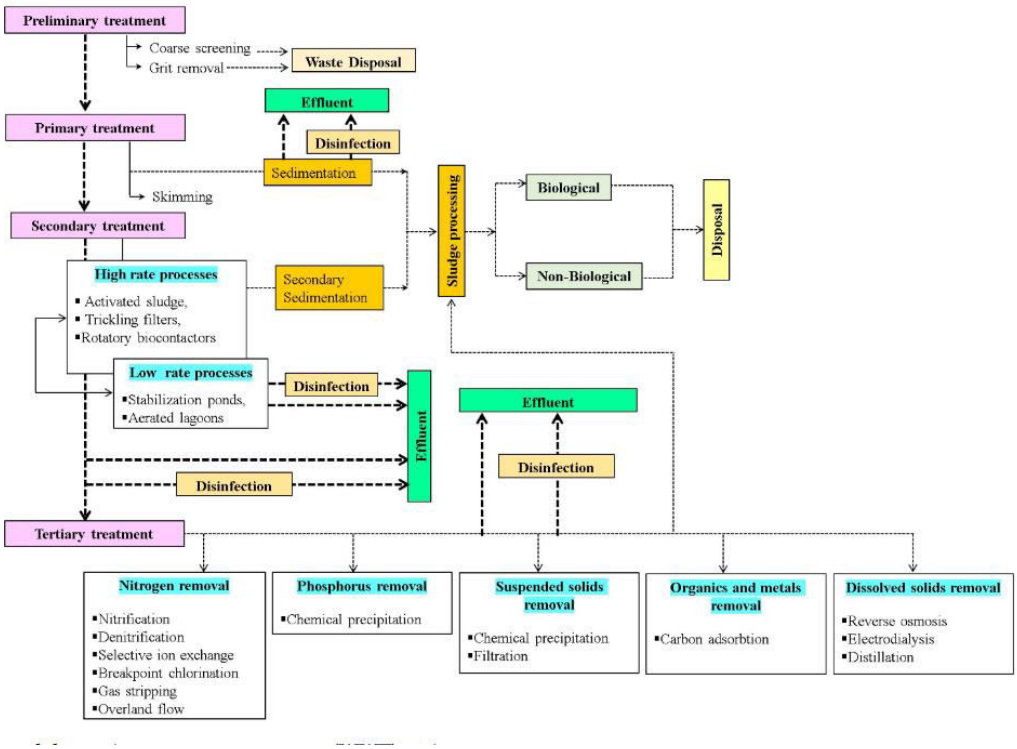


Fig. 2 Process of Treatment

Preliminary Treatment

The objective of preliminary treatment is to separate floating materials like dead animals, free branches, papers, pieces of rags, and also heavy settleable inorganic solids. This stage also helps

in removing oils, grease, etc., from the sewage. This treatment reduces the BOD of wastewater by 15-30%. Screening, detritus tank, Comminutors, floatation unit and skimming tanks are the various units involved in preliminary treatment. Screening is used for the removal of floating matter. Detritus tank is also known as grit chamber, is used for removal of sand and grit. Comminutors are used for grinding and chopping large size suspended solids. Floatation units and skimming tanks are used to remove oils and greases.

Primary Treatment

The physical processes of sedimentation and floatation are used in primary treatment to remove organic and inorganic solids. During primary treatment, about 5-50% of the incoming biochemical oxygen demand (BOD5), 50-70% of the total suspended solids (SS), and 65% of the oil and grease are removed. Even though organic nitrogen, organic phosphorus, and heavy metals associated with solids are removed during primary sedimentation, colloidal and dissolved constituents are not affected. In many industrialized countries, the minimum level of pre-application treatment required for wastewater irrigation is the primary treatment.

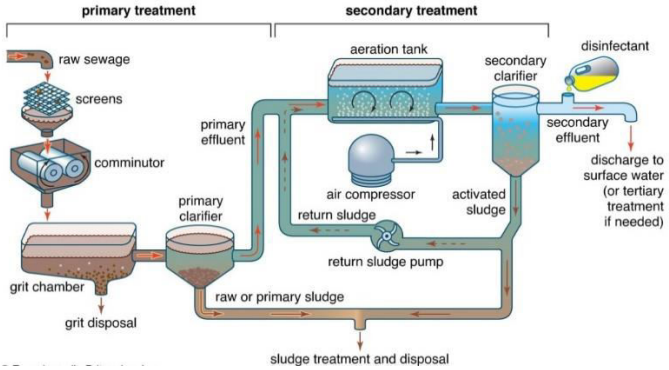
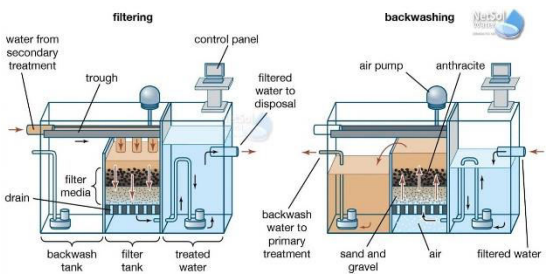


Fig. 3 Primary and Secondary Treatment Process

Secondary Treatment

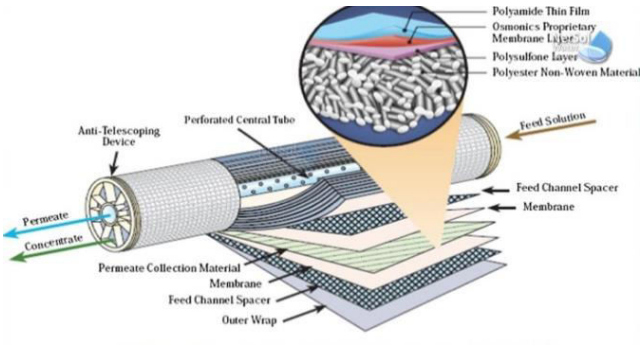
The objective of secondary treatment is the further treatment of the effluent from primary treatment to remove the residual organics and suspended solids. In most cases, secondary treatment follows primary treatment and involves the removal of biodegradable dissolved and colloidal organic matter using aerobic biological treatment processes. Aerobic biological treatment (see Box) is performed in the presence of oxygen by aerobic microorganisms (principally bacteria) that metabolize the organic matter in the wastewater, thereby producing more microorganisms and inorganic end-products (principally CO_2, NH_3, and H_2O). Several aerobic biological processes are used for secondary treatment differing primarily in the manner in which oxygen is supplied to the microorganisms and in the rate at which organisms metabolize the organic matter.



Tertiary Treatment

Fig.4 Tertiary Treatment

Tertiary treatment is performed when specific wastewater constituents which cannot be separated by secondary must be removed. The final cleaning process improves the wastewater quality before it is reused, recycled, or discharged to the environment. The treatment removes inorganic



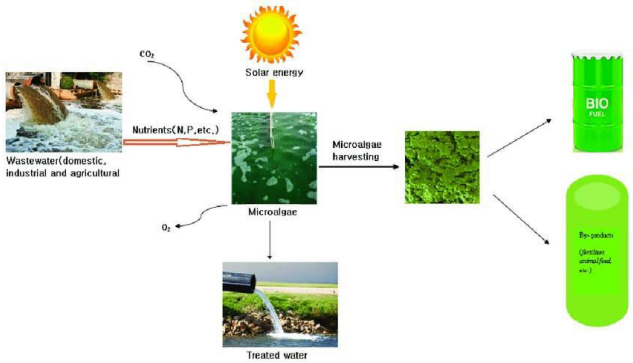
compounds and substance nitrogen and phosphorous.

Modern Wastewater Treatment Technologies

Nanofiltration (NF)

Fig.5 Nano Filter Media

Membrane filtration processes such as Nano filtration have recognized as effective means of providing a safe and reliable source of supply water by reuse for both drinking water and Non-



drinking water purposes. Before the membrane filtration process, wastewater was pre-treated by suitable techniques to remove most of the suspended or un-dissolved ingredients like suspended solid, inorganic and organic compounds.

Use of Algae in Wastewater Treatment:

Fig 6. Use of Algae in Wastewater Treatment

In the last 50 years, biological wastewater treatment systems using microalgae have grown in popularity, and it is now commonly believed that algal wastewater treatment systems are just as successful as conventional treatment systems. Because of their characteristics, algal wastewater treatment systems have become a viable low-cost alternative to more sophisticated and expensive treatment systems, particularly for municipal wastewater.

Biosorption

Biosorption is a Physico-chemical process that occurs naturally in certain biomass which allows it to passively concentrate and bind pollutants onto its cellular structure. It can be defined as the ability of biological materials to accumulate heavy metals from wastewater through metabolically mediated or Physico-chemical pathway of uptake. It does not require energy, and the number of

contaminants a solvent can remove is dependent on kinetic equilibrium and composition of the cellular sorbent surface.

TESTS ON DOMESTIC WASTE WATER

pH Test on Domestic Waste Water

Performing a pH test on wastewater is essential to determine the acidity or alkalinity of the water, which can have important implications for the environment and the effectiveness of wastewater treatment processes. Here's a general procedure for conducting a pH test on wastewater.

Fig. 7 pH Meter

Electrical Conductivity Test on Domestic Waste Water

Electrical conductivity (EC) is a measure of a solution's ability to conduct electrical current and is often used as an indicator of the concentration of dissolved ions in water, including in domestic wastewater. Conductivity testing can provide valuable information about the total dissolved solids (TDS) in the water, which can be an important parameter for assessing water quality. Here's a procedure for conducting an electrical conductivity test on domestic wastewater:

Fig. 8 Conductivity Meter

Acidity Test on Domestic Waste Water

Measuring the acidity of domestic wastewater is important to assess its pH level, which can indicate whether the water is acidic, neutral, or alkaline. An acidity test can help in understanding the quality of the wastewater and its potential impact on the environment and treatment processes. Here's a procedure for conducting an acidity test on domestic wastewater:

Fig 9. Acidity Test

Alkalinity Test on Domestic Waste Water

Measuring alkalinity in domestic wastewater is important for assessing its buffering capacity and ability to resist changes in pH. Alkalinity testing helps in understanding the water's ability to neutralize acids, which can be essential for maintaining stable pH levels in wastewater treatment processes. Here's a procedure for conducting an alkalinity test on domestic wastewater.

Total solids tests on domestic waste water

Total solids (TS) testing in domestic wastewater is a critical analysis to determine the concentration of both suspended and dissolved solids in the water. This information is valuable for assessing the quality of wastewater and its suitability for treatment processes. Here's a procedure for conducting a total solids test on domestic wastewater.

Chlorides Test on Domestic Waste Water

Testing for chloride ions in domestic wastewater is essential for assessing water quality and monitoring potential sources of contamination. Chlorides are common ions that can enter wastewater from various sources, including saltwater intrusion, industrial discharges, and other human activities. Here's a procedure for conducting a chloride test on domestic wastewater

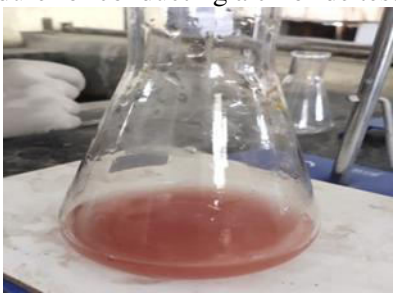


Fig. 10 Residual Chlorine

Chemical Oxygen Demand Test on Domestic Waste Water

The Chemical Oxygen Demand (COD) test is an essential parameter for assessing the amount of organic and inorganic pollutants present in domestic wastewater. It provides information about the water's pollution levels and the amount of oxygen needed to oxidize these pollutants. Here's a procedure for conducting a Chemical Oxygen Demand test on domestic wastewater.

Fig. 11 COD Test

4.0 RESULTS AND DISCUSSIONS

pH Test

Table 4.1 pH Test Results

S.NO	SAMPLE	pH Meter Reading
1	Nallakunta	8.30
2	Muthvelliguda	8.20
3	Muchkunda	8.15

Electrical Conductivity Test and Total Solids

Table 4.2 Electrical Conductivity Test

S.NO	NAME OF SAMPLE	TEMPERATURE (˚C)	ELECTRICAL CONDUCTIVITY(µmhos/cm)
1	Nallakunta	25	1.49
2	Muthvelliguda	25	1.28
3	Muchkunda	25	1.37

Total Dissolved Solids

Table 4.3 Total Dissolved Solids Test Results

S.NO	NAME OF SAMPLE	TEMPERATURE(˚C)	ELECTRICAL CONDUCTIVITY (µmhos/cm)	TOTAL DISSOLVED SOLIDS
1	Nallakunta	25	1.49	1.117
2	Muthvelliguda	25	1.28	0.96
3	Muchkunda	25	1.37	1.02

Acidity

Description of sample	Trial No	Burette Reading		Volume of NaOH used(ml)
		Initial	Final	
Methyl Orange	Nallakunta	15.5	17.5	2
	Muthvelliguda	25	28.5	3.5
	Muchkunda	0	5	5

Phenolphthalein	Nallakunta	17.5	25	7.5
	Muthvelliguda	28.5	30.5	2
	Muchkunda	12	15.5	3.5

Table 4.4(a) Acidity Test Results

Table 4.4 (b) Acidity Test Results

Description of sample	Sample	Acidity in mg/lit of $CaCO_3$
Methyl Orange	Nallakunta	20
	Muthvelliguda	35
	Muchkunda	50
Phenolphthalein	Nallakunta	75
	Muthvelliguda	20
	Muchkunda	35

Alkalinity

The alkalinity of collected samples are having low alkalinity values. The values cannot be found by the titration method.

Chloride

Table 4.5 Chloride Test Results

Sample No.	Sample Name	Volume of Sample (ml)	Burette Reading		Volume of Silver Nitrate (ml)	Chloride (mg/l)
			Initial	Final		
1	Nallakunta	20	25	28.8	3.8	95
2	Muthvelliguda	20	28.8	32.5	3.7	92.5
3	Muchkunda	20	32.5	35.8	3.3	82.5

Chemical Oxygen Demand

Table 4.6 COD Test Results

Trial No.	Sample Name	Burette Reading		Volume of Titrant (ml)
		Initial	Final	
1	Nallakunta	0	26	26
2	Muthvelliguda	26	53.2	27.2
3	Muchkunda	0	25	25

CONCLUSION

Domestic wastewater management is a critical aspect of modern society. Proper treatment and disposal of domestic wastewater are essential for environmental protection and public health.
The experiments on domestic waste water collected from 3 resources give us the conclusions:

- The pH of the water sample shows the water is slightly alkaline in nature.
- Electrical conductivity of the sample is between 1.28-1.5 µmhos/cm.
- The acidity of the water is in between 25-75 mg/l of $CaCO_3$ i.e., the water is considered as soft water.
- The alkalinity of water is very less.
- The residual chlorine 82-95 mg/l

This study gives an idea about the usage of treated and recycled water. The treatment reduces the soil and water pollution. The utilization of treated water increases the ground water table. The treated sludge is used as a manure in the agriculture.

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5. U.S. Environmental Protection Agency (EPA) - The EPA's website has a wealth of information and resources on domestic wastewater treatment. You can find technical documents, guidelines, and regulations related to wastewater treatment.