Journal of Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.777426

SEWAGE TREATMENT PROCESS FOR HOUSEHOLD PURPOSES

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Abstract: The project is aimed to deviate a way to recycle household wastewater, As the sewage problem is addressed on a large scale in industries and sewage treatment plants, a significant amount of sewage has accumulated in household societies and thus individual's homes. The main objective of this project is to ensure maximum recycling of water takes place. The two concepts involved in the project are Biological Oxygen Demand (BOD), which is a measurement of the oxygen needed to eliminate waste organic matter from water during aerobic bacteria's decomposition process, and Chemical Oxygen Demand (COD), which calculates how much oxygen is needed to chemically oxidise the organic matter and inorganic nutrients that are present in water. In the project we first begin with a collection of wastewater samples from a housing society near Pune weekly, then we use different chemical methods for sampling and testing the water to get the values of important parameters of water like pH, TSS etc. Then in the next process, the water was treated with a microbial culture of Spirulina, Methanococous, Pseudomonas, etc. which led to a reduction of the BOD of the water. Once we reached the optimal BOD(<= 10) we went ahead and treated the water in batches with a plethora of chemicals like Sodium Hypochlorite, Chlorine, etc. and checked which chemically reduces the COD to the maximum and then we used activated Carbon to remove the smell and colour of the water. The project derives a cycle of processes that reduces the BOD and COD and makes sure that all the parameters of the wastewater, e.g., pH, hardness, TSS, etc., are at the level of uncontaminated water.
Keywords: Analysis, Parameters, Sewage, Water treatment.

I. INTRODUCTION

In larger industries we have dedicated units for sewage and wastewater management but we cannot afford the same also the operational cost is very high. Despite these factors, sewage treatment is a must and hence the topic of the project here we have tried to devise methods.
A modern wastewater treatment system known as a household sewage treatment plant processes all kinds of wastewater produced in residential or domestic dwellings. To lower the risk to the environment and public health, it processes all types of home wastewater that include dangerous chemicals. Thus, a sewerage system for a home is required. For your residential residences, a compact or small sewage treatment facility will normally break down the received wastewater to create a treated effluent that is appropriate for release to a natural watercourse. The septic tank receives domestic wastewater and separates the liquids from the solids. Liquids

are transported to the ultimate soil treatment site while solids are stored in the septic tank. Microorganisms in the wastewater use the septic tank as a "bioreactor" to break down organic materials into liquids, gasses, and solids. The house vent stack is used to release gasses. Scum and sludge both makeup solids. Scum floats to the top of the septic tank because it is lighter than water. The solid components sink to the bottom of the tank because they are heavier than water. Wastes are fed by bacteria, and the portion that cannot degrade is referred to as "sludge." The septic tank's bottom collects sludge, which needs to be routinely evacuated.

In a nutshell, a basic water treatment plant has 3 processes

1. Primary or the Physical
2. Secondary or Biochemical
3. Tertiary

The 2 important parts of the entire process are the microbial organisms and chemicals used in the process, For the project, we have used Spirulina, Methanococcus, and Pseudomonas,

The basic criteria and type of microbes used are

Aerobic Bacteria: Aerobic bacteria are most commonly used in aerated environments in contemporary wastewater treatment facilities. By using the free oxygen in the water to break down the toxins in the wastewater, these bacteria make energy that they can use to grow and reproduce. This aids the bacteria's ability to carry out their duties, carry on growing, and reproduce.

Aerobic bacteria: In aerated conditions in contemporary treatment facilities, aerobic bacteria are most frequently used. These bacteria use the free oxygen in the water to break down the pollutants in the wastewater, which they then convert into energy for growth and reproduction. This aids the bacteria's ability to carry out their duties, carry on growing, and reproduce.

Eg. Pseudomonas aeruginosa, E. Coli, and Citrobacter

Anaerobic bacteria are frequently used in the treatment of wastewater. This bacteria's main role in the treatment of sewage is to lessen the amount of sludge and produce methane gas from it. When cleaned and handled appropriately, this gas can be utilised as a substitute for conventional energy sources. This particular strain of bacteria can obtain enough oxygen from its food source and does not need a separate oxygen supply. An additional benefit of anaerobic bacteria

Eg. Actinomyces, , Clostridium, Pseudomonas

and Facultative bacteria: In sewage treatment, facultative microorganisms are bacteria that may alternate between anaerobic and aerobic conditions based on their environment. These microbes prefer to live in an aerobic setting.

Eg. Staphylococcus, and Clostridium.

The Chemicals used in the entire procedure range from normal sodium bicarbonate i.e baking soda to sodium hypochlorite, alum, potassium permanganate, chlorine etc.

I. Literature survey

In rural communities in northern China, Shubiao Wu et al. tested integrated household-built wetland (IHCW) systems planted with willow (Salix babylonica) to treat domestic wastewater from households. Outside of the winter season, average removal efficiencies of 96.3%, 97.3%, 90.0%, and 87.6% for total suspended solids (TSS), ammonia-nitrogen (NH_3-N), and total phosphorus were attained (TP).[1]. Researchers Xianghao Ren and colleagues looked into the use of nonwoven fabric filter bags (NFFB) as membrane bioreactors.

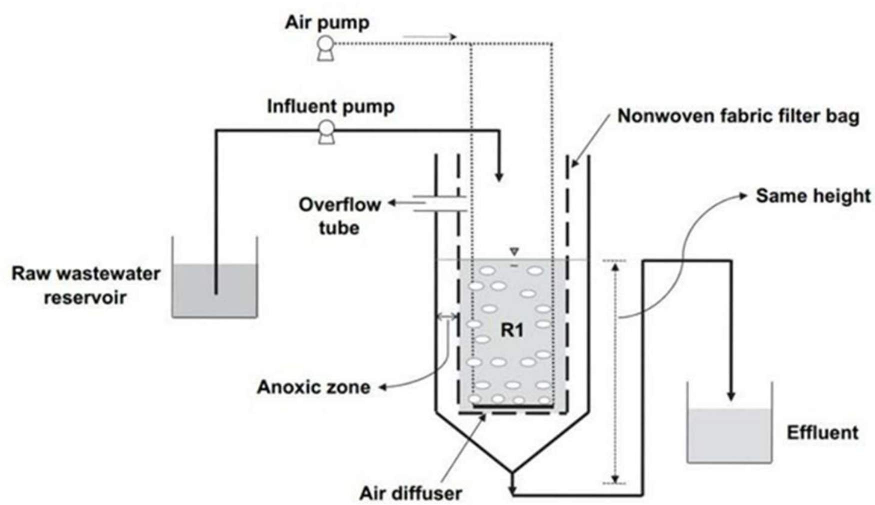

fig- Schematic diagram of the experimental NFFB system. RI: aerobic zone with activated sludge.[2].

According to this study, the NFFB system has great potential for successful wastewater treatment, is easy to operate, and is inexpensive, making it an appealing option for broad application in rural and sparsely inhabited areas.[2]. The development and assessment of an experimental on-site home wastewater treatment system were done by Tsuyoshi Ichinari et al. The system comprised an aerobic fluidised bed reactor, an up-flow anaerobic filter, a final settling tank, a disinfection chamber, and an aerobic sludge digester in the primary treatment unit (ASD). In comparison to 206.9 mgl-1 and 131.7 mgl-1 of raw wastewater, the average biochemical oxygen demand (BOD) and total suspended solids (TSS) were determined to be 33.5 mgl-1 and 19.6 mgl-1, respectively. [3]. The effectiveness of on-site treatment facilities for wastewater from households, hotels, and restaurants was compared by Jun Nakajima et al. The authors surveyed Gappei-shori-Johkasous in Chiba City. Based on the BOD data of these water treatment facilities, this article compares the water quality. [4]. The author conducted a series of studies to assess the dependability of domestic wastewater treatment in removing certain contaminants. The Weibull technique was used for this
investigation. The dependability of BOD5, COD, and total suspended particle removal in all wastewater treatment plants studied was relatively poor, often ranging from 60 to 70%.[5]. In this study, the author discusses household water treatment and safe storage and their effects on millennium development goals. Although safe storage provides sustainable access to water and improved quality of the same, It doesn't increase the availability or quality of water. [6] A thorough literature search was carried out in order to compile a number of household treatment devices suited for the affordable treatment of water on a household basis. After the survey, the ceramic candle filter (CCF), bucket filter (BF), bio-sand filter (BSF), and the four home treatment devices (SIPP) were chosen to be porous silver-impregnated filters. The levels of chemical and microbiological pollutants in test water sources significantly decreased thanks to

all filters, according to preliminary findings. Chemical contaminants were more easily removed from synthetic water than they were from natural water sources. Despite the fact that the CCF was better at reducing turbidity at rates up to 95%, none of the four filters met the SANS 24 standards.

[7]. The performance of two home water treatment and safe storage (HWTS) systems, the Danvor plastic bio-sand filter and the Potters for Peace Filtron ceramic filter were compared using systematic and comparable measurements under both ideal and modified operating conditions. This study looks into how user behaviour may alter operating conditions, reducing the effectiveness of two HWTS systems at removing bacteria from the community while increasing exposure to environmental risks. [8]. In this paper, the authors made an effort to discuss the total costs, nitrogen mitigation potential, and cost-effectiveness of a number of conventional and alternative municipal wastewater treatment technologies, as well as the uncertainties that affect these outcomes and how we can better understand these technologies[9]. In this study, the authors compared the efficacy of conventional and baffled septic tanks for treating domestic wastewater. The three HRTs' septic tanks performed admirably.

During HRTs of 24, 48, and 72 hours, the COD removal rates for normal septic tanks were 53.4%, 56%, and 65.3%, respectively. [10]. In order to protect water and soil resources from contamination, eliminate the perfusion process and hence reduce costs, maintain public health, and construct and implement the suggested purification unit for domestic wastewater treatment are the objectives of this research. The effluent wastewater quality requirements for a home wastewater treatment unit have been met. In this investigation, a tiny, non-electric sewage treatment system was modified and put in place[11].

II. MATERIALS AND METHODS

The process of treating sewage involves eliminating impurities from wastewater, typically from domestic sewage. Sewage treatment aims to create effluent that can be recycled or safely released into the environment.

Sewage treatment techniques include the following:

Primary treatment: In this initial step of treatment, big particles like leaves, twigs, and other debris are removed from the sewage by passing it through screens. The wastewater is then directed into a settling tank, where the lighter substances, such as oil and grease, float to the top while the heavier solids sink to the bottom.

supplementary therapy.

Secondary treatment: In this phase, wastewater is treated biologically to break down the organic material by microorganisms. The activated sludge process, in which wastewater is combined with a significant number of microorganisms in aeration tanks, is the most often used secondary treatment technique. When they break down the organic content in the wastewater, the microbes also produce water, carbon dioxide, and new microorganisms.

Tertiary treatment: This stage involves the removal of nutrients, such as phosphorus and nitrogen, from the wastewater. The most common method of tertiary treatment is the use of chemicals, such as alum, to precipitate the nutrients, which can then be removed by sedimentation or filtration.

Advanced treatment: This stage involves the use of advanced technologies to remove contaminants that are not removed by primary, secondary, or tertiary treatment. These technologies include reverse osmosis, ultraviolet radiation, and ozonation.

After the sewage has been treated, the resulting effluent can be discharged into a waterway or reused for irrigation, industrial processes, or even drinking water.

Home Wastewater Treatment.

Wastewater treatment at home can help reduce pollution and protect the environment. Here are some methods for treating wastewater at home:

Septic System: A septic system is a common wastewater treatment system for homes not connected to a public sewer system. The system uses a tank to collect and treat wastewater from the home. The solids settle to the bottom, and the liquid is discharged into a leach field, where it is filtered through the soil.

Constructed Wetlands: Constructed wetlands are another option for treating wastewater. A shallow pond is filled with plants, such as cattails or bulrushes, which absorb nutrients and pollutants from the water. The water is then discharged into the soil, where it is further filtered.

Composting Toilets: Composting toilets are a waterless option for treating human waste. The waste is mixed with sawdust or other materials to promote decomposition. The resulting compost can be used as a fertilizer.

Greywater Systems: Greywater is wastewater from sinks, showers, and laundry machines that do not contain human waste. A greywater system collects this water and treats it for reuse in irrigation or toilet flushing. The system typically involves a filter and a storage tank.

The problem that arises is over-construction and a lot of water gets wasted in the process hence the process we have described is a mixture of physical and chemical processes.

The first step in the treatment process was to collect the wastewater samples from housing societies for analysis and treatment of the water. These samples were further analysed for the presence of various pollutants, including heavy metals, organic matter, BOD and COD.

The anticipated outcomes aligned pretty closely with the lab findings from the treatment facilities. This demonstrates the fact that all housing societies have some variation of the same water quality. The following stage involved comparing the parameter values obtained from the tests to those of the original/ideal parameters, this in turn reduces the BOD and COD.

Biological Treatment: The samples were subjected to biological treatment, where microorganisms (spirulina, methanococcus, clostridium) were added to consume the organic matter. The AS method transforms organic waste into less complex substances like carbon dioxide, nitrates, sulphates, and more biomass. Membrane separation, DAF, or settling are the methods used to remove these substrates from the water. The efficiency of the treatment was evaluated by analysing the samples for changes in organic matter.

Chemical treatment: The samples were subjected to chemical treatment (chlorine, hypochlorite etc.) to adjust the pH and remove heavy metals. Dichromate and Potassium permanganate was added to the samples, and the efficiency of the treatment was evaluated by analysing the samples for changes in pH and heavy metal concentrations.

Disinfection: The samples were subjected to disinfection to kill any remaining pathogens. Chlorine (in form of calcium hypochlorite) was used as the disinfectant, and the efficiency of the treatment was evaluated by analysing the samples for changes in pathogen concentrations.

Secondary Clarification: The samples were subjected to activated carbon for decolourisation and then secondary clarification to remove any remaining suspended solids. The efficiency of the clarification was evaluated by analysing the samples for changes in suspended solids concentrations.

III. RESULTS AND DISCUSSION

A. The values were obtained after testing and sampling sewage water collected from household societies.

SR NO	PARAMETERS	UNIT	RESULT
1	pH @RT	-	7.52
2	BOD	mgL^{-1}	70
3	COD	mgL^{-1}	208
4	TSS	mgL^{-1}	37
5	Total hardness	mgL^{-1}	201

Table -1

B. The values were obtained after treating the sample with anaerobic culture.

SR NO	PARAMETERS	UNIT	RESULT
1	pH @RT	-	7.52
2	BOD	mgL^{-1}	8.016
3	COD	mgL^{-1}	208
4	TSS	mgL^{-1}	37
5	Total hardness	mgL^{-1}	201

Table -2

C. The values obtained after chemical treatment of the sample.

SR NO	PARAMETERS	UNIT	RESULT
1	pH @RT	-	7.32
2	BOD	mgL^{-1}	8.016
3	COD	mgL^{-1}	134.1
4	TSS	mgL^{-1}	13
5	Total hardness	mgL^{-1}	127

Table -3

IV. CONCLUSION

The Project leads to the overall development of a sustainable and cost-efficient process for cleaning sewage water in household residencies and the reuse of water. The process is a two-step cleaning process in which there is the reduction of the Biological Oxygen Demand (BOD) of water using microbes and then the subsequent step follows the reduction of the Chemical Oxygen Demand (COD) using chemicals and thus forming a cycle of steps beginning from the sewage water collection in a tank to cleaning it and then reusing it for sanitation, washing purposes. This study illustrates the efficacy of removing contaminants from wastewater using a combination of chemical and biological treatment strategies. The findings of this study offer insightful information about the treatment procedure and will be helpful for future wastewater treatment process modification. The results of this study will be valuable to academics, engineers, and professionals working in the wastewater treatment industry

Interest Conflicts

The authors have no conflict of interest while publishing the paper.

Funding Statement

The complete project was funded by the students performing it.

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