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Planning, Design and Estimation of Waste Water Treatment Plant Sector 1 of Virat Khand

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Abstract: ***This study's primary goal is to carry out the design of a sewage treatment facility for Lucknow's Virat Khand Sector 1. due to constant domestic and municipal sewage will be produced at a faster rate as the population grows. All species become sick from the foul stench that sewage produces. To prevent this however, appropriate treatment is required prior to disposal on land in order to utilise the treated water and avoid dumping sewage directly into natural resources, which ultimately lowers the demand for fresh water as a whole. Its goal is to generate solid waste and fluid waste that are safe for the environment and can be recycled or disposed of. In a single day, how much sewage was produced overall, based on the anticipated population of Virat Khand Sector 1 over the following 20 years? As a result, the sewage generation in the Virat Khand area is the main topic of this study, and a sewage treatment plant is constructed in accordance with it. It is suggested that the different parts of the sewage treatment plant be designed taking into account the various standards and allowable limits of treated sewage water. Screening, a grit chamber, a main sedimentation tank, a biological reactor, a secondary clarifier, an activated sludge tank, and drying beds are some of the parts of a sewage treatment plant.***

Keywords: Design Approach, Sewage Treatment Plant, Sludge, Grit chamber, Screening.

I. INTRODUCTION

Wastewater is produced when water is used for industrial, commercial, or residential purposes. Municipal wastewater, which is also known as sewage, consists of all water and waste collected from various sources like drains, sinks, toilets, and gutters. It may also include rain and storm water. This wastewater contains particles that are typically derived from feces, food waste, personal hygiene products, cleaning agents, cosmetics, medicines, and other items. These particles may be dissolved, suspended, or floating in the wastewater and are separated or filtered out as sludge through treatment. Industrial wastewater, on the other hand, contains chemicals or substances specific to the manufacturing process of the industry producing it.

In the treatment process, wastewater is referred to as influent when it flows into a treatment unit, and as effluent when it flows out of the unit after treatment.

A. Objectives

Objective of sewage water treatment plant are :

1) To remove impurities and contaminants from wastewater so that it can be safely discharged into the environment or reused for various purposes. The specific goals of sewage water treatment may include:
2) Protecting public health by removing harmful bacteria, viruses, and other pathogens from wastewater.
3) Protecting the environment by removing pollutants and contaminants from wastewater before it is discharged into natural water bodies, such as rivers, lakes, or oceans.
4) Conserving water resources by treating wastewater for reuse in irrigation, industrial processes, or other non-potable applications.
5) Meeting regulatory requirements for wastewater discharge, including local, state, and federal environmental regulations.
6) Improving the overall quality of life in communities by reducing water pollution and enhancing public health and safety.

B. Advantages

There are many advantages of a sewage water treatment plant, some of which are:

Environmental Protection: Sewage water treatment plants play a vital role in protecting the environment by treating wastewater before it is discharged into water bodies. This helps to reduce pollution, protect aquatic life, and prevent the spread of waterborne diseases.

1) *Resource Conservation:* Sewage water treatment plants help to conserve resources such as water and energy by treating and reusing wastewater. This reduces the demand for freshwater and reduces the energy required to pump, treat and distribute freshwater.
2) *Cost-Effective:* Sewage water treatment plants are cost-effective as they can be used to generate energy from waste and can also produce treated wastewater that can be used for irrigation or other non-potable applications.
3) *Compliance with Regulations:* Sewage water treatment plants are necessary to comply with environmental regulations that mandate the treatment of wastewater before discharge. Failure to comply with these regulations can result in fines and other penalties.
4) Health and Safety: Sewage water treatment plants help to ensure public health and safety by treating wastewater and preventing the spread of waterborne diseases. Treated wastewater is also less likely to contaminate groundwater or surface water, which can be used for drinking or other purposes.

C. *Disadvantages*

There are several potential disadvantages of sewage water treatment plants, including:

1) *Capital costs:* Sewage water treatment plants require a significant amount of capital investment to construct and maintain. This can be a barrier to entry for smaller municipalities or companies.
2) *Energy consumption:* Sewage water treatment plants require a considerable amount of energy to operate, particularly during the treatment process. This energy usage can contribute to greenhouse gas emissions and climate change.
3) *Odour:* Sewage treatment plants can generate unpleasant odors, particularly during the treatment process. This can be a nuisance for nearby residents and businesses.
4) *Sludge disposal:* The sewage treatment process produces a significant amount of sludge, which must be disposed of properly. This can be an expensive and challenging process.
5) *Chemical use:* Some sewage treatment plants use chemicals, such as chlorine, to disinfect the water. While these chemicals can be effective at killing bacteria and viruses, they can also be harmful to human health and the environment if not used properly.
6) *Maintenance and operation:* Sewage treatment plants require regular maintenance and operation to ensure they are functioning correctly. This can be a challenge for smaller municipalities or companies that may not have the resources to maintain and operate the plant effectively.
7) *Water scarcity:* Sewage treatment plants require a significant amount of water to operate. In areas with water scarcity, this can be a significant drawback.

D. *Study Area*

For our research work on sewage wastewater treatment in Virat Khand sector 1 of Gomtinagar Lucknow as a study area and visited there to carry on the research.
In this small area of 300m^2, there was total of approx. 330 houses has been estimated.
Following data has been collected from there:

Area (2023)	0.09 Km^2
Population (2023)	1134
Population Density	10805 people per km^2
Nearest airport & distance (Aerial)	Chaudhary Charan Singh International Airport, 13.54 Km
Nearest Railway station	Gomtinagar, 1.3 Km

Fig. 1: Site Image 1

Fig. 2: Site image 2

Virat Khand -1 is developing on a fast pace as the population density is so high there, So there will be more generation of domestic and municipal sewage. So there is need of construction of sewage treatment plant with a view of sufficient capacity to treat the sewage. Its objective is to produce an environmentally safe fluid waste and solid wastesuitable for disposal or reuse.

E. Background

A facility called a sewage water treatment plant is made to clean sewage and wastewater before it is released into the environment or used again. The wastewater is treated at the plant using a combination of physical, chemical, and biological procedures to get rid of pathogens, nutrients, and organic materials. The cleaned water can then be utilized for irrigation or other non-potable uses before being released into surrounding waterways. Untreated sewage can include dangerous contaminants that can contaminate water supplies and constitute a risk to human health and aquatic life, making sewage treatment plants essential for preserving public health and the environment.

II. LITRATURE REVIEW

1) Karrman, 2001 and Erbe et.al (2002) Their research paper was based on sewage treatment plants. Karrman's review focused on the presence of endocrine disrupting chemicals in wastewater and the effectiveness of treatment plants in removing them. Erbe et al.'s review covered various aspects of sewage treatment plants, including the processes involved in removing pollutants, the impact of treated effluent on the environment, and the use of advanced technologies for wastewater treatment. Both reviews emphasized the importance of continued research and improvements in sewage treatment to protect public health and the environment.
2) Nuhoglu Et.al (2004) Conducted a study on the household wastewater treatment plant in Erzincan City, Latin America. The study included a detailed characterization of the incoming wastewater and an evaluation of the plant's performance. The authors likely analyzed parameters such as chemical oxygen demand (COD), biochemical oxygen demand (BOD), and total suspended solids (TSS) to assess the efficiency of the treatment process. The results of the study could be used to improve the plant's performance and potentially inform the design of future wastewater treatment facilities in the region.
3) Neethling and Gu (2006) Pure chemical tests at the research centre have shown that the process is more complicated than expected and that the arrangement of and sorption to carbonates or hydroxides are crucial elements. In fact, full-scale structures might perform better than the 0.05 mg/L limit predicted.
4) Murthy Polasa et.al (2014) Sewage treatment plant design for gated communities has been studied. These operations involve three different types of treatment units. The same way that physical, chemical, and biological processes. The elimination of undesired contaminants is more effectively accomplished by lengthening the time sewage is held in each treatment unit.
5) Ramya et.al. (2015) The study of characterization of waste water, especially residential sewage, is a result of the demand for decontaminating water due to the expanding environmental pollution. The waste water inspires the creation and application of fresh methods for treating nitrogen and other important contaminants.
6) Pramod Sambhaji Patil et al. (2016) Research focused on the treatment of sewage water using various treatment units such as screens, grit chambers, aeration tank, skimming tank, and settling tank. The study aimed to provide a solution for various uses of treated wastewater such as fire protection, lawn sprinkling, artificial recharge of groundwater, and others. The authors likely analyzed the effectiveness of each unit in removing contaminants from the sewage water, including solids, organic matter, and pathogens. The results could be useful for designing effective wastewater treatment systems for similar applications.

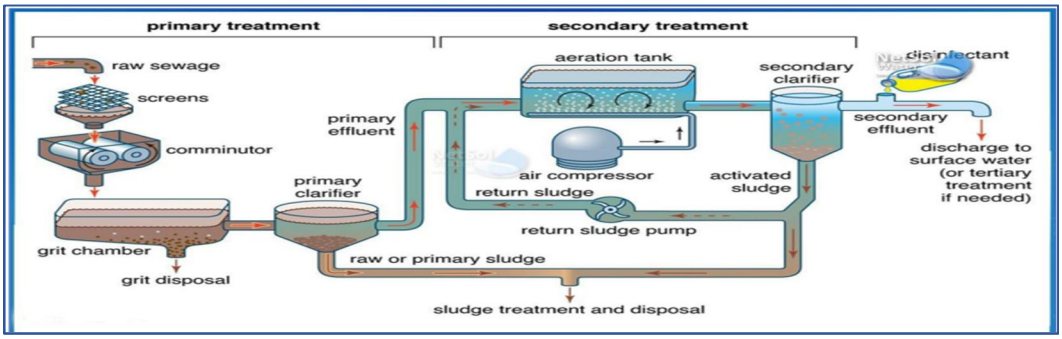
III. METHDOLOGY

A. *Activated Sludge Process*

Activated-sludge technique, a sewage-treatment process in which sludge, the amassed, microbe's rich deposits of settling tanks and basins, is seeded into the approaching wastewater and the blend agitated for a few hours (4-8 hours) within the sight of an adequate air supply. Suspended solids and numerous organic solids are adsorbed by the sludge, while organic matter is oxidized by the microorganisms. The measures of air and sludge utilized can be differed to control the level of treatment got. The sludge is then isolated out in a settling tank.

Activated sludge plant involves:

1) Wastewater aeration in the presence of a microbial suspension,
2) Solid-liquid separation following aeration,
3) Discharge of clarified effluent,
4) Wasting of excess biomass,
5) Return of remaining biomass to the aeration tank



a) *Physical Treatment:* At this stage, the effluent is being purified physically. Methods like screening, sedimentation, and skimming are used to remove solids. This technique makes no use of chemicals. One of the most common physical methods for treating wastewater is sedimentation, which involves suspending insoluble or heavy particles from wastewater. Once the insoluble material has fallen to the bottom, you can separate the clear water. Another good physical water treatment technique is aeration. This process involves passing air through the water in order to provide oxygen to it. Filtration is the third strategy, and it is utilized to get rid of all contaminants. Specific filters can be employed to pass the wastewater and separate the contaminants and insoluble particles it contains. Sand is the most popular type of filter.

b) *Biological Treatment:* A number of biological processes break down the organic materials in sewage, such as food, oil, and human waste. This uses a range of biological processes to break down organic materials in wastewater, including soap, human waste, oils, and food. Organic compounds in wastewater are broken down by microorganisms during biological treatment.

c) *Aerobic processes:* As organic materials are digested by bacteria, carbon dioxide is produced that plants can use. In this process, oxygen is used.

d) *Fermentation:* Waste is fermented at a specific temperature during anaerobic processes. Oxygen is not necessary for the anaerobic process. Composting is an aerobic wastewater treatment technique that entails adding sawdust or other carbon sources to the wastewater.

e) *Chemical Treatment:* As the name suggests, this therapy makes use of chemicals in water. Chlorine is a common oxidizing agent used to get rid of germs that pollute water and cause it to deteriorate. Another oxidizing agent used to clean wastewater is ozone. In order to neutralize water and return it to its normal pH of 7, an acid or base must be added. Pure water is produced when chemicals prevent bacteria from developing in water.

f) *Sludge treatment:* It is a method of solid-liquid separation in which the solid phase must include the least amount of moisture-remaining material and the separated liquid phase must contain the least number of solid particle residues. An example of this is the dewatering of sludge from industrial wastewater or sewage plants, where the quality determines the pollution load that is returned to the treatment facility and the residual moisture in the dewatered solids determines disposal costs. Both should be minimized.

IV. CONCLUSION

A successful technical project involves the integration of various knowledge from different field. This is an attempt to combine several aspects of environmental, biological, part of chemical and mostly civil engineering from which the knowledge were acquired.

Since in Metro Sattelite, Palasuni, due to increase in population in recent days and looking on the future aspect, it was quite necessary to construct a sewage treatment plant. The plant is designed perfectly to meet needs and demands of approximate 4000 population with a very large period of time. The project consist of the design of complete Sewage treatment plant components starting from receiving chamber, screening, grit chamber, skimming tank, sedimentation tank, secondary clarifier, activated sludge tank and drying bed for sewage.

V. FUTURE SCOPE OF STUDY

Future Scope of Project

The future scope of the project on sewage wastewater treatment plant is significant as the world's population continues to grow, and urbanization continues to expand. With these changes, there is a growing demand for water resources, which places a strain on our natural sources of freshwater. Therefore, sewage water treatment plants are becoming increasingly important in meeting the demand for clean water.

Some of the future areas of development in sewage water treatment plants include:

1) *Sustainable and Energy-efficient Technologies*: As the demand for clean water increases, so does the demand for energy-efficient sewage water treatment plants that can operate sustainably. Researchers are developing new technologies that can lower the energy required for treatment, such as using algae to treat wastewater and capturing energy from the treatment process.

2) *Advanced Treatment Techniques:* There is a growing need for advanced treatment techniques that can remove emerging contaminants such as microplastics, pharmaceuticals, and personal care products from wastewater. Advanced treatment techniques like reverse osmosis, advanced oxidation, and membrane filtration are being developed to achieve this.

3) *Decentralized Treatment Systems:* Decentralized wastewater treatment systems are becoming more popular as they offer a cost-effective and flexible solution to wastewater treatment. These systems can treat wastewater from individual buildings, small communities, and rural areas, reducing the need for centralized treatment plants.
4) *Resource Recovery:* Sewage water treatment plants can also be used to recover resources such as energy, nutrients, and water. Technologies like anaerobic digestion and nutrient recovery can be used to recover energy and nutrients from wastewater.
5) *Smart Monitoring and Control Systems:* Smart monitoring and control systems can help improve the efficiency and effectiveness of wastewater treatment plants. These systems can provide real-time data on treatment processes, allowing for better decision-making and optimization of plant operations.

Overall, there are several areas of development in sewage water treatment plants that will shape the future of this field. These developments will help to improve the efficiency, sustainability, and effectiveness of wastewater treatment, ensuring that we have access to clean water resources for years to come.

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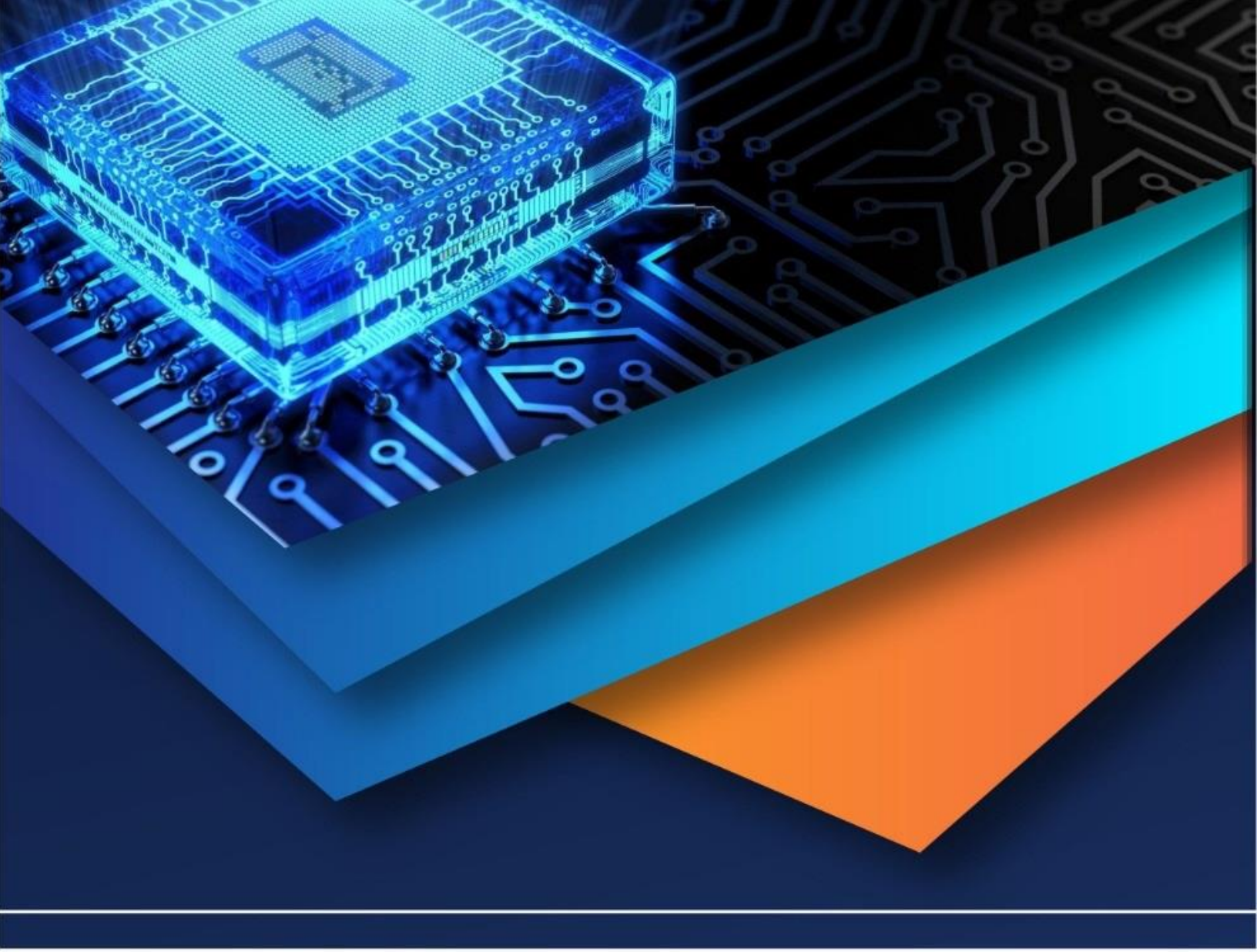

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