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Study and Verify the Performance Evaluation and Percentage Removal Efficiency of the Plant

Duvvuru Susendra, S. Sharada, N. Raveendhar

Abstract: ***Domestic, commercial, and industrial wastewater all belong to the category of urban wastewater. There are various treatment technologies available to treat the waste water from simple oxidation ponds to advanced MBBR systems. The present study is to verify the performance evaluation and percentage removal efficiency of the plant. The various water quality parameters like COD, BOD, TSS, TDS, Oil & Grease , Nitrates, pH, EC, DO, Turbidity and Phosphates of the waste water were being analyzed for the which were collected. Water samples were collected at different stages of treatment plant such as (raw water inlet, Aeration tank, Clarisettler and Treated water outlet) in the weekly basis for a period of 6 weeks before disposal into water body streams. After treatment, the average percentage removal efficiency for the parameters COD, BOD, TSS, TDS, Oil & Grease, and Phosphates was found to be 89%, 88%, 85%, 68%, 69% and 75%. After the analysis the result were finalized by comparing data with CPCB and IS standard values and ultimately, the performance and removal efficiency of the waste water treatment facility was found to be under good condition and the treated water are being used for flush-outs and gardening.***

Keywords: Percentage Removal Efficiency, Performance Evaluation, MBBR, BOD, COD.

I. INTRODUCTION

Every living thing on the planet has a fundamental need for water. Despite there being only 3% of drinkable water on the planet, water covers over 71% of its surface. Water resources are becoming scarce as a result of the industrialization and increasing population growth, which necessitates the treatment and reuse of waste water**.** Sewage is defined as water that has been released into the environment after being used extensively by society, homes, and other industrial sources [1][10]. Domestic sewage is composed primarily of water (99.9%), suspended particles (0.02–0.03%), and other organic and inorganic components [2]. STPs are crucial in the process of purifying sewage to generate liquid and solid (sludge) that are appropriate for reuse or release to the environment.

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Limited freshwater resources may be found in many nations across the world. The degree of BOD and suspended solids reduction, which together make up organic pollutants, serves as the standard by which the STP's performance is measured. STP performance efficiency is based on appropriate operation and maintenance in addition to adequate design and construction. The STP performance evaluation is very beneficial as it shows how the system is operating and makes it easier to spot problems that may be fixed. The Moving Bed Biofilm Bioreactor (MBBR), which is the center piece of all activities, will be used in this study to find whether the plant is operating effectively [3].

A. About STP

The STP flow diagram is shown in Fig. 1 and is located at Gachibowli, Hyderabad, Telangana, India. Wastewater from the campus may be treated by the STP at a rate of 400 m3/day. It is a modern small-scale treatment facility where sewage is cleaned up and produces wastewater that may be used for flushing toilets, irrigation, and garden supplies. The wastewater was screened via a bar screen chamber to remove big material such as sticks, leaves, garbage, and other large particles that might clog further purification procedures. In the treatment process Urea and DAP were introduced as nutrients for the growth of microorganisms as the effluent was being pumped into the aeration tank. Air was continuously supplied into the aeration tank, effectively aerating the sewage. During its descent, sewage is extensively mixed with the activated sludge. Once the sludge has settled in the settler tank, the water is then sent to the raw water tank [2]. The treatment process was carried out in three stages Primary, secondary and tertiary treatment. Primary treatment is used to remove heavy or big items from wastewater such as plastics, scum such as oil and grease. Secondary treatment is the most significant procedure in wastewater treatment since it involves the removal of total solids, which include both organic and inorganic matter. Tertiary treatment's objective is to provide a last treatment stage to further improve effluent water quality before disposal, here activated carbon filters and slow sand filters are used to filter out pollutants in the water [4][7][8][9]. Existing treatment plant performance evaluation is required to assess existing effluent quality in order to fulfill higher treatment requirements, as well as to learn about the treatment plant [5][6].

B. Dimensions of the treatment units:

a Coarse screen chamber:

It has 1.2 x 0.5 x 0.3m dimensions and is built of 10mm thick SS plates with 20mm center to center spacing.

b *Fine screen chamber:*

It has 1.2 x 0.6 x 0.3m dimensions and is built of 10mm thick SS plates with 10mm center to center spacing.The tank already exists and has up to 250 cum of influent storage capacity.

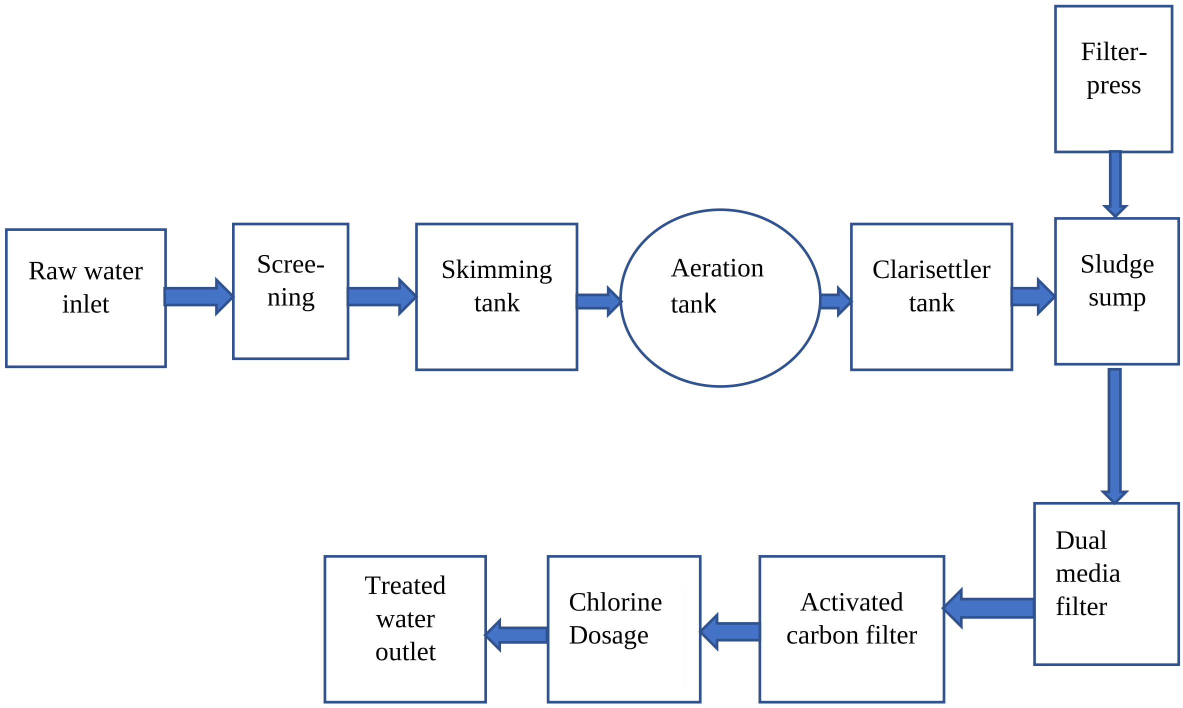

Figure 1. Flow Chart of STP

c *Aeration (or) MBBR tank:*

The aeration tank has dimensions of 5 m d x 4 m. Aerobic microbial method is used to reduce the burden of biodegradable organic material. There are three blowers two on working and one as stand by with capacity of 150m3/hour and o.5 kg/cm2.

d *Clarisettler tank:*

It was a single number made of RCC with dimensions of 3.1 x 3.1 x 2.5m. It is used to separate Solid-Liquid by transferring aerated water from an aeration tank via a flow pipe of 17 m3/hour.

e *Sludge Sump:*

It is used to collect sludge from the Clarisettler tank and transport it to the filter press using a screw type pump. The sludge sump is 2.0 x 2.0 x 2.0 m.

f *Pressure sand filter:*

The vessel measures 1.4 m x 1.5 m in dimension (HOS). The pressure sand filter vessel is layered with filter sand and used to filter out fine suspended particles.

g *Activated carbon filter:*

The vessel of the activated carbon filter is consisting of filter sand and carbon to reduce the traces of organic components (color, taste and odor). The vessel is 1.6 x 1.5 m in size.

h *Treated water tank:*

The RCC treated water tank is 9.0 x 4.5 x 4.5m and is useful for collecting treated water.

II. STUDY AREA

The Gachibowli IIIT Campus in Hyderabad, Telangana state, India, comprises a 400 KLD treatment facility established with various sorts of equipment and technology like MBBR for the treatment of sewage. There are more than 3000 residents living in campus. The focus of this study is the region surrounding the Gachibowli IIIT Campus, which has coordinates of 17.4449° N and 78.3498° E. The north Old Mumbai Highway, the south Telangana Institute of Medical Sciences and Research, the east ISB Road, and the west Gachibowli Stadium are a few of the areas adjacent to IIIT campus. Sewage is processed at the IIIT Campus sewage treatment facility before being used for things like toilet flushing and gardening.

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Figure 2. Study Area Map

III. METHODOLOGY

The performance of a 400KLD wastewater treatment plant in Hyderabad was examined in the study. The analysis of several parameters such as BOD, COD, TSS, TDS, Phosphates, and O&G, and others. The samples were collected in four different points in 2-liter capacity plastic containers during a six-week period at four sample points of the sewage treatment facility: (1) the wastewater treatment plant inlet; (2) the Aeration tank outlet; (3) the Clari-Settler tank outlet; and (4) the treated water outlet. The samples were tested in a government-approved laboratory in Hyderabad. All laboratory analyses for the samples were performed in accordance with Standard Methods for Water and Wastewater Examination [8].

Based on the findings, we can calculate the removal efficiency of the various parameters at each stage of the wastewater treatment facility. Fig. 3 shows the flowchart for the methodology of the project.

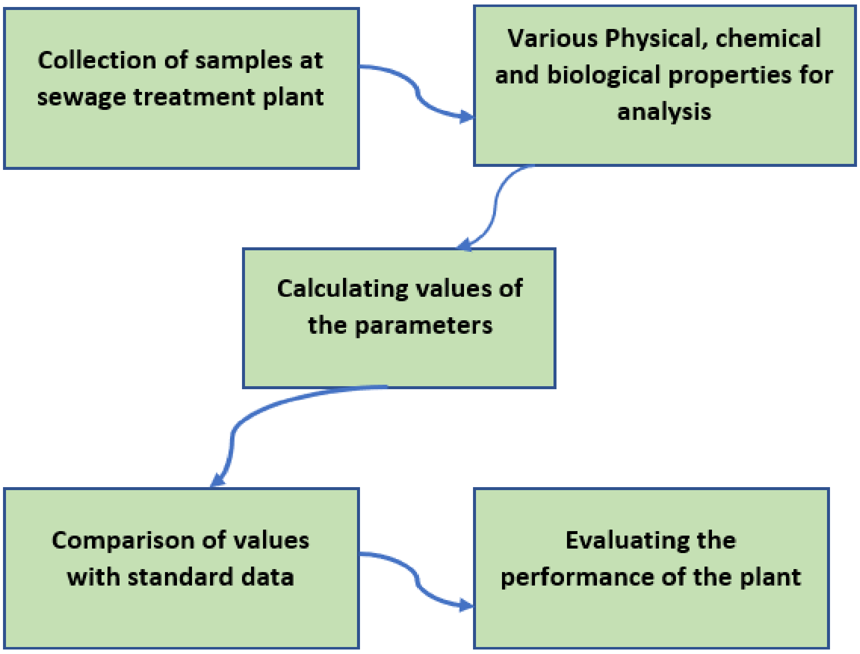

Figure 3. Methodology of Sewage Treatment Plant Performance Analysis

IV. RESULTS AND DISCUSSION

The samples were collected at four different sampling points for a time period of six weeks in the months of May, June, July 2022 from the sewage treatment plant and analysis was done for BOD, COD, TSS, TDS, Oil &Grease etc.,

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A. Biochemical Oxygen Demand

The BOD measurement aids in detecting the quantity of oxygen utilized by microorganisms in the process of degrading organic pollutants in water. The BOD inlet and outlet values were found to be maximum at 1st week and average values of BOD in the sample collection at inlet, aeration tank, Clari-settler and outlet before and after treatment are 233 mg/l, 156 mg/l, 99 mg/l and 26mg/l respectively. Fig 4 shows the performance of sewage treatment plant according to biochemical oxygen demand. As the outlet values of the BOD after treatment are within the standard limits the plant is running under good performance.

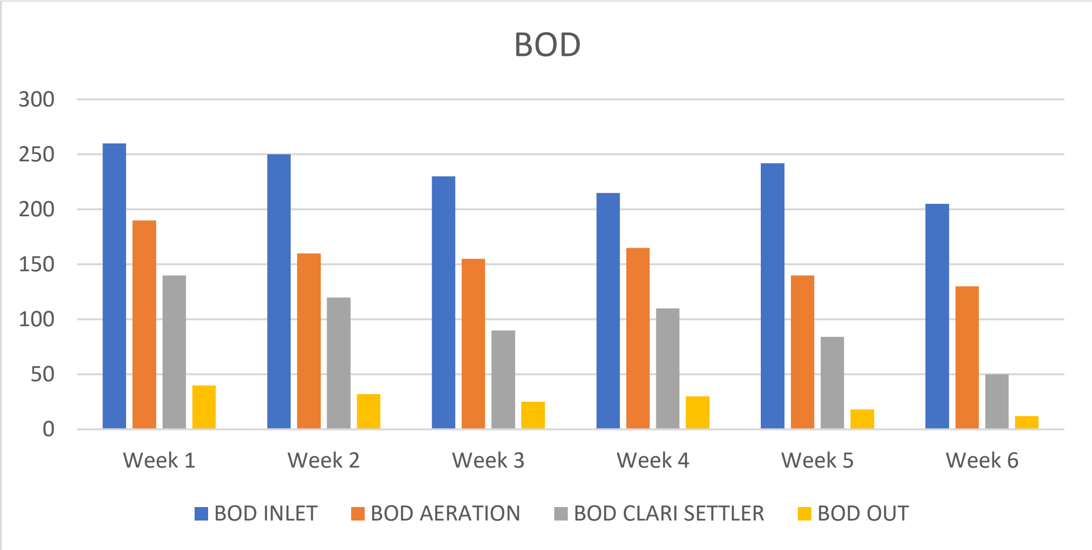

Figure 4. Performance Analysis of Bio-chemical Oxygen Demand

B. Chemical Oxygen Demand

The chemical oxygen demand is a measure of the quality of water and wastewater. The COD test is frequently used to measure the performance of water treatment plants. The inlet and outlet values of COD were found to be maximum at 1st week and average values of BOD in the sample collection at inlet, aeration tank, Clari-settler and outlet before and after treatment are 473 mg/l, 335 mg/l, 209 mg/l and 49 mg/l. Fig 5 shows the performance of sewage treatment plant according to Chemical oxygen demand. As the outlet values of the COD after treatment are within the standard limits the plant is running under good performance.

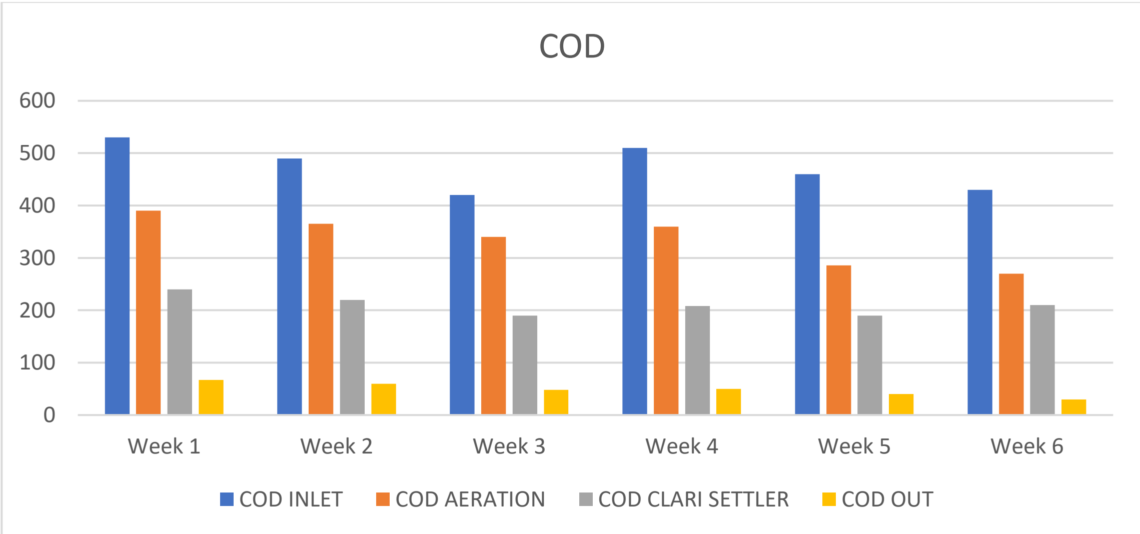

Figure 5. Performance Analysis of Chemical Oxygen Demand

C. Total Suspended Solids (TSS)

The inlet and outlet values of TSS were found to be maximum at 1st week and average values of TSS in the sample collection at inlet, aeration tank, Clari-settler and outlet before and after treatment are 320 mg/l, 250 mg/l,160 mg/l and 60 mg/l. Total suspended solids are being arrested at screenings, pressure sand and activated carbon filtration. Fig 6 shows the performance of sewage treatment plant according to Total suspended solids. As the outlet values of the TSS after treatment are within the standard limits the plant is running under good performance.

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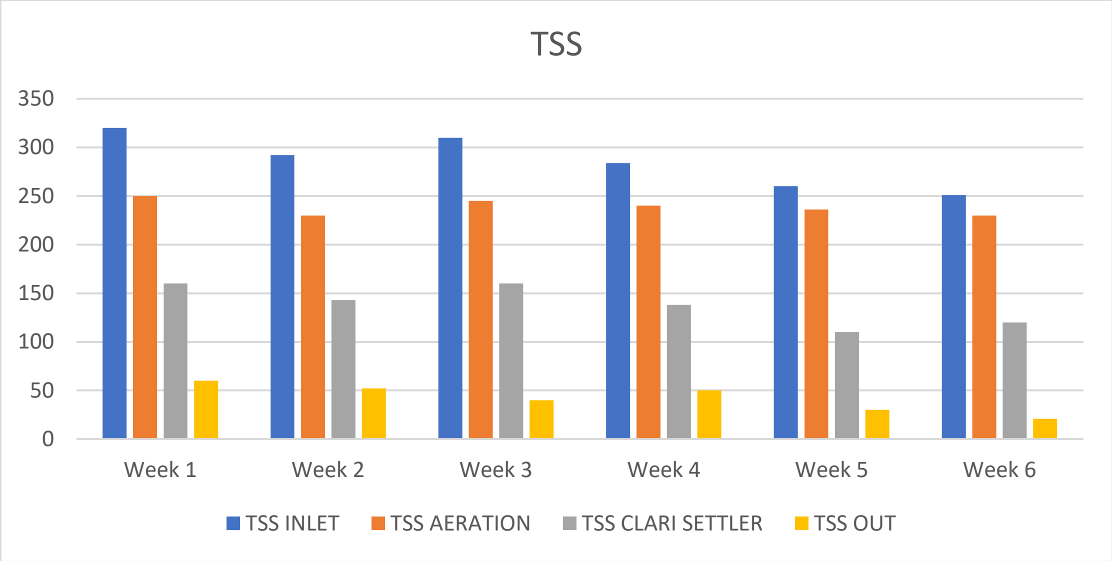

Figure 6. Performance Analysis of Total Suspended Solids

D. Total Dissolved Solids (TDS)

The inlet and outlet values of TDS were found to be maximum at 1st week and average values of TDS in the sample collection at inlet, aeration tank, Clari-settler and outlet before and after treatment are 1410 mg/l 1043 mg/l, 763 mg/l and 455 mg/l. Total dissolved solids can be removed through membrane filtration. Fig 7 shows the performance of sewage treatment plant according to Total dissolved solids. As the outlet values of the TDS after treatment are within the standard limits the plant is running under good performance.

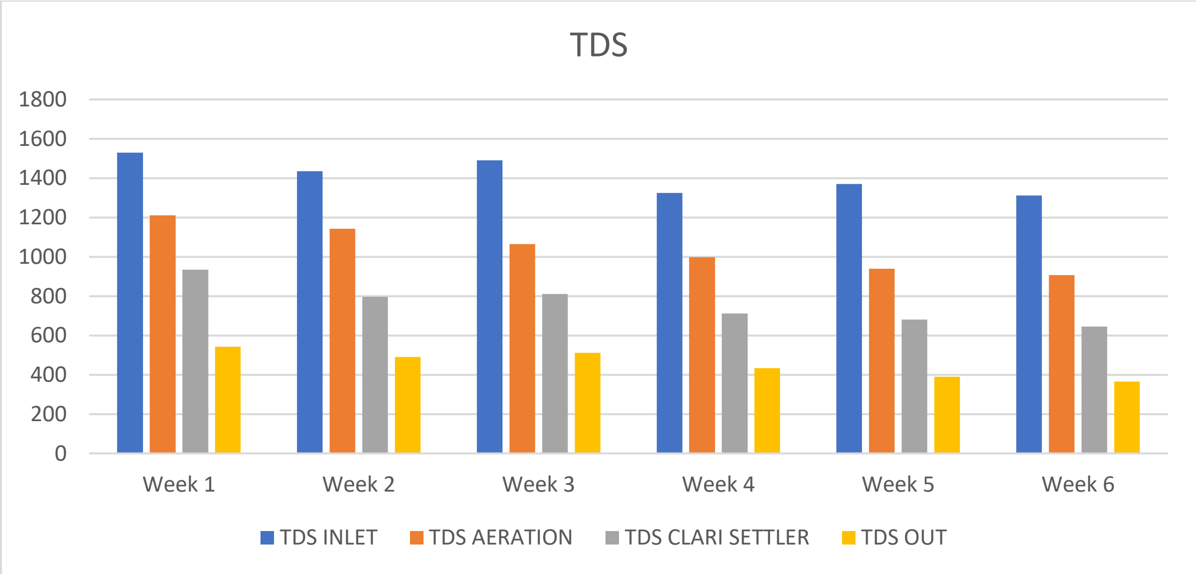

Figure 7. Performance Analysis of Total Dissolved Solids

E. Oil & Grease

Oil and Grease comes from kitchens, chemical and oil industries etc., The inlet and outlet values of O&G were found to be maximum at 1st week and average values of the parameter sample collection at inlet, aeration tank, Clari-settler and outlet before and after treatment are 25 mg/l, 17 mg/l, 12 mg/l and 8 mg/l. Oil and grease will be removed through skimmer tank and Dual media filters. Fig 8 shows the performance of sewage treatment plant according to Oil and Grease. As the outlet values of the oil and grease after treatment are within the standard limits and it was found to be the plant is running satisfactorily.

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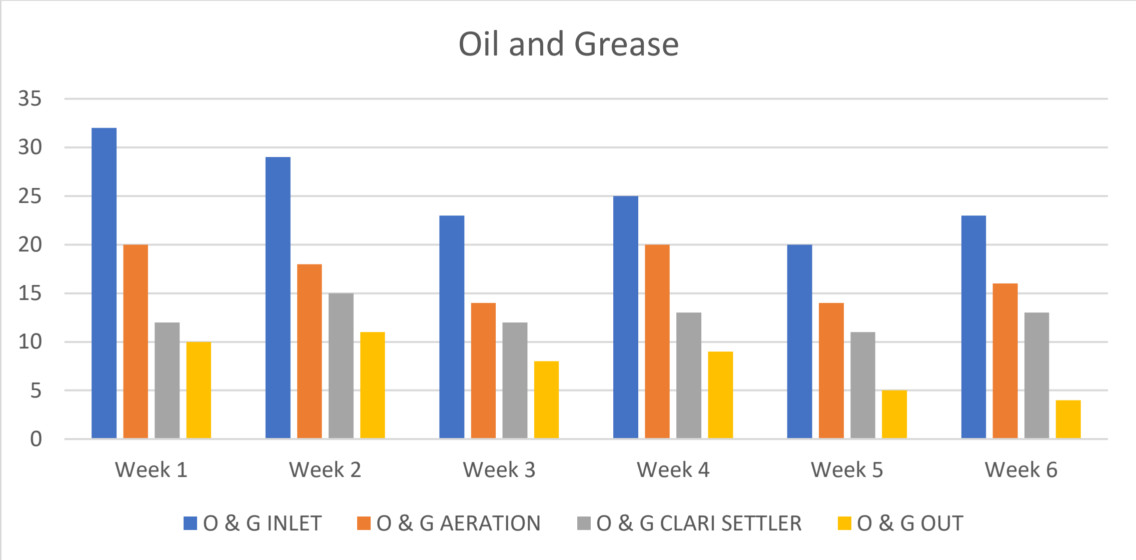

Figure 8. Performance Analysis of Oil and Grease

F. Phosphates

Fig 9 shows the performance of sewage treatment plant according to Phosphates. The inlet and outlet values of Phosphates were found to be maximum at 6th week and average values of the parameter sample collection at inlet, aeration tank, Clari-settler and outlet before and after treatment are 5 mg/l, 4 mg/l, 3 mg/l and 1 mg/l. As the outlet values of the Phosphates after treatment are within the standard limits and it was found to be the plant is running satisfactorily.

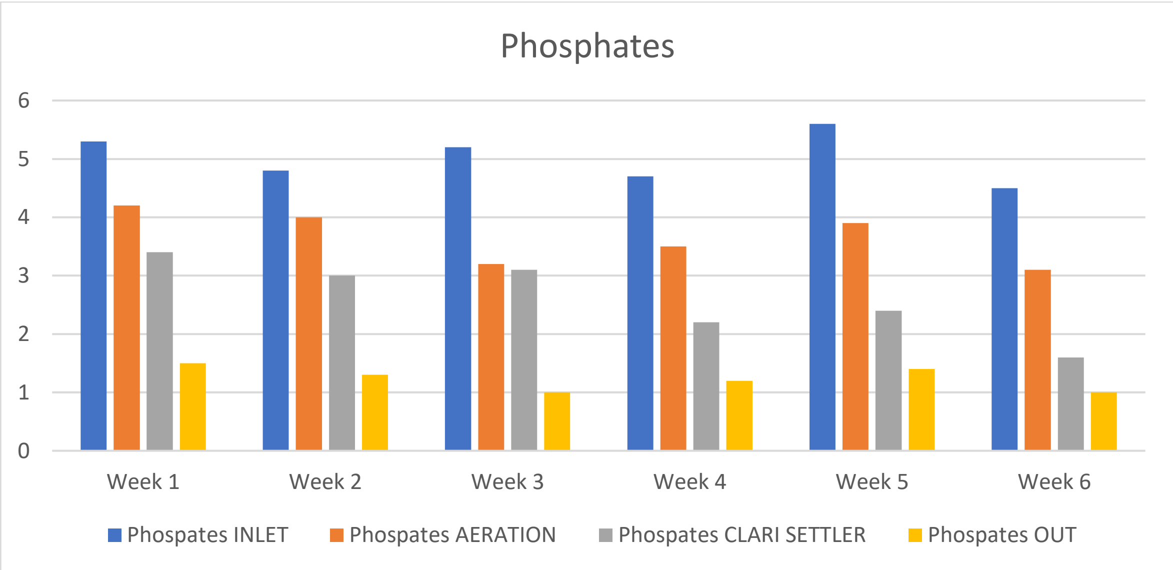

Figure 9. Performance Analysis of Phosphates

Along with these many other parameters such as Volatile solids, Chlorides, DO, pH, Electrical Conductivity and Nitrates etc., were also analyzed.

G. Overall Percentage Removal Efficiency of the Treatment Plamt

The percentage removal efficiency helps the plant organic pollutants removal and the data is very useful for plants future expansion purpose. This graph showing the percentage removal efficiency of COD, BOD, TSS, TDS, Phosphates and oil & Grease of 400Kld sewage treatment plant.

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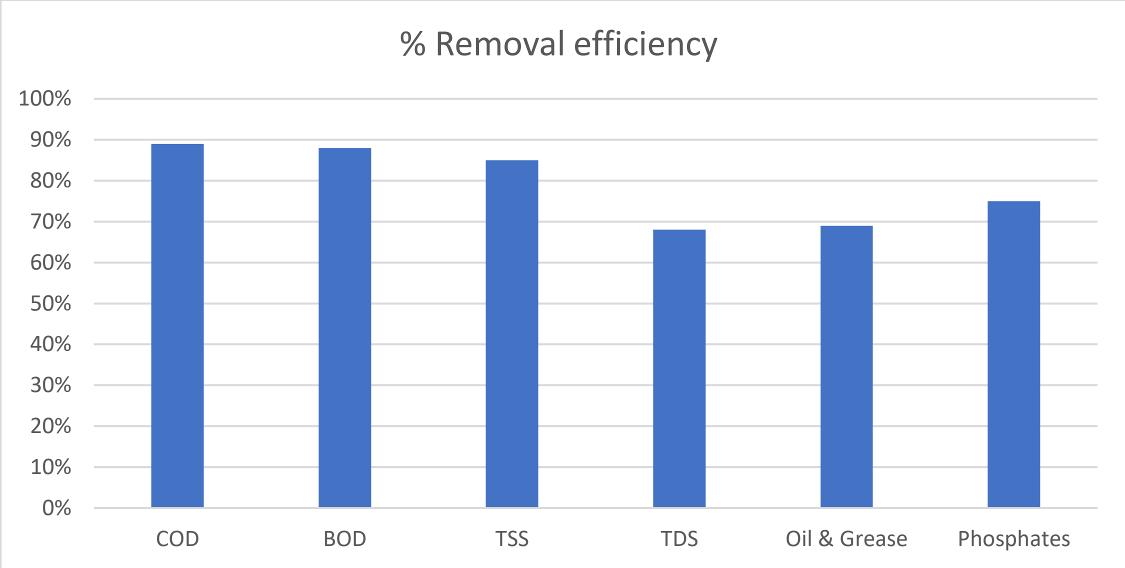

Figure 10. Overall % Removal Efficiency of the Plant

Fig 10 shows the percentage removal of COD, BOD, TSS, TDS, Phosphates and Oil & Grease of the sewage treatment plant as 90%, 89%, 85%, 67%, 80% and 69% respectively.

V. CONCLUSIONS

The sewage treatment plant with MBBR Technology and attached growth process as biological treatment was considered for performance evaluation. The performance of the plant was carried out for a period of six weeks and various parameters such as COD, BOD, TSS, TDS, Phosphates and Oil & Grease was analyzed. The percentage removal of BOD, COD, TSS, TDS, Phosphates and Oil & Grease was observed to be 90%, 89%, 85%, 67%, 80% and 69% respectively.

For achieving the better performance maintenance of the plant should be regularly done. After treatment process of the plant the overall performance of the sewage treatment plant was found to be good and the values were within the standard limits of Pollution Boards. The treated effluent water will be used for gardening, flush-outs etc.

DECLARATION STATEMENT

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Ethical Approval and Consent to Participate	No, the article does not require ethical approval and consent to participate.
Availability of Data and Material	Not relevant.
Authors Contributions	All authors have equal participation in this article.

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