Performance Evaluation of STP's based on Different Technologies

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Abstract- *Wastewater treatment is a process of converting highly polluted raw influent into an effluent that can either be returned to water cycle with low environmental impact or safely reused. The purpose of this study was to compare the performance of different STP technologies around Dal Lake, including Sequential Batch Reactor (SBR), Fluidized Aerobic Bio-Reactor (FAB), and Activated Sludge Process (ASP). Following the examination, it was determined that the overall performance of the various wastewater treatment plants is in the following order: SBR> FAB> ASP.*

Keywords- Biochemical Oxygen demand (BOD), Chemical Oxygen demand (COD), Dal Lake, Sewage treatment plant (STP).

1.INTRODUCTION

A wastewater treatment plant is a collection of distinct treatment processes or units that work together to create a high-quality effluent from wastewater(influent) of known composition and flow rate. The goal of wastewater treatment is to convert the wastewater into stable oxidised end products that can be safely disposed of in inland waters without causing environmental harm and protecting public [32]. STPs typically have two types of treatment systems: physical and biological purification. Chemical removal is mostly accomplished through sorption of chemicals to organic carbon in physical purification. The size and density of the particles have a direct relationship with the effectiveness of the removal. Biological purification relies on bacterial biodegradation, which is primarily accomplished through oxidation. Sludge and final effluent are degraded at the end of the treatment operations and reach the environment via effluent or evaporation from the STP. The main goals of the wastewater treatment are to decompose organic wastes so that they don't deplete oxygen in receiving water bodies, remove nutrients to prevent eutrophication, and protect public health by eradicating harmful microbes [4]. Physico-chemical parameters of the final effluent, such as biological oxygen demand (BOD), chemical oxygen demand (COD), electrical conductivity, total hardness, alkalinity, dissolved oxygen, and several metals and non-metal ions, have been demonstrated to be affected by sewage treatment methods [2,29]. Purification techniques also get rid of pathogenic microbes.

Various studies have analyzed the chemical concentrations in the influent and effluent to assess the efficiency of STPs. The majority of the studies [11,20,30] have found considerable reductions at STP outlet sites. However, several studies have found little or no reduction in pollution levels, which is a major concern for both water bodies and public health. Some studies have previously indicated that STPs differ from the typical permitted limit set by the World Health Organization (WHO) and the United States Environmental Protection Agency (EPA) [4,6,16,23,27].

Dal Lake receives effluent from six STP's namely

1) STP Lam

2) STP Habak

3) STP Hazratbal

4) STP Brari-Nambal New

5) STP Brari-Nambal Old

6) STP Nallah Amir Khan

It also gets domestic wastewater from numerous house boats and human settlements that thrive within the Lake. These STPs were built in 2004 at a cost of Rs 8.90 crore by a private company following the rules of the Jammu and Kashmir Lake Conservation and Management Authority (LCMA). The working capability of these STPs has recently been questioned.

Although the LCMA appears to be comfortable with the functioning state of these STPs and maintains that the Dal Lakes' health would improve, several analytical reports have expressed concerns about the operational conditions of these STPs.[7]. The current study was carried out to determine the influence of wastewater effluent discharged and to estimate the pollutant removal efficiency of STPs around the Dal Lake. The removal efficiency, we projected, would be determined by the specific STPs characteristics (working capabilities), the level of aeration, hydraulic retention time, contact time and type of treatment used.

2.MATERIALS AND METHODOLOGY

The current study was carried out at three Sewage treatment plants namely Nishat Laam, Brari-Nambal Old and Brari-Nambal New which are located between geographical co-ordinates 33°25'N to 34° 50'N & 74° 75'E,34° 05'03.96" N & 74° 48'56.31"and34° 08'69" N & 74° 81'39" E, respectively around Dal Lake. The effluent is dumped into Dal Lake, River Jhelum and Brari-Nambal Lagoon respectively, after treatment of wastewater. The STP Nishat's catchment region comprises the residential areas of Zabarwan, Brain, Nishat, Ishbar and Shalimar, while the STP Brari-Nambal Old's catchment area includes inflow from Bohri- Kadal drains and adjoining areas and STP Brari-Nambal New's catchment area contains Boulevard area.

Because the city has comparable social base, the quality of sewage generated is nearly identical. The study looked at three sewage treatment plants that used Fluidized aerobic bioreactor (FAB), Activated sludge process (ASP) and Sequential batch reactor (SBR) technologies.

The receiving sump or inlet which receives raw sewage from connected sewage systems, and the STP's outlet, where the treated wastewater leaves the plant were identified as the sampling points in all the three STPs, with the first and third being the identical for all three STP's. The second point in the FAB STP was the outflow of the bioreactor tank or FAB-B, which contains plastic media for bacterial growth; in ASP STP, it was after the aeration tank cum clarifier stage II; and in the SBR STP, it was after the settling tank outlet.

From October 2021 to December 2021, sampling was carried out for three months. During the study, grab samples were taken. Throughout the investigation, wastewater samples were collected every 15 days from three treatment plants. Water samples were collected at all of the selected locations in 1- liter polyethylene bottles that had been washed with distilled water before being filled with sample water. Physical, chemical, bio chemical and chemical oxygen demand samples were collected separately for analysis. For Dissolved Oxygen (DO), separate samples were collected in BOD bottles and the DO was fixed at site using Winkler's and Manganese reagent. COD samples were collected in 250ml bottles and preserved with 2ml Sulfuric acid. Untreated, aerated and treated wastewater samples were analyzed physically and chemically in accordance with American public health association (APHA) protocols.

2.1 DESCRIPTION OF TREATMENT TECHNOLOGIESEVALUATED

1) STP Nishat (FAB)

STP, which is located in Nishat is a 4.5 MLD Fluidized aerobic bio-reactor based treatment facility. It is made up of floating media in cylindrical shapes and various sizes, as the name suggests. FAB reactors are compact, energy efficient and user friendly. Air diffusion is controlled. The connected bacteria growth process, which is supported by specially designed eco-friendly media, is the basis of the FAB- based sewage treatment system. This form of treatment relies heavily on the utilization of air to keep bacteria alive in the wastewater treatment plant. The growth of organisms that break down the organic material is aided by air diffusion.

Fig-1: Showing STP Nishat (FAB)

Components of FAB:

Receiving Sump: Wastewater is collected in this chamber and pumped to the settling chamber via pumps. It consists of six pumps, each with a 118 cubic meter capacity.

Settling Chamber and Screens: This chamber allows water to settle, allowing heavier particles to settle as well. The sewage is then sent through a Bar Screen Chamber and an Oil & Grease Chamber, where any floating or superfluous waste is caught.

Grit Chamber: The sewage is subsequently collected in this chamber where it is subjected to flow fluctuations and other factors. It dampens features that could otherwise cause operational issues, and it also provides for a steady flow rate downstream. By using coarse air bubble diffusion, the sewage is retained in a mixed state.

Fluidized Aerobic Bio-Reactors: The equalized sewage is then pumped to the Fluidized Aerobic Bio-Reactors (FAB), where aerobic microbial activity reduces BOD/COD levels. The FAB reactors are linked together. It is made up of floating media in various sizes and shapes. Air diffusion is controlled. The connected bacteria growth process, which is supported by specially designed eco-friendly media, is the basis of the FAB- based sewage treatment system. Coarse air bubble diffusers or Blowers provide the essential oxygen. FAB-A is where 70% of the treatment takes place, whereas FAB-B is where the remaining takes place. When the water leaves FAB-B, it is treated with 40kg Poly-aluminum chloride (PAC) for 24 hours to remove the phosphate that is dissolved in wastewater.

Claritube Settler Tank: in this tank, water is allowed to rest while it is clarified, and the clear supernatant is then pumped into the Chlorine Contact Tube via troughs. This chamber traps the sludge, which is then delivered to sludge thickener and then to the Sludge Sump.

Chlorine Contact Tube (CCT): In this tube, chlorine is added to clarified water, 15 liters of chlorine for 24 hours. Chlorine functions as disinfectant, destroys pathogens and other micro-organisms in the water, before the treated effluent is discharged into Dal Lake.

Sludge Sump: The biological sludge from the Claritube Settler tank flows via a sludge thickener, where it is dewatered before being sent to the sludge sump, to produce cakes which are then used as manure.

2) STP Brari-Nambal Old (ASP)

An Activated Sludge Process-based treatment plant with a capacity of 17.08 MLD is one of the STPs in Brari-Nambal. The activated sludge process is a type of wastewater treatment that can be referred or defined as a biological treatment process that removes BOD and suspended solids using a suspended growth of organisms. The process requires an aeration tank and a settling tank. In this technique, no chemical treatment is used.

Fig-2: Showing STP Brari-Nambal Old (ASP)

Components of ASP:

Collection Chamber and Screens: The Collection Chamber collects raw sewage, which is pumped by three pumps which work alternatively each having a capacity of 7 cusec. The sewage is subsequently filtered through screens to catch any floating debris.

Grit Washer: The chamber is made up of tanks that are designed to slow down the flow of wastewater, allowing heavy particles like sand, eggshells, grounds to settle and partially purify the wastewater.

Aerator Cum Clarifier: In this chamber, Air is delivered to a combination of primary treated or screened sewage which is coupled with organisms to form a biological floc. Biological activity in the aeration tank reduce the concentration of biodegradable components in the influent. The mixed liquor from the aeration tank is discharged into settling tank and the supernatant is clarified before being discharged. A portion of settled activated sludge is returned to the aeration tank's head to re-seed the new sewage, while the remainder of the thickened sludge is evacuated via the sludge pump house.

Effluent Pump House: Following clarifying, the supernatant is held in the effluent pump house before being discharged into the River Jhelum.

3) STP Brari-Nambal New (SBR)

Another STP in Brari-Nambal, with a capacity of 16.1 MLD, is based on Sequential batch reactor technology. The sequencing batch reactor (SBR) technique uses a single complete mix reactor in which aeration is followed by clarifying, therefore the name "sequential". When aeration is turned off and the supernatant treated water is drained, sludge settles.

Fig- 3: Showing STP Brari-Nambal New (SBR)

Components of SBR:

Raw Sewage Pump: This is the first stage of the operation, and it involves filling the first tank with influent wastewater. It contains six pumps to lift the water, each of which has a capacity of 30 KW and works alternatively.

Settling Chamber: Wastewater is piped to this chamber to settle heavy materials before being routed through screens to capture floating solid like trash. There are two screens one that operates manually and the other that operates automatically.

Grit Chamber: A Grit chamber, also known as a grit basin, is intended to remove the inorganic particles like sand, gravel, or any other inert solid material from the wastewater. At the bottom, there are surfacers that collect the materials. Raw water that is in excess is stored in Storage tanks.

Pre-Conditioning Tank: After solid wastes have been removed, wastewater is allowed to aerate in this chamber but with less availability of air. It is critical that the water be filled with a steady but quick flow so that the food to microorganism's ratio remains balanced. It is analogous to the selection mechanism which ensures that microbes with better settling characteristics can grow to their full potential.

Aeration Tank: Aerators are turned on here, and the contents of the basin are aerated to produce an aerobic Zone. By using blowers to turn on and off the oxygen during this phase, oxic and anoxic conditions are established, allowing nitrification, denitrification, and the rate of organic elimination to rise. After aeration, raw water is pumped into the Settlement tank and treated with 50 kg of Poly aluminum chloride (PAC) for 24 hours.

Settlement Tank: Depending on the number of cycles each day, settling takes 60 to 90 minutes. Aeration is turned off, and the sludge settles, which is evacuated via a sludge sump, while clear, effluent water accumulates on the sludge blanket.

Chlorine Contact Tank: After the sludge has settled, decanting, or extracting the effluent from the tank without disturbing the sludge at bottom, is done. Finally, 50 liters of chlorine are treated in 24 hours, and the cleaned water is disposed of in the Brari-Nambal Lagoon.

2.2 PARAMETERS CHECKED AND METHODS ADOPTED

Table- 1: Showing Methods adopted

Parameters	Methods Adopted
pH	Electrometric method
COD	Open reflux method
BOD	Titrimetric method
PO_4	Stannous Chloride method
NH_3-N	Nesslerization method

2.3 Comparative Performance Evaluation of Various STP's around Dal Lake.

I. pH

The logarithm of the reciprocal of hydrogen ion concentration is used to calculate pH. It has a range of 0 to 14, with 7 being neutral; a value of less than 7 suggests acidity while a value of more than 7 indicates alkalinity. Water is made up of positively charged hydrogen ions (H^+ions) and negatively charged hydroxyl ions(OH^-ions). The concentration of H^+ions is equal to that of OH^-ions in pure water. When a material is dissolved in pure water, the resulting solution ionizes, disrupting the equilibrium between the quantities of H^+ions and OH^-ions. The water solution becomes acidic when the concentration of H^+ions exceeds the concentration of OH^-ions and vice-versa. Mineral acids, free carbon dioxide, iron sulphates, aluminium sulphates, among other things, cause acidity in water. Alkalinity in water, on the other hand, is created by the presence of calcium and magnesium bicarbonates, as well as carbonates or hydroxides of sodium, potassium, calcium and magnesium.

Comparative performance evaluation of STP's in respect of pH

Table- 1

pH			STP BNB OLD	STP NISHAT	STP BNB NEW
OCTOBER	06/10/2021	RAW	7.01	7.10	7.20
		AERATED	7.29	7.19	7.36
		FINAL	7.34	7.30	7.46
	21/10/2021	RAW	7.50	7.29	7.24
		AERATED	7.52	7.31	7.35
		FINAL	7.58	7.35	7.42

Table-2

pH			STP BNB OLD	STP NISHAT	STP BNB NEW
NOVEMBER	06/11/2021	RAW	7.11	7.23	7.28
		AERATED	7.23	7.25	7.42
		FINAL	7.26	7.35	7.61
	21/11/2021	RAW	7.20	7.16	7.15
		AERATED	7.32	7.21	7.30
		FINAL	7.40	7.50	7.35

Table-3

pH			STP BNB OLD	STP NISHAT	STP BNB NEW
DECEMBER	06/12/2021	RAW	7.29	6.93	7.21
		AERATED	7.31	7.29	7.33
		FINAL	7.35	7.32	7.35
	21/12/2021	RAW	7.24	7.12	7.23

		AERATED	7.39	7.36	7.36
		FINAL	7.38	7.37	7.39

II. Ortho Phosphate (PO_4)

Phosphorus is found in sewage and industrial effluent as a component of agricultural fertilizers, manure, and organic wastes. It is necessary for plant life, but too much of it in water can hasten eutrophication (a decrease in dissolved oxygen in water bodies due to an increase in mineral and organic nutrients). Soil erosion contributes a significant amount of phosphorus to streams. During floods, bank erosion can transfer a lot of phosphorous from river banks and neighboring land into a stream, lake, or other body of water. In water, phosphorus can be found as orthophosphates or total phosphates. The presence of considerable amounts of phosphates suggests pollution from sewage and industrial wastes.

Comparative performance evaluation of STP's in respect of PO_4

Table-1

PO_4			STP BNB OLD	STP NISHAT	STP BNB NEW
OCTOBER	06/10/2021	RAW	1.920	1.199	2.029
		AERATED	1.702	0.809	1.023
		FINAL	1.287	0.707	0.625
	21/10/2021	RAW	1.640	1.104	2.150
		AERATED	1.453	0.756	1.083
		FINAL	1.099	0.661	0.641

Table-2

PO_4			STP BNB OLD	STP NISHAT	STP BNB NEW
NOVEMBER	06/11/2021	RAW	1.553	1.256	1.406
		AERATED	1.505	0.649	0.419
		FINAL	1.240	0.535	0.363
	21/11/2021	RAW	1.805	1.195	1.549
		AERATED	1.598	0.817	0.780
		FINAL	1.207	0.713	0.475

Table-3

PO_4			STP BNB OLD	STP NISHAT	STP BNB NEW
DECEMBER	06/12/2021	RAW	2.074	1.505	2.020
		AERATED	1.790	0.531	0.367
		FINAL	1.756	0.502	0.289
	21/12/2021	RAW	2.134	1.611	2.102
		AERATED	1.629	0.623	0.396
		FINAL	1.50	0.590	0.310

III. Ammonical Nitrogen (NH_3-N)

Ammonia, a harmful contaminant commonly found in landfill leachate and waste products such as sewage, liquid manure, and other liquid organic waste products, is measured in Ammonical nitrogen (NH3-N). It can also be used to assess the condition of water in natural bodies like rivers and lakes, as well as man-made reservoirs. Ammonia can cause direct poisoning in humans and disrupt the balance of water systems.

Comparative performance evaluation of STP's in respect of NH_3-N

Table-1

NH_3N			STP BNB OLD	STP NISHAT	STP BNB NEW
OCT	06/1	RAW	9.400	9.629	8.102

		AERATED	9.27	8.934	3.762
		FINAL	8.512	8.862	2.081
	21/10/2021	RAW	8.810	9.315	8.405
		AERATED	8.695	8.645	3.900
		FINAL	7.877	8.574	2.157

Table-2

NH_3N			STP BNB OLD	STP NISHAT	STP BNB NEW
NOVEMBER	06/11/2021	RAW	7.589	7.401	7.939
		AERATED	7.49	6.180	3.684
		FINAL	6.786	6.911	2.038
	21/11/2021	RAW	9.041	7.652	8.550
		AERATED	8.910	7.099	3.967
		FINAL	8.790	7.041	2.192

Table-3

NH_3N			STP BNB OLD	STP NISHAT	STP BNB NEW
DECEMBER	06/12/2021	RAW	10.179	9.061	9.124
		AERATED	8.849	7.595	3.440
		FINAL	7.950	7.542	2.017
	21/12/2021	RAW	10.296	9.126	9.632
		AERATED	8.932	7.782	3.522
		FINAL	7.991	7.710	2.312

IV. Chemical Oxygen Demand (COD):

The oxygen demand equivalent of organic matter that is prone to oxidation is determined using a powerful chemical oxidant in a chemical oxygen demand test. It's a method of determining the organic strength of streams and polluted bodies of water.

Comparative performance evaluation of STP's in respect of COD

Table-1

COD			STP BNB OLD	STP NISHAT	STP BNB NEW
OCTOBER	06/10/2021	RAW	368.1	305	285.11
		AERATED	248.5	200.69	207.61
		FINAL	139.2	85	71.9
	21/10/2021	RAW	280	245	253
		AERATED	189	161.21	184.2
		FINAL	80	100	93

Table-2

COD			STP BNB OLD	STP NISHAT	STP BNB NEW
NOVEMBER	06/11/2021	RAW	243.9	390.2	250
		AERATED	121.9	146.3	120
		FINAL	105.7	56.9	81.3
	21/11/2021	RAW	349.5	284.5	268.2
		AERATED	235.77	186.99	195.1
		FINAL	170.73	73.17	73.1

Table-3

COD			STP BNB OLD	STP NISHAT	STP BNB NEW
DECEMBER	06/12/2021	RAW	302	354	280
		AERATED	244	160	125
		FINAL	185	105	52

	21/12/2021	RAW	329	360.8	286.6
		AERATED	346	166.4	131.5
		FINAL	189	109.6	61.7

IV. Bio-Chemical Oxygen Demand (BOD):

It is an empirically validated laboratory test that determines the amount of oxygen required for aerobic oxidation of decomposable organic matter and certain inorganic compounds in water and wastewater under regulated temperature and incubation conditions. A measure of the test is the amount of oxygen required for the aforesaid oxidation process. It is used for finding out the level of pollution, assimilative capacity of water body and also the performance of waste treatment plants**.**

Comparative performance evaluation of STP's in respect of BOD

Table-1

BOD			STP BNB OLD	STP NISHAT	STP BNB NEW
OCTOBER	06/10/2021	RAW	100.2	89.5	84
		AERATED	54.02	42.11	39.78
		FINAL	48.2	27.2	17.2
	21/10/2021	RAW	100	90	97
		AERATED	53.92	42.35	45.94
		FINAL	38	22	13.3

Table-2

BOD			STP BNB OLD	STP NISHAT	STP BNB NEW
NOVEMBER	06/11/2021	RAW	112.4	152.4	80
		AERATED	36.4	36.4	30
		FINAL	26.4	13.4	17
	21/11/2021	RAW	102	85	95
		AERATED	55	40	45
		FINAL	38	19.2	17

Table-3

BOD			STP BNB OLD	STP NISHAT	STP BNB NEW
DECEMBER	06/12/2021	RAW	106	106	90
		AERATED	61	40	40
		FINAL	45	23.1	12
	21/12/2021	RAW	109	108.24	91.7
		AERATED	61.5	41.6	42.08
		FINAL	45.4	24.2	14.19

3. RESULTS AND OBSERVATIONS

1. pH

In all STPs, the pH increased slightly from raw to final effluent, which could be owing to lower free CO_2 levels in the final effluent and the addition of poly-aluminium chloride. The pH range observed at all test sites is within the acceptable range, i.e., 6 to 9, for wastewater discharge into a water body. Our findings are consistent with those of reference [24], who discovered an increase in pH level during the treatment process.

2. Ortho phosphate

Phosphorus, in the form of various forms of phosphates, can be found in natural waterways and wastewater. Orthophosphates, polyphosphates in soluble form, are found in municipal sewage, either in detritus particles or in the bodies of aquatic creatures. Laundry, other cleaning, fertilisers, bodily wastes, and food residues are all major sources of phosphates, which must be removed from wastewater on a regular basis in order for it to be discharged into bodies of water. Polyphosphates are hydrolysed and return to orthophosphate forms in most cases. Because phosphorus is an important plant nutrient and can operate as a limiting factor among all other critical plant nutrients, it is valuable in determining water quality [12]. The orthophosphate concentration fell from influent 1.760 mg/l to effluent 1.285 mg/l in the Brari-Nambal Old STP, from 1.311 mg/l to 0.618 mg/l in the Nishat Laam STP, and from 1.876 mg/l to 0.4505 mg/l in the Brari-Nambal New STP, according to the current study.

The following methods are used to remove ortho-phosphate from wastewater:

a) Phosphate incorporation into TSS and subsequent removal from these particles.

b) Chemical precipitation using poly-aluminium chloride. Poly-aluminium chloride is a pre-polymerized coagulant with 7 positive ions that causes phosphate ions to adsorb.

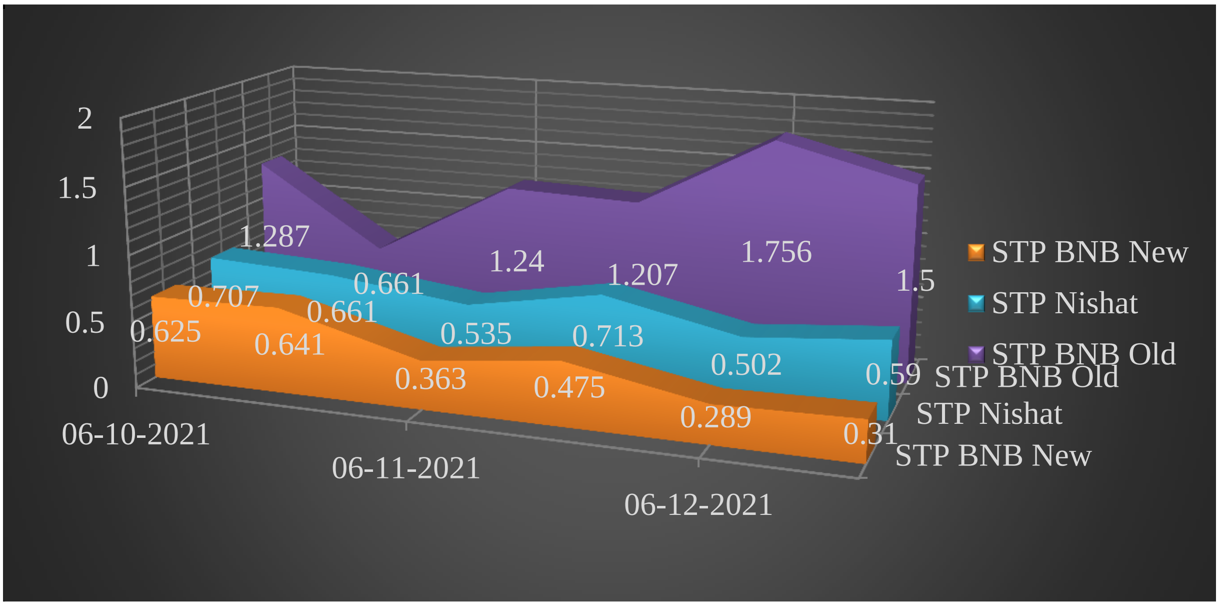

Chart -1: Comparison of PO_4 concentration in final effluents of STP's

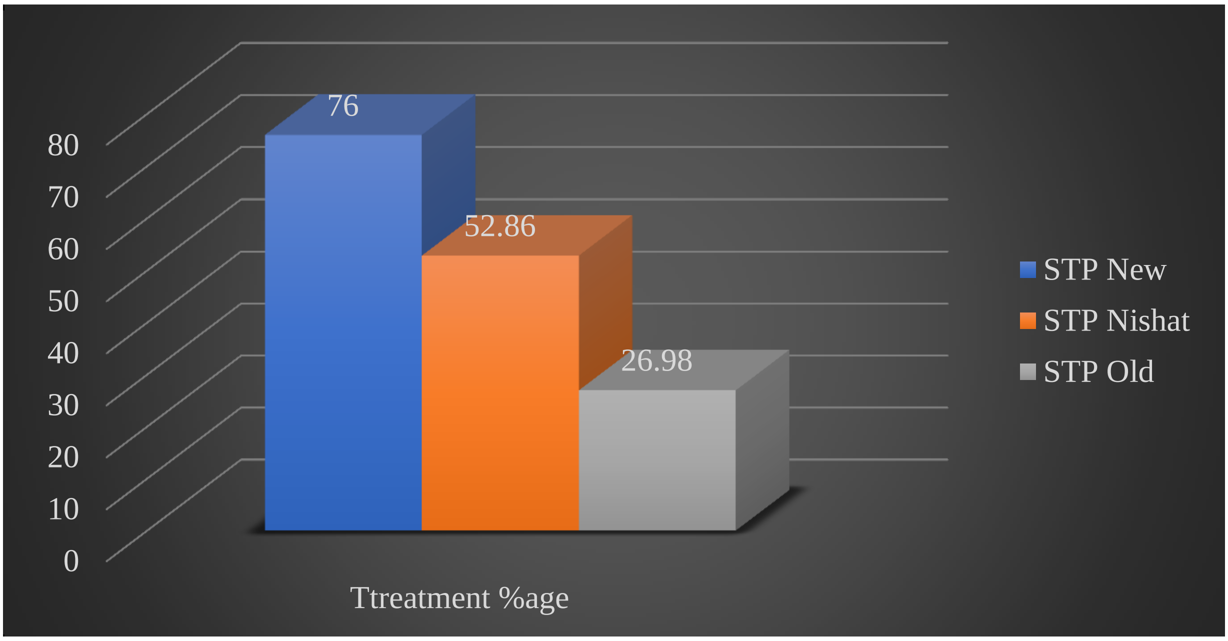

Chart- 2: Showing treatment percentage of PO_4

3. Ammonical Nitrogen

The level of nitrogen in sewage water is measured by Ammonical-Nitrogen. Because ammonia is the most important plant nutrient, it influences the nutrient load and pollution level in a water body. Microbial decomposition of organic nitrogenous materials produces it. The results of this study demonstrate that the mean value of ammonia nitrogen decreases from 9.219 mg/l influent to 7.98 mg/l effluent in Brari-Nambal Old STP, from 8.697 mg/l to 7.77 mg/l in Nishat Laam STP, and from 8.635 mg/l to 2.13 mg/l in Brari-Nambal New STP.

This significant reduction in sewage volume from intake to exit in the case of SBR technology could be due to the increased rate of nitrification produced by microorganisms, which results in the conversion of NH3-N to NO3-N [10]. Another probable factor is a temperature increase from intake to output, which reduces NH3-N content and boosts nitrification rate by creating a favourable environment for microorganisms to thrive [31].

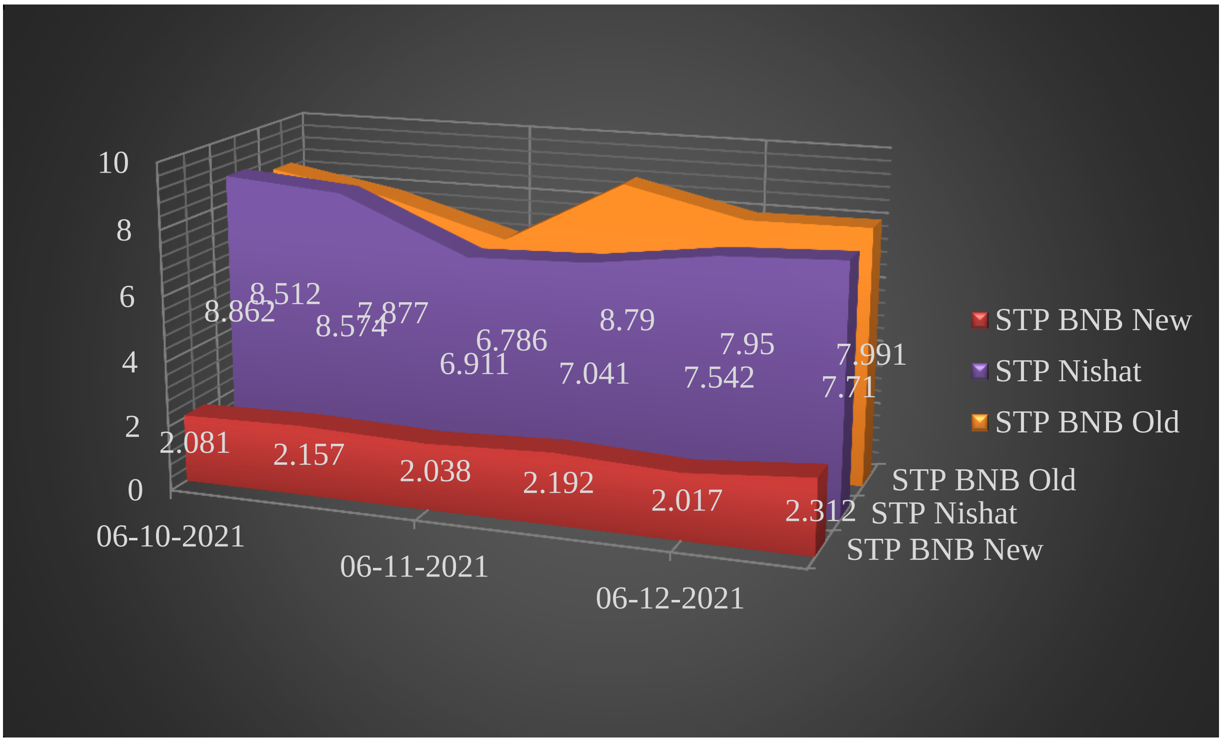

Chart-3: Comparison of NH_3N concentration in final effluents of STP's

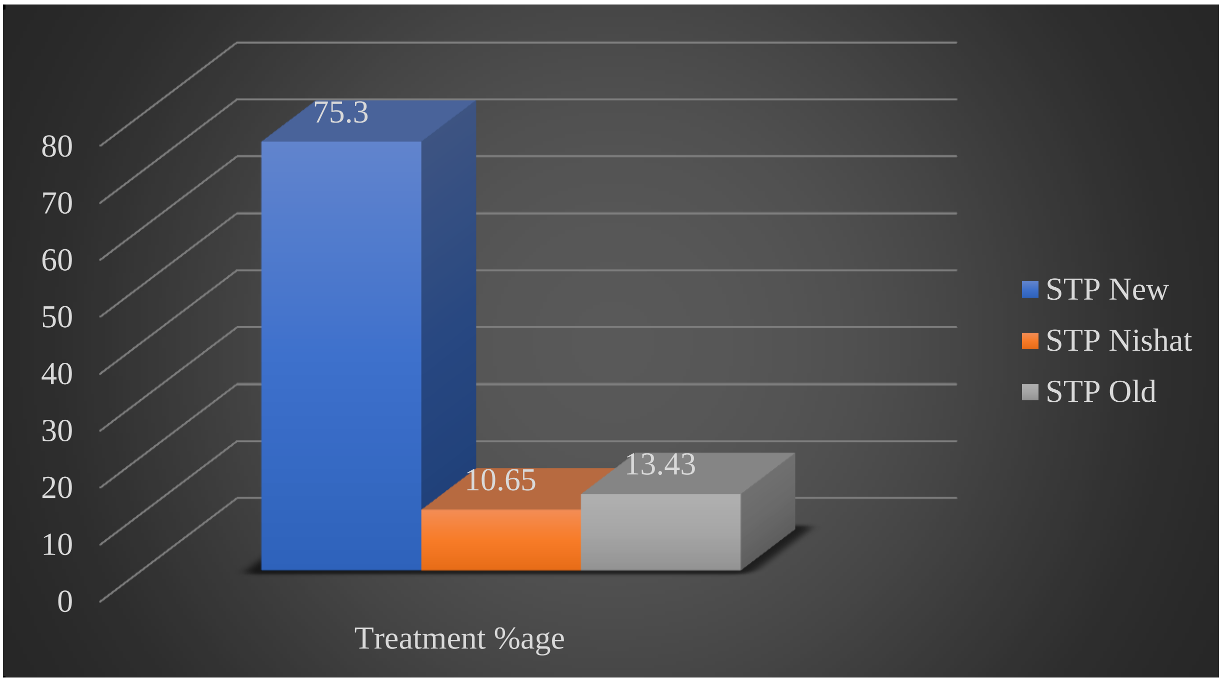

Chart-4: Showing treatment percentage of NH_3

4. Chemical Oxygen demand (COD)

Chemical oxygen demand is a metric for the amount of oxygen required by organic matter that can be oxidized with the help of a powerful chemical oxidant. It's a technique for determining the organic strength of wastewater. The mean value of COD dropped from influent 312 mg/l to effluent 144.9 mg/l in ASP based STP, from 323.25 mg/l to 88.27 mg/l in FAB based STP, and from 270.48 mg/l to 72.16 mg/l in SBR based STP, according to the current study.

The decrease in COD from intake to exit is due to a reduction in organic matter digested by bacteria, primarily during the aeration, coagulation, and flocculation processes that occur in treatment plant settling chambers.

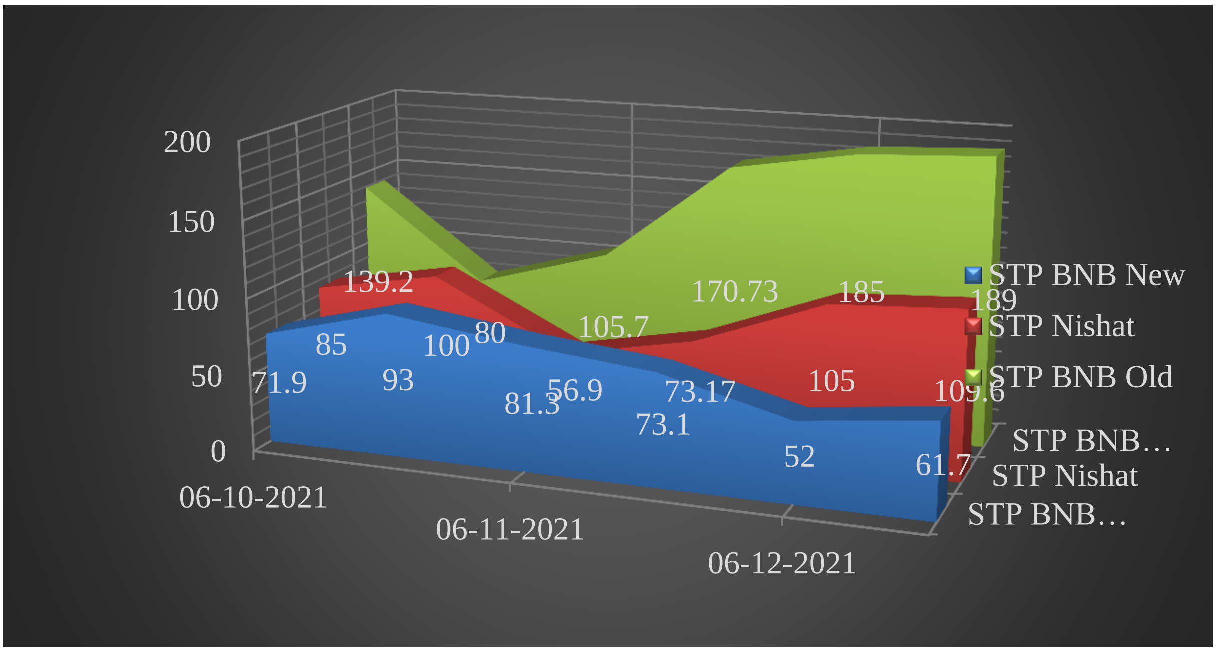

Chart-5: Comparison of COD concentration in final effluents of STP's

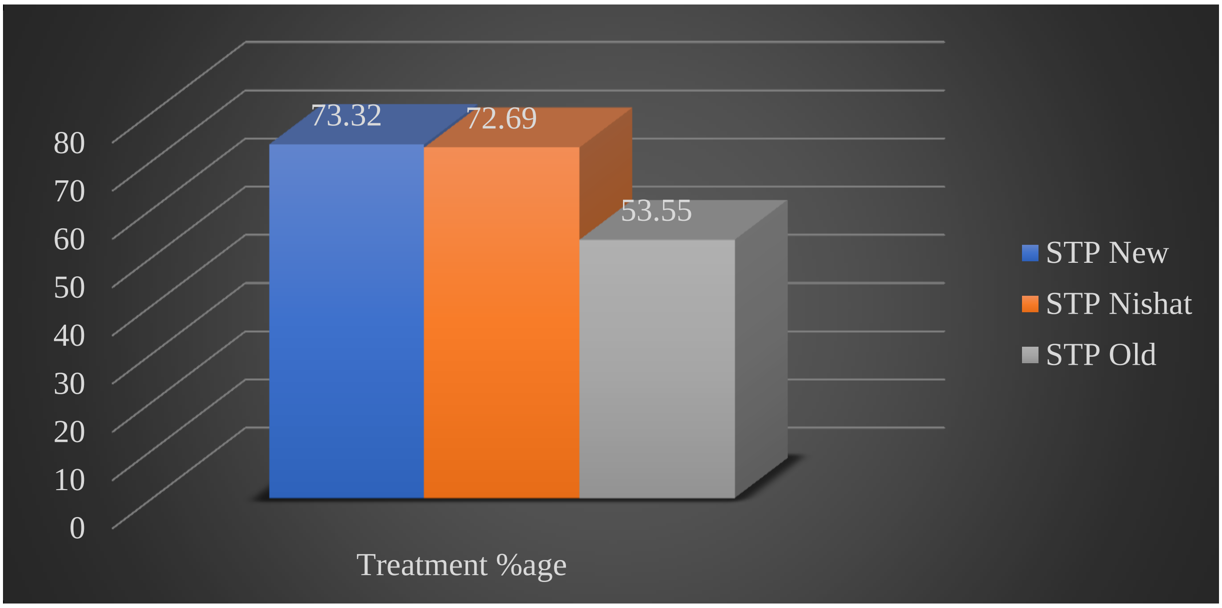

Chart-6: Showing treatment percentage of COD

5. Bio- Chemical Oxygen demand (BOD)

The amount of oxygen needed by the bacteria in the aerobic oxidation of organic materials is measured by Bio-Chemical Oxygen demand. The mean value of BOD dropped from influent 104.9 mg/l to effluent 40.167 mg/l in ASP based STP, from 105.19 mg/l to 21.5 mg/l in FAB based STP, and from 89.6 mg/l to 15.24 mg/l in SBR based STP, according to the current study.

Mechanical aeration and aerobic digestion are to blame for the decline. During the investigation, it was also discovered that, due to low water temperature and reduced microbial activity, the efficacy of reducing BOD 5 levels was reduced during winter conditions. These findings are consistent with references [32,33]. The oxidation of organic waste by microorganisms in aeration tanks may be responsible for the reduction in BOD in all STPs during the treatment process.

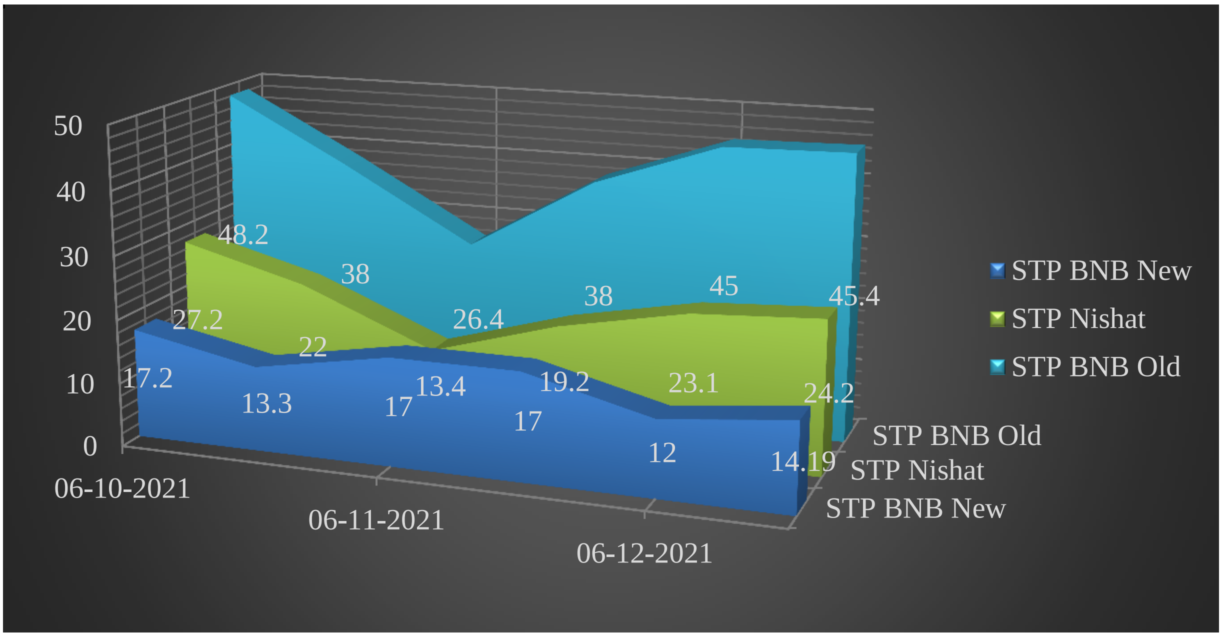

Chart-7: Comparison of BOD concentration in final effluents of STP's

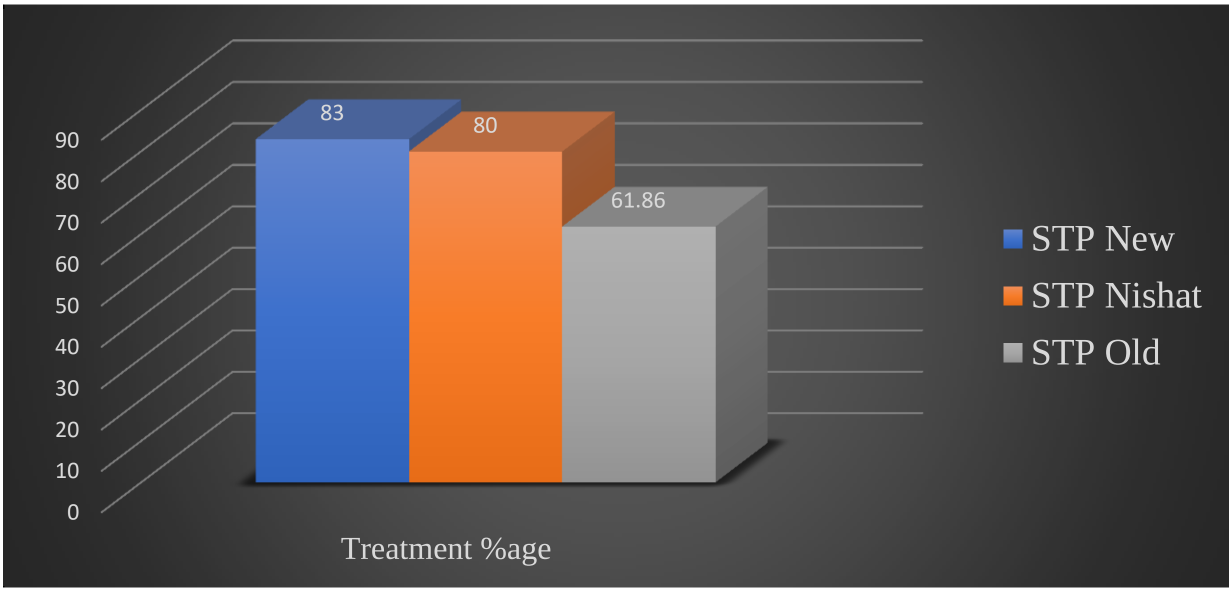

Chart-8: Showing treatment percentage of BOD

4. CONCLUSIONS

Over the course of four months, the performance of various sewage treatment plants was assessed. pH, Orthophosphate, Ammonical nitrogen, COD, and BOD were among the parameters that were measured. After every 15 days, the removal efficiencies in terms of the above-mentioned criteria for each of the treatment plants were studied and determined.

For every parameter in the current investigation, the removal efficiency changes in the order of SBR>FAB>ASP, with the exception of pH, which increases in every STP regardless of the method used.

In the case of SBR, FAB, and ASP STP's, Ortho-phosphate treatment percentages are 76 percent, 52.86 percent, and 26.98 percent, respectively, whereas Ammonical nitrogen treatment percentages are 75.3 percent, 10.65 percent, and 13.43 percent. As can be seen, SBR treatment percentages are substantially higher than those of FAB and ASP treatment plants, with COD and BOD treatment percentages of 73.32 percent, 72.69 percent, 53.55 percent, and 83 percent, 80 percent, and 61.86 percent, respectively, in the order of SBR> FAB> ASP.

In comparison to the other two treatment plants, the Brari-Nambal New Sewage Treatment Plant clearly demonstrates its potential and effectiveness in reducing excessive nutrient loads. As a result, due to its numerous benefits, more emphasis should be placed on SBR-based sewage treatment plants. Furthermore, for better results and to increase the operating competence of these STPs, regular monitoring of each STP should be made possible.

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