Performance evaluation of Municipal wastewater treatment plants in Bangalore

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ABSTRACT

India is confronted with a slew of water and wastewater concerns, as well as water-related health risks. Almost 80% of the water used for domestic purposes is returned as wastewater. Untreated wastewater is usually released, which either sinks into the earth as a possible pollutant of ground water or is dumped into the natural drainage system, polluting downstream areas. In most places, sewage treatment plants (STPs) have been built to reduce the total pollutant load on receiving water bodies, hence lowering the degradation of water quality. When poorly treated wastewater with significant levels of contaminants is discharged to surface water or on land, it causes serious environmental problems due to inadequate design, operation, or maintenance of treatment systems. The purpose of this study is to assess the performance efficiency of a waste water treatment facility, namely a sewage treatment plant. The primary water quality indicators, such as Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Suspended Solids (TSS), were measured in waste water samples collected at various phases of treatment units (TSS), Oil grease, Total Settleable Solids (TSS), Total Dissolved Solids (TDS), Nutrients (N&P), and Total Settleable Solids (TSS). Each unit's performance effectiveness in removing pollutants was assessed. The plant's overall performance has also been estimated. The collected data were extremely helpful in identifying and correcting operating and maintenance issues, as well as the plant's future expansion to accommodate greater hydraulic and organic loadings

Keyword: - *Waste water, sewage treatment plant, COD, BOD, TDS, and TSS*

1.0 Introduction

Water is one of the most valuable commodities on the planet. The usage of water has expanded dramatically as a result of population growth and industrialization. The availability of water, on the other hand, is restricted. Approximately 80% of the water used is turned to sewage. Traditionally, natural water bodies, land, and coastal areas have been used to dispose of created sewage. These sources of water are frequently used as a source of drinking water. Because sewage is high in nutrients, it promotes algae development in the water bodies where it is discharged, lowering water quality. We're heading for a "water shock" that could exceed any oil catastrophe, since for the first time in human history, more water is being pulled out over the planet than Nature is able to replenish. Water is used to dissolve waste materials such as excrement, food scraps, oils, soaps, chemicals, and household wastes. Corporations and In addition to storm runoff, businesses contribute their share of spent water/waste waters. Contaminated with dangerous compounds as a result of fleeing from roadways, parking lots, and rooftops, which could impair our H2O systems, however, Although nature has an exceptional ability to deal with limited amounts of toxins, there is a need to clean the billion gallons of garbage and waste material generated daily by homes, factories, and corporate institutions before returning it to the environment. One such alternative is wastewater or sewage treatment, in which several procedures are planned and run to replicate natural treatment processes in order to lower pollution load to a level that nature can tolerate. For this project, a complete study of the entering wastewater as well as a performance evaluation were conducted for Cubbon Park, vrishabhavathi valley, Mailasandra treatment plant. The goal of wastewater treatment is to eliminate contaminants while also protecting and preserving the natural water bodies that already exist.

Objectives

1. To study existing system of unit operation and process of municipal wastewater treatment plant.
2. Characterization of wastewater of each Unit operation process of each treatment plant
3. Performance evaluation of municipal wastewater treatment plant.

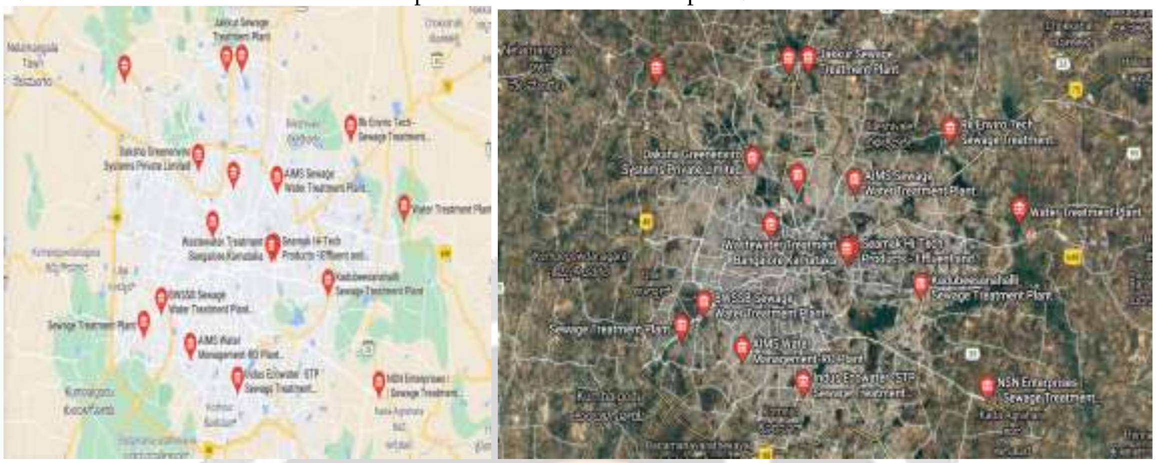


Fig 1: Map of Various Sewage Treatment Plants In Bangalore

2.0 Literature Review.

Colmenarejo, M.F. et.al (2006). The research involves a performance examination of waste treatment plants in three separate districts in West Bengal, India (Kolkata, Howra, and Hugli). Despite the fact that total and filthy coliform removal potencies were high (85-98 percent), none of the plants met coliform discharge requirements due to high entering Total Coliform and filthy Coliform levels. A large amount of discharge water is flowing onto agricultural areas as a result of the large amount of discharge water. To measure and link effects on soil, possible groundwater contamination, and food quality features, impact evaluations must be distributed.

Tulip,et.al(2006): Because water scarcity is a concern all over the world, wastewater must be cleansed and reused in accordance with its impacted condition. Because companies use such a large amount of water, waste water treatment requires specific care. Because a large volume of water is utilised, H2O cannot be used, so the used water must be treated for the laundry and cooling functions.

Hamidu Hassanet.al (2008). : Pumping check information for the eighteen boreholes tested was acquired from the Kaduna state ministry of water resources' agricultural facility unit. Boreholes were dug. Carling Earth Resources provided training in 2009 under the MDGs (millennium development gold) initiative. African countries are prohibited. This research was conducted in Kaduna, Nigeria. Taking a look at information from There were a total of eighteen boreholes used. The geological formation was put to the test for periods ranging from sixty to one hundred and eighty minutes, depending on how long it took for the individual well to attain equilibrium. On a semi-log graph sheet, the pumping part knowledge was plotted against the appropriate time, and a line was drawn through the sector knowledge points. The slope of the graph as s was used to calculate the values of the drawdown per log cycle of your time. The use of cutting-edge technology and scientific methods such as groundwater modelling can aid in providing a clear picture of the submerged and a better knowledge of the realm's groundwater resources.

Ravi Kumar,P,et.al(2010).: In the Mailasandra and Nagasandra biodegradable pollution Treatment plants, the percentage reduction in TDS is twenty-one percent and twenty-eight percent, respectively, (recommended 70-80 percent), indicating low efficacy in terms of TDS removal.
In Mailasandra biodegradable pollution Treatment plants, the general potency is within the order TDS COD syndrome physique, but in Nagasandra biodegradable pollution Treatment plants, it is TDS COD physique syndrome. In each case, the performance of the aeration tank and secondary clarifier was practically perfect.

Kavita, N. ChoksiP, Rajasulochanaet.al (2015): For performance analysis, a waste water treatment plant with the Activated Sludge method as a biological treatment technology has been considered. The removal potency as per the sample tested in the laboratory and s.t.p. (of shape and TSS) have been determined. So, after checking the facts with SMC and having a sample checked in the lab, the plant appears to be in good working order.

P, Rajasulochana et.al (2016). : It should be mentioned that the new wastewater treatment solutions are owing to microalgae, and that they are vulnerable to being effective in lowering hazardous components. It has been discovered that standard approaches are ineffective in eliminating nephrotoxic, severe metals, nitrogen, phosphoric, and other contaminants.

G.D.Mali et.al (2020). : In this paper where the waste water system adopted Because of its ease of operation, better human body and toxic shock removal efficiencies, and nutrient removal efficiencies, the modified activated sludge method (ASP), particularly the sequencing batch reactor (SBR) technology, is thought to be the best treatment technology for domestic biodegradable pollution.

Kumar Chetan ET. al(2020).: in this paper where the Monthly samples of waste water from the treatment plant were collected, analyzed, and compared, and trends suggest a decrease in pH scale, TSS, BOD, COD, and an increase in DO level.

3.0 Study Area:

Bangalore now generates 1400 MLD wastewater, according to BWSSB's cautious projections. The city has a total treatment capacity of 721 MLD, although on average, only 520 MLD is treated. Here's a map of the BWSSB/existing BBMP's and prospective STPs in Bangalore. The majority of Bangalore's wastewater is discharged into the environment untreated. Many farmers use this water for irrigation since it is a more consistent source of water, especially during droughts. Domestic wastewater, whether untreated or partially treated, is a source of nutrients. Bangalore's wastewater, on the other hand, contains industrial effluents, therefore its use for irrigation, while potentially beneficial, is not recommended. The health and environmental dangers of using wastewater in irrigation are now largely unregulated; nevertheless, if these risks are handled, irrigation can ensure water and nutrient reuse. Wastewater reuse is a key component of the solution to Bangalore's water crisis. We can do a lot more if individual houses and smaller apartments treat their own sewage. STPs will be better maintained and the quality of treated water released into the environment will improve with the use of appropriate technologies.

Fig 2: Map

3.1 Cubbon park

Fig3 : Sewage Treatment Plant Cubbon Park located in Bangalore.

The Cubbon Park treatment facility, which has a 1.5 MLD capacity and uses MBR (Membrane Bioreactor) technology in combination with aeration technology, was built in 2004/2005 at a cost of around Rs 4 crore and has a footprint of 0.8 acres on a 2 acre plot. The plan was to collect 1.5 million gallons of sewage from a nearby drain and utilise the purified water for park planting. This was accomplished by releasing clean water with a BOD of less than 2 on a regular basis.

Fig4: The Cubbon Park treatment

3.2 Vrishabhavathi valley

Fig5: Vrishabhavathi Valley Wastewater Treatment Plant located in West Bangalore.

The treatment plant has 33.2 acres of undeveloped land that could be used for expansion. In order to retain the plant's existing capacity during the construction phase, this project must be timed and coordinated in such a way that it does not interfere with any of the plant's existing treatment operations. Because the plant is located beside the river, levees will be required. Because the facility is located along the river, levees will be needed to protect it from any flooding that may occur during the seasonal monsoons.

Fig6: Vrishabhavathi Valley Wastewater Treatment Plant trickling Filter.

3.3 Mailasandra treatment plant.

Fig7: Mailasandra Waste Treatment located in Bangalore.

After the Karnataka forest government failed to preserve Mylasandra Lake in Bengaluru, residents of Mylasandra and Rajarajeshwarinagar banded together to combat unlawful sewage waste disposal. Mailasandra waste treatment has a capacity of 75MLD,and capital cost 5200, in such a waste treatment plant they are using Extended Aeration Process.

Fig 8: Mailasandra Waste Treatment

4.0 Methods and Methodology

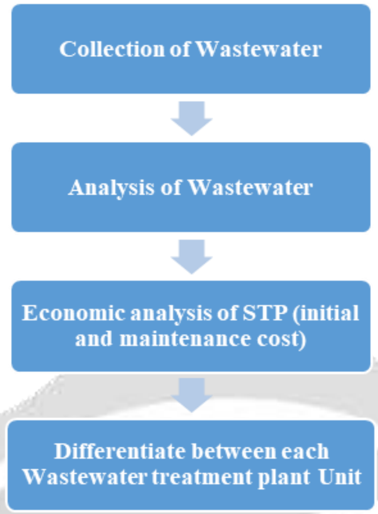


Fig 9: flow chart

Visited three different treatment plant such has, Cubbon Park, Vrishabhavathi valley, Mailasandra Sewage Treatment Plant. The samples were collected in a clean plastic bottle and it's been collected in the month of March. The samples were brought to the laboratory and tested for various parameters such has Biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), proportion of hydrogen (pH), Electrical Conductivity and turbidity are all significant characteristics to examine. The efficiency of the treatment plant has been determined using the following factors, and the predicted outcome is the efficiency of the treatment plant. As a result, a precautionary action against untreated water can be taken. The Economic analysis of STP of their initial and maintenance cost of the three different treatment plant was studied in detail, and at last we have done the comparison between the each waste water treatment plant for their cost, maintenance, and for the chemical characteristics.

Fig 10: Collection of the sample

4.1 Average Characteristics of Influent and Effluent of all the Parameters of 3 STP's in the month of April was done.

1. COD
2. pH
3. Electrical conducitivity
4. Chloride
5. TSS
6. TDS
7. Turbidity
8. BOD

1. TSS
2. TDS
3. COD
4. BOD

4.3 **Analysis of waste water done for:**

1. COD
2. pH
3. Electrical conductivity
4. Chloride
5. TSS
6. TDS
7. Turbidity
8. BOD

4.2 Overall Performance or Removal/Reduction Efficiency of all the 3 STP's Done for

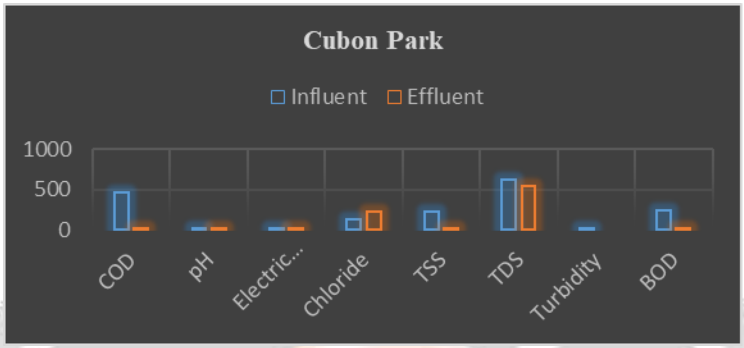
5.0 Result and Discussion.

5.1 Average Characteristics of Influent and Effluent of all the 3 STP's in the month of April

Table 1: Cubbon Park Influent and Effluent for various Parameters

Parameters	Cubbon park	
	Influent	Effluent
COD	465mg/l	16.89mg/l
pH	6.65	7.18
Electrical conducitivity	0.965mM/s	1.323mM/s
Chloride	121.99mg/l	225.99mg/l
TSS	226mg/l	0.55mg/l
TDS	627.25mg/l	550mg/l

Turbidity	16.6NTU	0NTU
BOD	235mgl	2.04mg/l

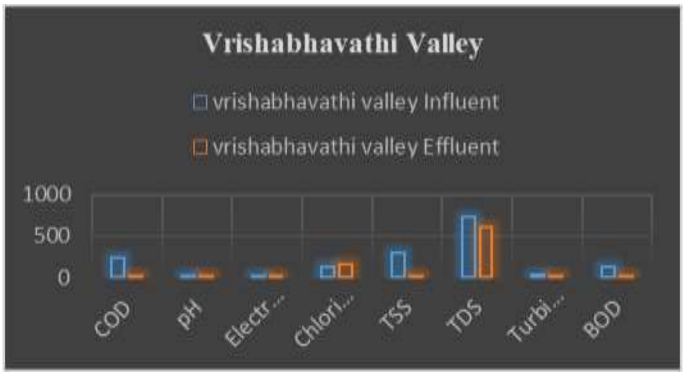


Graph 1: Cubbon Park Influent and Effluent for various Parameters.

The Graph Represents the various Influents and Influents of the various parameters such has, COD,pH, Electrical Conductivity, Chlorides, TSS, TDS, Turbidity, BOD of Cubbon Park Treatment Plant

Table: 2Vrishabhavathi Valley Influent and Effluent for various Parameters

	vrishabhavathi valley	
parameters	Influent	Effluent
COD	240	22.89
pH	7.54	7.3
Electrical conducitivity	1.113	1.016
Chloride	125.99	157.99
TSS	300	4.03
TDS	723.45	600
Turbidity	27.3	2.4
BOD	120	1.85

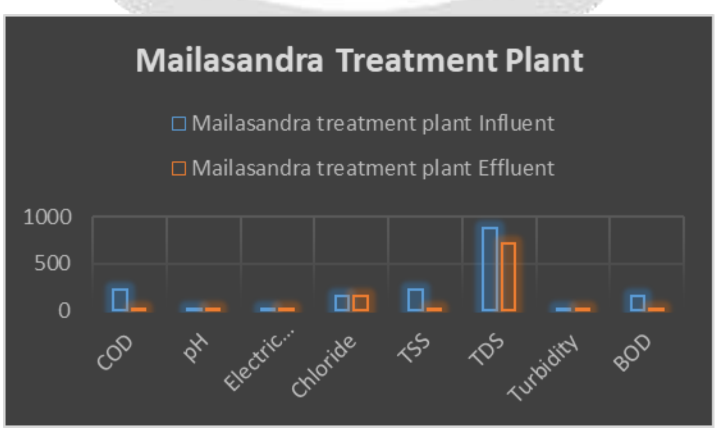


Graph 2: Vrishabhavathi Influent and Effluent for various Parameters

The Graph Represents the various Influents and Influents of the various parameters such has, COD,pH, Electrical Conductivity, Chlorides, TSS, TDS, Turbidity, BOD of Vrishabhavathi Valley

Table 3: Mailasandra Treatment Plant Influent and Effluent for various Parameters

	Mailasandra treatment plant	
Parameters	Influent	Effluent
COD	220	20.18
pH	7.31	8.1
Electrical conducitivity	1.352	1.217
Chloride	153.99	161.99
TSS	220	5.67
TDS	878.8	720
Turbidity	25.9	1
BOD	154	4.42



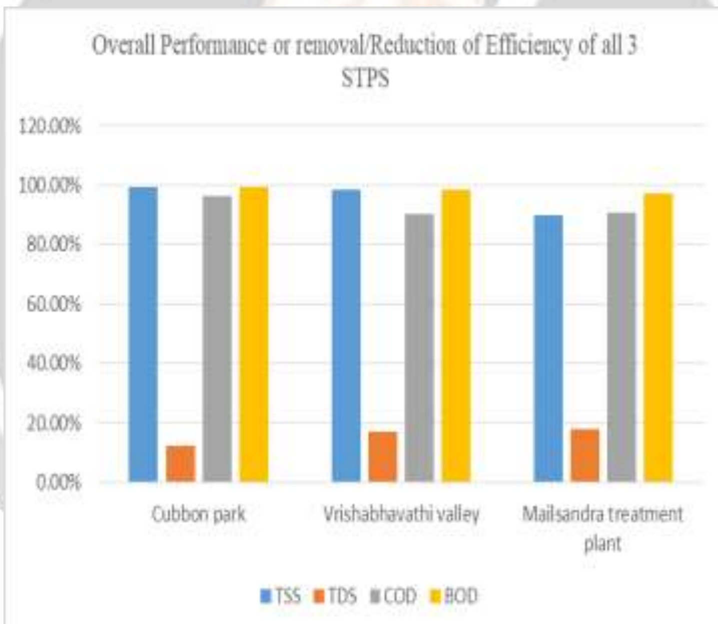
Graph 3: Mailasandra Treatment Plant Influent and Effluent for various Parameters.

The Graph Represents the various Influents and Influents of the various parameters such has, COD,pH, Electrical Conductivity, Chlorides, TSS, TDS, Turbidity, BOD of Mailasandra Treatment Plant

5.2 Overall Performance or Removal/Reduction Efficiency of all the 3 STP's

Table 4: Removal/ Reduction Efficiency of 3 STP's

Removal/reduction efficiency	Cubbon park	Vrishabhavathi valley	Mailsandra treatment plant
TSS	99.45%	98.65%	90%
TDS	12.31%	17%	18%
COD	96.36%	90.46%	90.84%
BOD	99.13%	98.45%	97.05%



Graph 4: Removal/ Reduction Efficiency of 3 STP's.

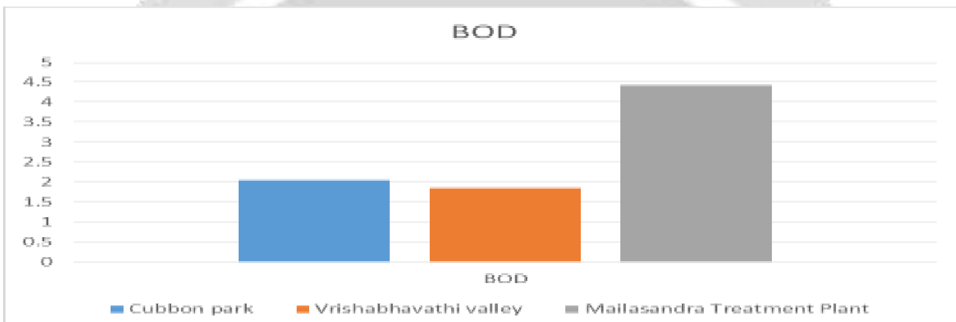
The graph represents the removal/ Reduction of Efficiency of all the treatment plant such has Cubbon Park, Vrishabhavathi Valley and Mailasandra Treatment Plant.

5.3 Comparison of 3 STP's, Average Effluent With the CPCB effluent Discharge Standards into Land for Irrigation

1.0 BOD

Table5 5: Average Effluents of BOD

parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigation
BOD(mg/l)	2.04	1.85	4.42	Lower than permissible limit(100)



Graph 5: Average Effluents Bod parameter

The BOD of the Mailasandra Treatment Plant has a higher value compared to the remaining two treatment plant.

2.0 COD

Table 6: Average Effluents of COD Parameter

parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigation
COD(mg/l)	16.89	22.89	20.18	Lower than permissible limit(250)

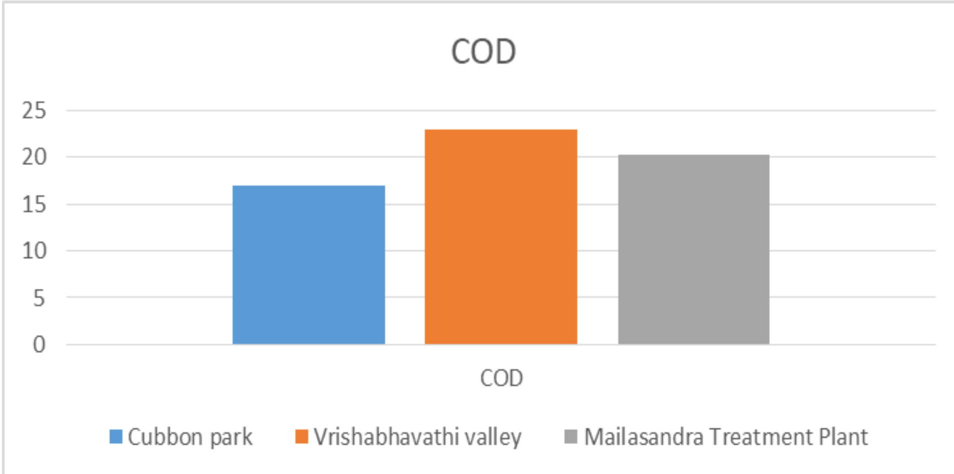


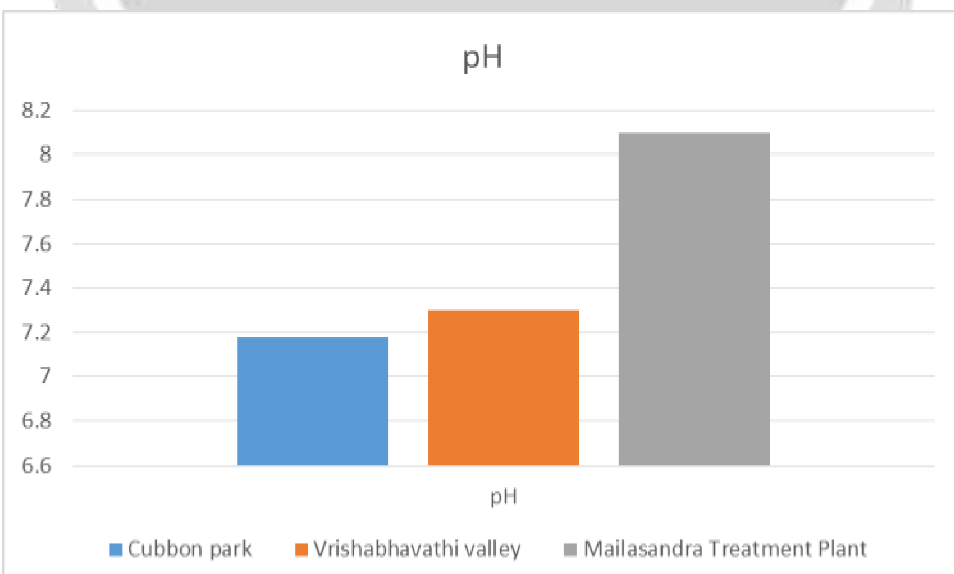
Table 6: Average Effluents of COD Parameter

COD of the Vrishabhavathi Valley has a higher value than cubbon park and Mailasandra Treatment Plant.

3.0 pH

Table 7: Average Effluents of Ph Parameter

parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigation
pH	7.18	7.3	8.1	Lower than permissible limit



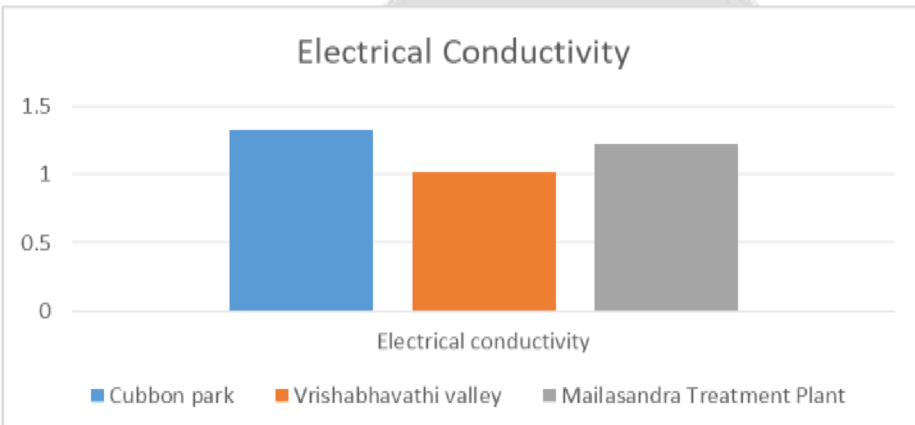
Graph 7: Average Effluents of Ph. Parameter

Ph of the Mailasandra Treatment Plant have a higher value than the cubbon park and vrishabhavathi valley

4.0 Electrical Conductivity.

Table 8: Average Effluents of Electrical Conductivity Parameter

parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigation
Electrical conductivity(mM/s)	1.323	1.016	1.217	Lower than permissible limit



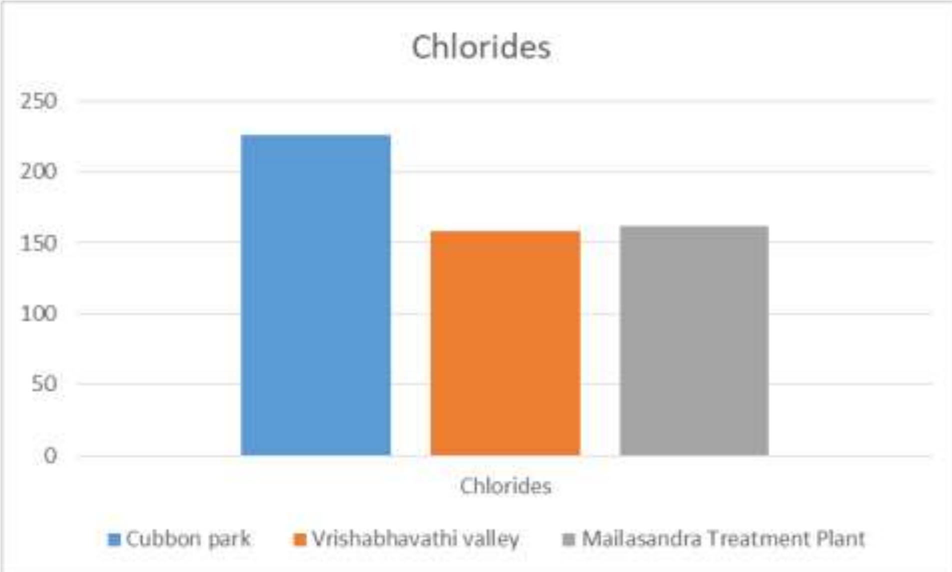
Graph 8: Average Effluents of Electrical Conductivity Parameter

Electrical Conductivity of Cubbon park has a higher value when compared with Vrishabhavathi valley and Mailasandra Treatment Plant.

5.0 Chlorides

Table9: Average Effluents of Chlorides Parameter

parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigation
Chlorides(mg/l)	225.99	157.99	161.99	Lower than permissible limit



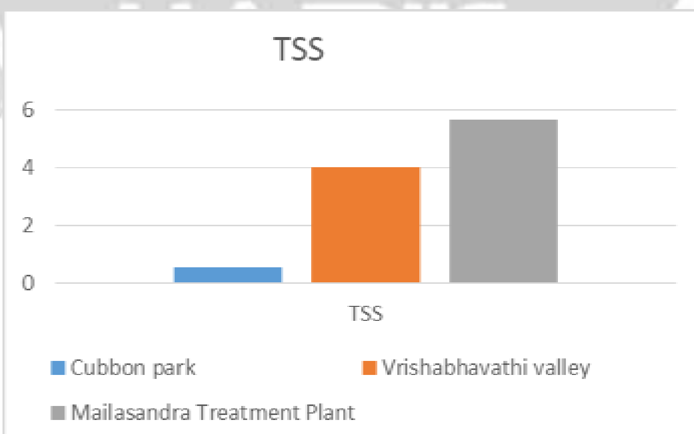
Graph10: Average Effluents of Chlorides Parameter

Cubbon Park has a higher Chloride content compared to others treatment plant

6.0 TSS

Table 11:Average Effluents of TSS Parameter

parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigation
TSS(mg/lt)	0.55	4.03	5.67	Lower than permissible limit



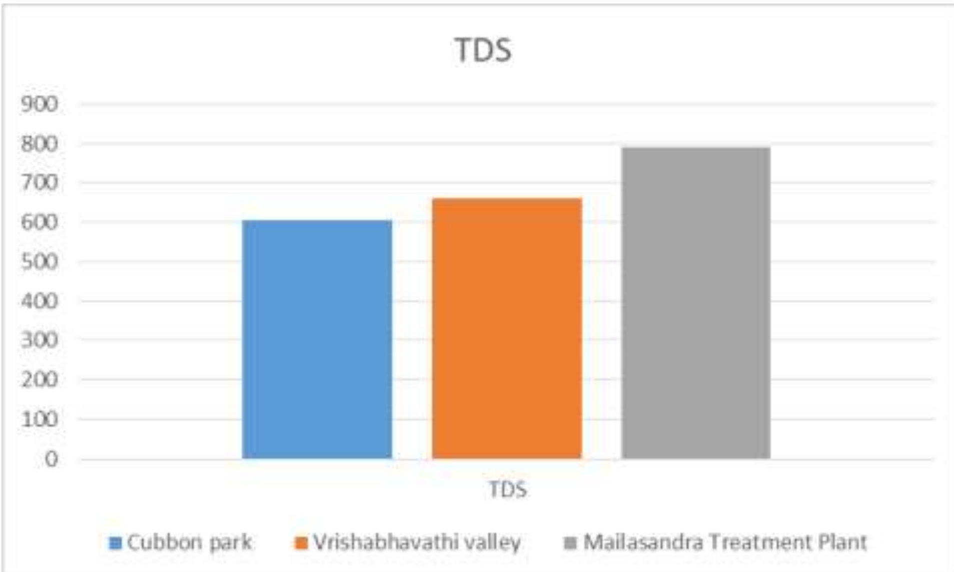
Graph 11: **Average Effluents of TSS Parameter**

Whereas Cubbon has a lower TSS and Vrishabhavathi have a high TSS content.

7.0 TDS

Table12: Average Effluents of TDS Parameter

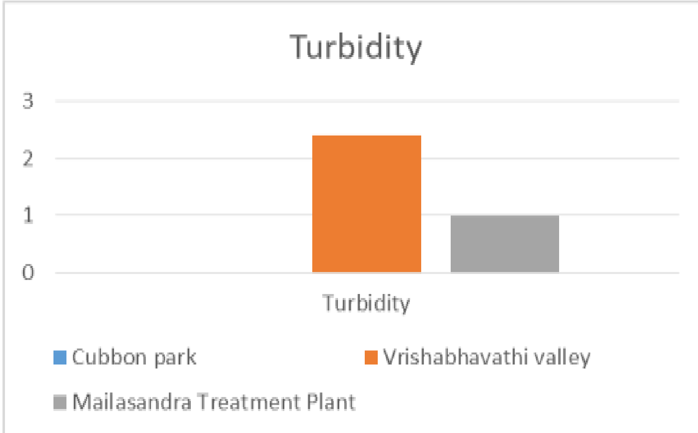
parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigation
TDS(mg/l)	605.95	660.4	791.05	Lower than permissible limit



Graph 12: Average Effluents of TDS Parameter
TDS parameter has a less variation among all the three treatment plants .

8.0 Turbidity
Table13: Average Effluents of Turbidity Parameter

Parameters	Cubbon park	Vrishabhavathi valley	Mailasandra Treatment Plant	Comparison Result With CPCB Effluent Discharge Standards into Land for Irrigati**on**
Turbidity(NTU)	0	2.4	1	Lower than permissible limi



Graph 13: Average Effluents of Turbidity Parameter.

Cubbon has no Turbidity and Vrishabhavathi Valley has a higher Turbidity content compared to Mailasandra Treatment Plant.

5.4 **COMPARISON BETWEEN CUBBON PARK, VRISHABHAVATHI VALLEY AND MAILASANDRA TREATMENT PLANT**

Table 14: comparsion Cubbon Park, Vrishabhavathi Valley and Mailasandra Treatment Plant.

Sr. no	paramaet ers	cubbon park	vrishabhavathi valley	Mailasandra treatment plant
1	Type of process	Membrane bioreactor process	Trickling filter	Extended aeration process
2	Area of STP in Acre	12	50	25
3	Total power cost/ann um, Rs. Lacs	8.4	84	420
4	Capital Cost, Rs. Lacs	280	200(in 1974)	4557(in 2005)
5	Source of sewage	Rajabhavan,vidhanas oudha, Shivajinagar etc	Malleshwaram,kadumallesh waram, Subramanyanagar,gayathrin agar, gandhinagar,subhash nagar etc	Uttarahalli, Kumaraswamy layout,channasandr a,RR nagar,peenya etc
6	Capacity	4mld	180mld	75mld

6.0 Conclusion

1. It is concluded that the efficiency of the existing treatment plants can be increased by proper selection of treatment process, proper control over the treatment process of and adequate operation and timely maintenance of the three treat plants of Cubon Park, vrishabhavathi valley Mailasandra treatment plant treatment facility.

2. Mailasandra Have shown a greater varioation when compared to Cubon Park and Vrishabhavathi Average Effluent With the CPCB effluent Discharge Standards into Land for Irrigation.
3. The modifications of ASP, particularly the SBR technology can be considered as the best treatment technology for domestic sewage due to its simple operation and higher BOD5 and TSS removal efficiencies along with nutrient removal.
4. Mailasandra Treatment Plant have higher Capital Cost, compared to the other treatment palnts.

7.0 References

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