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Analysis of Performance Evaluation and Efficiency of Sewage Treatment Plant of Naini Plant, Allahabad

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Abstract - Allahabad city host Wastewater Treatment Plant (WTP) based on activated sludge process with surface aerator and air diffuser along the side of GANGA River, located in Naini, Allahabad, U.P, India. This plant is constructed and design with an aim to manage wastewater so as to minimize disease-causing organisms, organic matter, solids, nutrients, and other pollutants. It was revealed from the performance study that efficiency of the treatment plant was good enough with respect to removal of total dissolved solids in contrast to the reduction in other parameters like, total suspended solids, BOD and COD. In Naini plant, BOD, COD and TSS removal efficiency of three month were, 87.74, 87.46 and 87.80% respectively. The order of reduction efficiency was COD < BOD < TSS STP. In addition to this, the problem associated with the maintenance and operation of wastewater treatment plants is discussed. The research work presents the results of the evaluation carried out for the efficiency analysis of STP based on activated sludge process with surface aerator and air diffuser located in Allahabad for handling and treating the municipal wastewater.

Keywords - Performance Evaluation, activated sludge process with surface aerator and air diffuser, Total Suspended Solid, Chemical Oxygen Demand, Biochemical oxygen demand.

I. INTRODUCTION

Every community produces both solid and liquid wastes. The liquid portion -wastewater - is essentially the water supply of the community after it has been fouled by a variety of uses. From the standpoint of sources of generation, wastewater may be defined as a combination of the liquid - or water-carried wastes removed from residences, institutions, commercial and industrial establishments together with such groundwater, surface water and storm water as may be present. If untreated wastewater is allowed to accumulate, the decomposition of the organic materials it contains can lead to the production of large quantities of malodorous gases. In addition, untreated wastewater usually contains numerous pathogenic, or disease-causing, microorganisms that dwell in the human intestinal tract or that may be present in certain industrial waste. Wastewater also contains toxic compounds. For these reasons, the immediate and nuisance-free removal of wastewater from it sources of generation, followed by treatment and disposal, is not only desirable but also necessary in an industrialized society. There are several methods of treating the domestic / municipal /industrial wastewater. Certain parameters, which are on higher side in raw wastewater needs to be, reduced according to the pollution control board's norms by giving specific treatment. One of them is to supply the oxygen for removal of BOD i.e. Bio-chemical Oxygen Demand. This is achieved by different methods of Aeration like surface aeration or by diffused aeration etc. The type of Air diffuser use in Naini plant is Complete mix aeration. In this the influent and the returned sludge are mixed and applied at several points along the length and width of the basin. The contents are mixed and the MLSS flow across the tank to the effluent channel. The oxygen demand and organic loading are uniform along entire length of basin. Flow regime in complete mix flow the sludge retention time is about 5-15 day, food to micro-organism ratio is about 0.2-0.6 d^{-1} aerator loading is about 0.8-2.0 kg/m^3d, MLSS is about 3000-6000 mg/l, aeration period is about 3-5 hours, recirculation ratio (Q_r/Q) is 0.25-1.00. Aeration system is coarse bubble is which various nozzles or orifices with check-valve feature; Spurger air escapes from periphery of a flexible disc that may lift over. The transfer efficiency of coarse bubble aeration is 4-8%, the transfer rate is about 0.6-1.2 $kgO_2/kW.h$.

A. Advantages of coarse bubble aeration system are:

1) Non-clogging
2) Low maintenance
3) Air filter not needed

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4) Used to produce spiral flow

B. Disadvantages of coarse bubble aeration system are:

1) High initial cost
2) Low oxygen transfer
3) High power cost

Mechanical aerator or surface aerators in this the oxygen is entrained from the atmosphere. The aerators consist of submerged or partially submerged impellers that are attached to motors mounted on float or fixed structures. Surface aerators are classified according to the rotational speed of impeller there are four types of surface aerators

1) Radial flow, low speed 20-60 rpm
2) Axial flow high speed 300-1200rpm
3) Brush rotor
4) Submerged turbine

The mechanical aerators fall into two major groups: surface impeller and submerged turbine. In Naini plant the mechanical aerator use is surface impeller with axial flow high speed 300-1200rpm this aerator having high speed, use smaller dia propeller and floating structure. The transfer rate is 1.2 - 2.4 $kgO_2/kW.h$

C. Advantages of mechanical aerator of axial flow high speed:

1) Low initial cost
2) It can be adjusted to varying water level,
3) Flexible operation

D. Disadvantages of mechanical aerator of axial flow high speed:

1) Icing in cold climate
2) Poor accessibility for maintenance
3) Mixing inadequate

II. STUDYAREA

The study area covers Sewage Treatment Plant (STP) based on activated sludge process with surface aerator and air diffuser and situated on the north bank of Situated on the right bank of river Ganga in North –west of Allahabad city. Process Flow Diagram of Sewage Treatment Plant of Naini working on the principle of activated sludge process with surface aerator and air diffuser given in Fig. 1. The STP is of the capacity of Naini is 80 MLD. It has surface aerator and air diffuser in which surface aerator contain 60 MLD capacity and air diffuser contain 20 MLD capacity of wastewater. By which wastewater get aerated and further used for treatment. As Naini plant was firstly has capacity of only 60 MLD by surface aerator after expansion of the city and population it require to expand the treatment plant then 20 MLD of air diffuser is attached to the Naini plant for getting the better result. This STP work on improving the quality of wastewater by reducing the value of the total suspended solids (TSS), chemical oxygen demand (COD), biological oxygen demand (BOD), and increasing the value of dissolve oxygen (DO). Allahabad Naini plant has chemical oxygen demand (COD) of raw wastewater 239mg/l and after treatment 122mg/l. Biological oxygen demand (BOD) of raw wastewater is 60 mg/l and after treatment 17mg/l. Total suspended solid (TSS) of raw wastewater is 231mg/l and after treatment 19mg/l. Average wastewater received by STP is about 57MLD, the efficiency of total suspended solid (TSS) of STP is about 87.54% and the efficiency of biological oxygen demand (BOD) is about 79.98%. As per information given by the Ganga Pollution Control Board (U.P.) to Central Pollution Control Board (CPCB) the expenditure of operation and maintenance cost of sewage treatment plant of Allahabad Naini is about 229.038 lakh. Total area captured by Naini is 11 hectare. This research work evaluated the performance of the STP based on surface aerator and air diffuser in terms of wastewater characterization to derive a comparative account between the pollution load before and after the treatment processes, besides, discerning their efficiency

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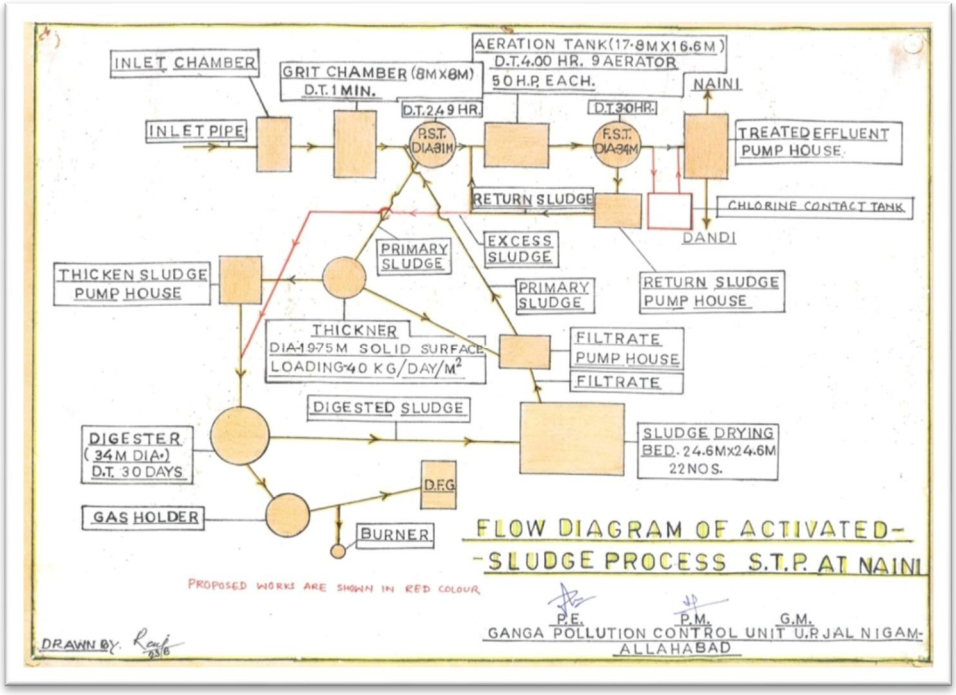
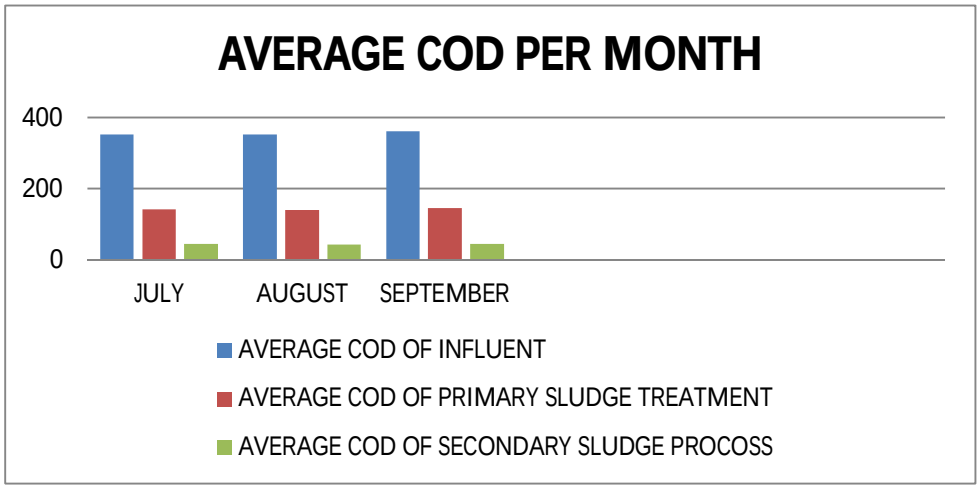


Fig1: Process Flow Diagram of Sewage Treatment Plant of Naini

III. RESULT

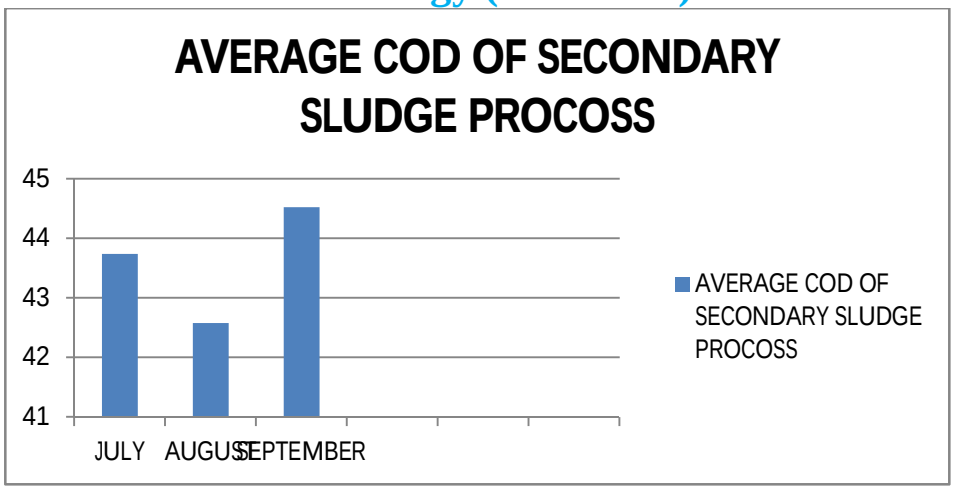
The study carries out the parameters such as COD, TSS and BOD of both the plants followed by overall Efficiencies of three months i.e. July to September shown in figure.

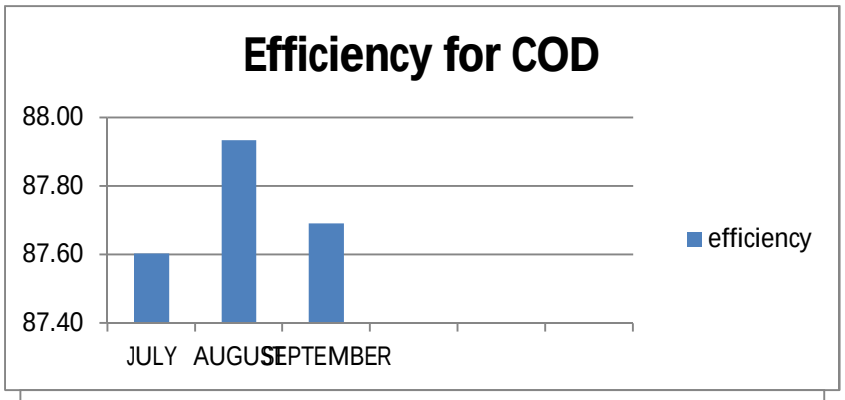
MONTH	AVERAGE COD OF INFLUENT	AVERAGE COD OF PRIMARY SLUDGE TREATMENT	AVERAGE COD OF SECONDARY SLUDGE PROCOSS	AVERAGE SLUDGE VOLUME INDEX	EFFICIENCY
JULY	352.83	141.29	43.74	62.96	87.60
AUGUST	352.9	140.19	42.58	62.7	87.93
SEPTEMBER	361.8	144.8	44.53	64.13	87.69

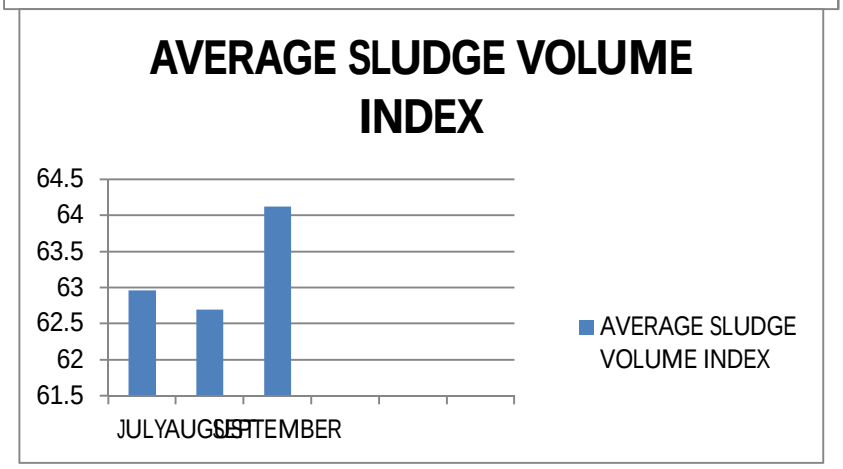


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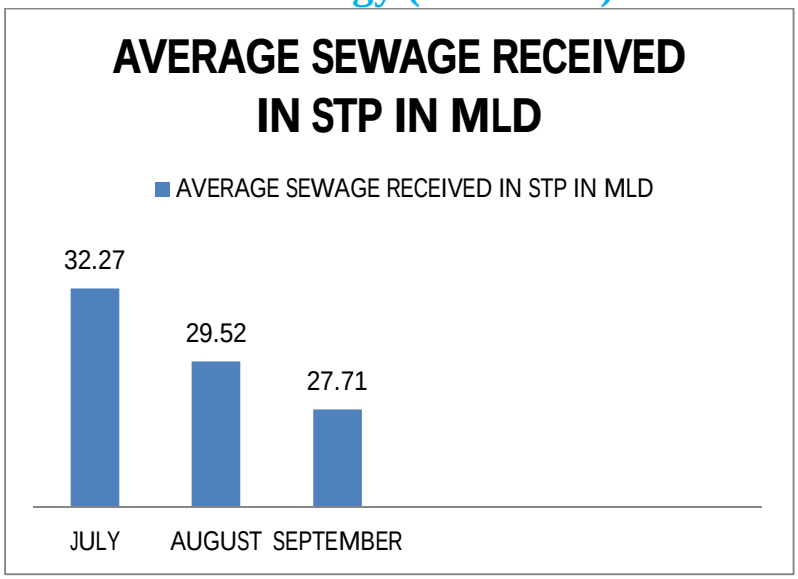


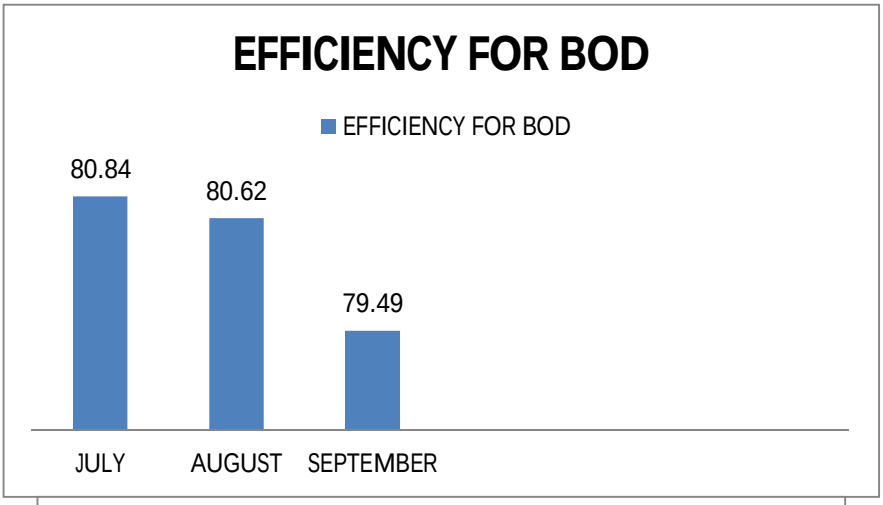


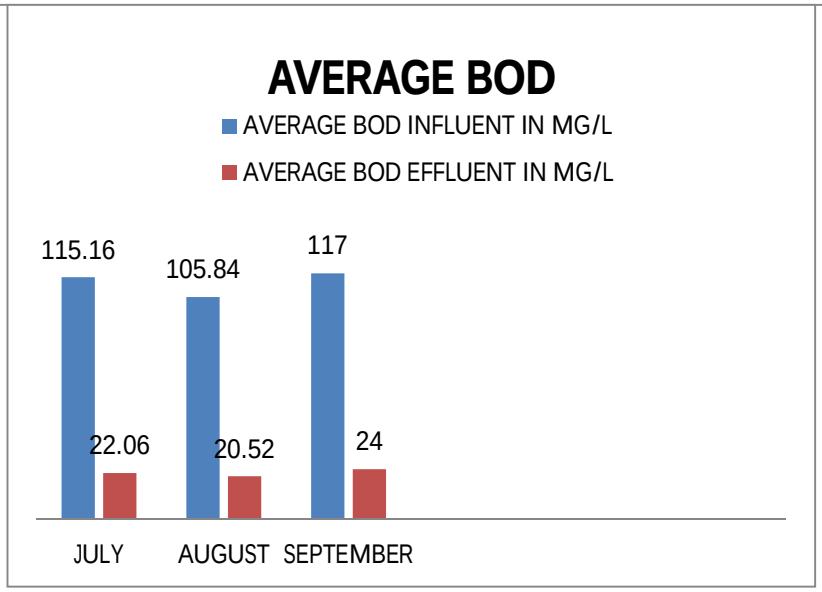
MONTH	AVERAGE SEWAGE RECEIVED IN STP IN MLD	AVERAGE BOD INFLUENT IN MG/L	AVERAGE BOD EFFLUENT IN MG/L	EFFICIENCY FOR BOD
JULY	32.27	115.16	22.06	80.84
AUGUST	29.52	105.84	20.52	80.62
SEPTEMBER	27.71	117	24	79.49

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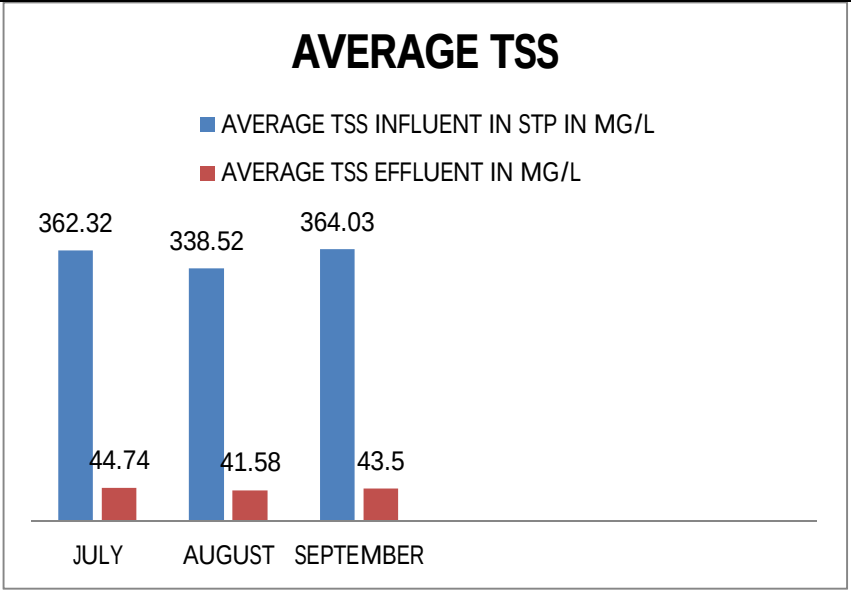


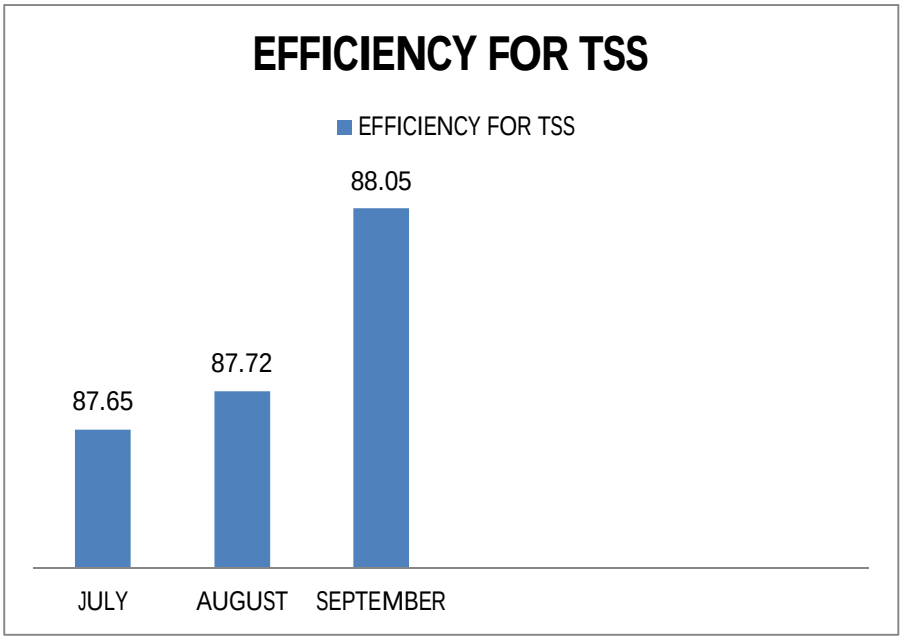


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MONTH	AVERAGE TSS INFLUENT IN STP IN MG/L	AVERAGE TSS EFFLUENT IN MG/L	EFFICIENCY FOR TSS
JULY	362.32	44.74	87.65
AUGUST	338.52	41.58	87.72
SEPTEMBER	364.03	43.5	88.05





IV. CONCLUSIONS

Allahabad city was selected for the study of the performance of STP in running condition i.e. the 80MLD based STP at Naini and 10MLD. The conclusions drawn from the study are as follows:

Presently the existing sewage treatment plant is working satisfactory and the results of treated water are observed as per the central pollution control board norms. It has been observed that 100 % of the waste water generated is not treated; thus more plants are

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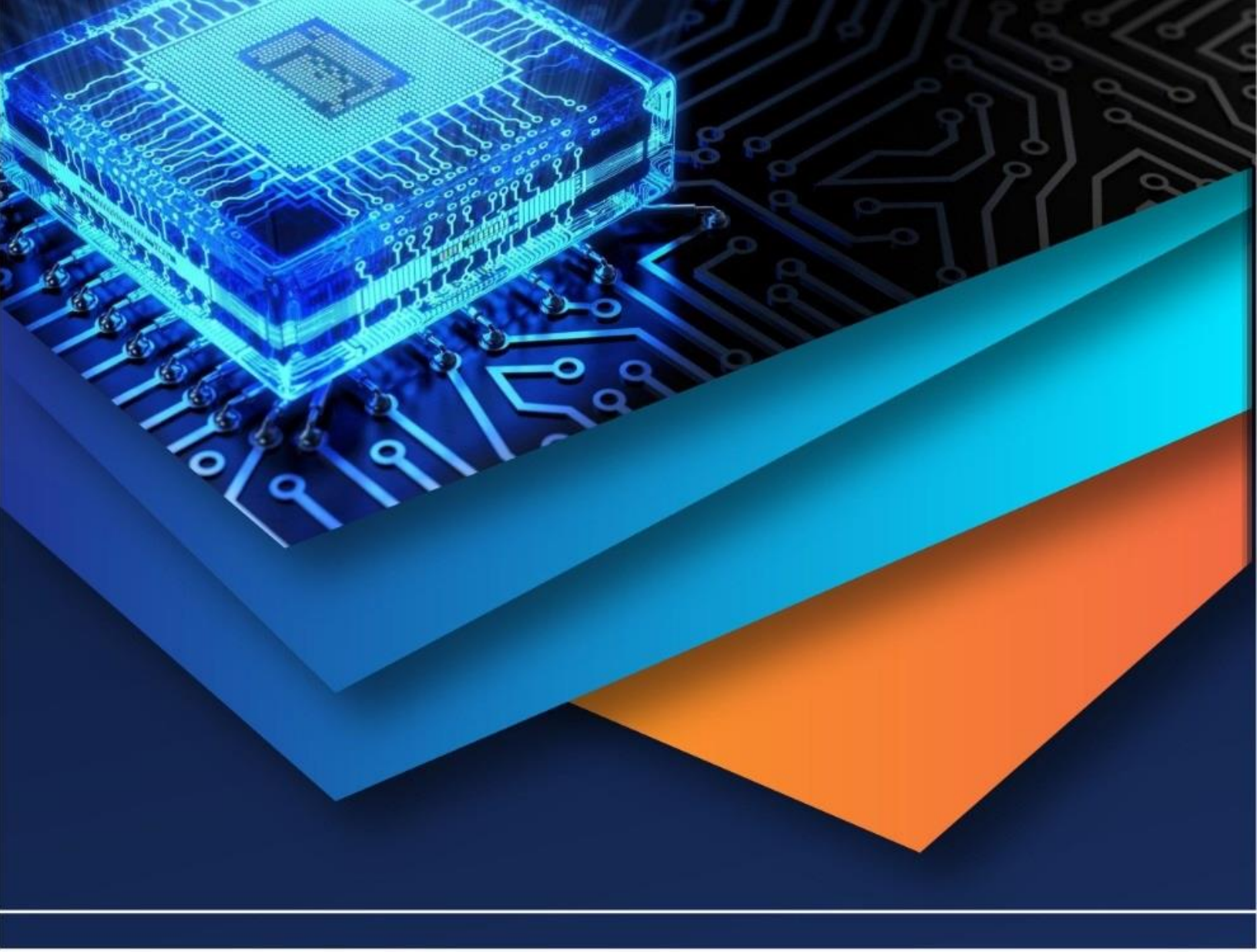
required.

All treated water is disposed into the Ganga River. The treated water may also be used for agricultural and industrial purposes. Several important Water Quality Parameters like Fecal Coliform, Oil, Sulphate and Grease are not measured on a regular basis.

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