

# Working & Efficiency Analysis of Sewage Treatment Plant using Surface Aerator & Air Diffuser

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**Abstract**— In Allahabad city, Wastewater Treatment Plant (WTP) is based on activated sludge process with surface+aerator and air+diffuser on the riverside of GANGA, Naini, Allahabad, U.P, India. This STP is constructed and designed with an aim to manage wastewater so as to minimize disease-causing organisms, organic matter, solids, nutrients, and other pollutants. It was examined from the performance study that efficiency of the treatment plant was good enough with respect to removal of TDS in opposite to the reduction in other parameters like, TSS, BOD and COD. In Naini plant, BOD, COD and TSS removal efficiency of three month were, 67.81, 62.59 and 62.16% respectively. The diplomatic order of reduction efficiency was BOD < TSS < COD STP. In addition to this, the disadvantages associated with the maintenance and operation of waste water treatment plant is examined. 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.

**Key words:** Working Analysis, Activated Sludge Process with Surface Aerator and Air Diffuser, Total Suspended Solid, Chemical Oxygen Demand, Bio-Chemical Oxygen Demand

## I. INTRODUCTION

All community produces both solid and liquid wastes. The liquid portion of wastewater is essentially the water supply of the community after it has been wasted by a variety of uses. From the view point 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<sup>[1]</sup>. If untreated wastewater is allowed to accumulate, the decomposition of the organic materials it contents can lead to the production of large quantities of harmful gases. In addition, untreated wastewater usually contains number of 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 area. 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 the continuous 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 used in Naini plant is an accurate 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 directly to the effluent channel. The oxygen demand and organic loading are uniform along the length of basin<sup>[8]</sup>. 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<sup>3</sup>d, MLSS is about 3000-6000 mg/l, aeration period is about 3-5 hours, recirculation ratio (Q<sub>r</sub>/Q) is 0.25-1.00. Aeration system is coarse bubble in 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<sub>2</sub>/kW.h. Advantages of coarse bubble aeration system are- 1. Non-clogging 2. Low maintenance 3. Air filter not needed 4. Used to produce spiral flow 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<sup>[5]</sup>. 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<sup>[9]</sup>. The transfer rate is 1.2 - 2.4 kgO<sub>2</sub>/kW.h 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 Disadvantages of mechanical aerator of axial flow high speed- 1. Icing in cold climate 2. Poor accessibility for maintenance 3. Mixing inadequate

## II. STUDY AREA

The study area covers Sewage Treatment Plant (STP) based on activated sludge process with surface aerator and air diffuser and situated exactly 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 ASP with surface aerator and air diffuser given<sup>[7]</sup>. 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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