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Performance Evaluation of a Sewage Treatment Plant (STP): A Critical Review

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ABSTRACT

Increase in population and urbanization has lead to water depletion and deterioration in water quality. Construction of Sewage Treatment Plants (STP) based on latest technologies in different parts of the country is necessary to reduce the problem of water pollution. The purpose of STP is to reduce the excessive contaminants from sewage and make the sewage reusable. Sewage treatment helps to reduce the pollution level of the water bodies and reduce the use of water by ensuring that treated water is used for irrigation & flushing toilets. Thus, the efficient working of the STP is utmost important. Anaerobic and aerobic biological processes are commonly used for wastewater treatment. The efficiency of individual units of STP determines the overall performance of the plant and quality of the final treated effluent in accordance with the prescribed governmental standards. This paper presents a critical review on the treatment of sewage by aerobic process and specifically by Activated Sludge Process (ASP) and its modifications. From the present paper it can be concluded that Sequencing Batch Reactor (SBR) technology is good in treating sewage.

KEYWORDS: *Efficiency, STP, SBR*

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INTRODUCTION

Water is one of the important commodities on earth. Due to increase in population and industrialization, the use of water has drastically increased. On the other hand the availability of water is limited. About 80% of water utilized is converted into sewage. The site for the disposal of generated sewage is traditionally natural water bodies, land and coastal areas. These water bodies are most of the times used as a source for drinking water. Sewage being rich in nutrients, causes algal growth in the water bodies where it is released thus deteriorating the water quality of the water bodies. The aim of wastewater treatment is to remove the pollutants and protect and preserve the existing natural water bodies.

Most of the treatment processes in STPs imitate the natural treatment process to reduce the water pollutants level. The treatment in the treatment plant mainly consists of mechanical, biological and chemical process. The efficient working of the existing STPs is important to reduce the water pollution level and protect the environment. In present study, efforts are made to review the evaluated STPs. This can prove useful to improve the efficiency of the STPs.

REVIEW ON PAST WORK DONE

Pipraiya Ashutosh (2017) conducted a study for the performance evaluation of a STP at Kaithal town; Haryana during the period of January 2014 to April 2014. The plant capacity is 10 MLD and the plant is based on SBR technology. Sampling was done at inlet (grit chamber) and outlet of the STP. The parameters analyzed were pH, BOD5, COD, TSS, turbidity, nitrate, phosphate, Total Nitrogen (TN) and Total Phosphorous (TP). The laboratory analysis indicated that turbidity, BOD5, COD, TSS, nitrate, phosphate, TN and TP removal efficiencies were 91.14%, 95.96%, 90.89%, 96.74%, 42.59%, 35.29%, 46.20%, 43.34% respectively [6]. It is concluded that BOD5, COD and TSS in effluent were within the permissible limits due to proper aeration and settling mechanism. The treated effluent is found to be safe against disposal on land and used for irrigation. Proper settling is suggested to reduce turbidity in the effluent. pH, BOD5, COD, TSS, turbidity, TN and TP variations with respect to each sample were represented graphically.

Gedekar Ankusha R. et. al., (2016) assessed the performance efficiency of a sewage treatment plant (STP) of a tractor making company located at MIDC, Hingana, Nagpur (Maharashtra). The STP is based on extended aeration process and it is designed to treat a flow of 270 m3/d. During the study, the sewage was analyzed for design parameters like BOD5, COD, pH, solids. For the six months study period, composite and grab samples were collected from each unit of STP (at inlet, equalization tank, aeration tank, secondary sedimentation tank, final effluent) for every

month. Overall percentage removal efficiency of COD and BOD5 was found to be 98.21% and 99.04% respectively. Total solids, Total Dissolved Solids (TDS) and TSS removal observed were 80.22%, 75.05% and 79.6% respectively [2].

Mohamed H. Hegazy and Mohamed A. Gawad (2016) evaluated and analyzed the performance and the efficiency of Shoubra Al Khaima (Balqus) wastewater treatment plant (WWTP). The treatment plant consists of three phases in terms of each stage is considered as an independent unit which are: Pretreatment, Primary treatment, Secondary (biological) treatment and Disinfection (chlorination). The performance evaluation is done based on the analysis of mainly four parameters Biochemical Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and Oil and Grease (O & G). The sampling was done for a period of six months. They have identified four sampling points: (1) the wastewater treatment plant influent; (2) the outlet of the primary sedimentation tanks; (3) the outlet of the secondary treatment process; (4) the outlet of the disinfection stage. All the laboratory analysis for samples was done according to Standard Methods for examination of water and wastewater. In the primary treatment the COD removal efficiency was 51% regarding to an average concentration of 213 mg/l [3]. The BOD removal efficiency was 49% with an average concentration of 140 mg/l [3]. The TSS removal efficiency was found 52% with an average concentration of 235 mg/l [3]. The O&G removal efficiency was 53% with an average concentration of 135 mg/l [3]. From the obtained results, it is concluded that the removal efficiencies of COD, BOD5, TSS and O& G were acceptable according to the process guide lines. Graphs of the removal efficiency (%) against the sampling time were plotted for all the analyzed parameters. It is suggested that the operation of the Secondary (Biological) treatment need a full control of the factors which affect the systems' efficiency such as temperature, organic loading rates, up flow velocity and the hydraulic retention time.

Kulkarni Bhakti et. al., (2016) conducted a research to evaluate the quality of sewage at the sewage treatment plant located at Vashi, Navi Mumbai. The plant is of 100 MLD capacity based on cyclic activated sludge technology. The treated effluent from the plant is discharged into the Vashi creek. Samples were collected from influent and effluent of the sewage treatment plant for the month of April 2015. The samples were analyzed for pH, COD, BOD5 and TSS. The obtained results were then compared with the standards given by the MPCB. The BOD5 value of treated effluent is 3.8 mg/l and that of COD is 20 mg/l [5]. It is concluded that the plant is working efficiently within the standards set by Maharashtra Pollution Control Board (MPCB).

Tsvetko Prokopov et. al., (2014) conducted a performance evaluation study on the wastewater treatment plant (WWTP) located in the Hisarya town which is one of the famous Bulgarian resorts with its mineral springs attracting thousands of tourists especially in summer. This study aimed the monitoring of physicochemical characteristics of municipal wastewater before and after treatment at SBR based treatment plant. The samples were collected into the plastic bag and brought to the laboratory for analysis. The following standard parameters were selected for the physicochemical monitoring of the wastewater treatment: BOD5, COD, TN, TP and Suspended Solids (SS). Individual emission limits for controlled pollutants which were specified in the permit for the use of Hisarya river water for discharge of wastewater were used for the WWTP performance evaluation. It was concluded that the WWTP is working perfectly. The average removal of BOD5 (95.1±0.6%), COD (93.2±0.7%), TN (80.3±8.0%), TP (53.4±7.2%) and SS (95.1±0.6%) of municipal wastewater were recorded after SBR treatment [7]. The obtained values of the standard parameters analyzed were considerably below the emission limits thus, indicating the better performance of the SBR wastewater treatment.

Wakode Prachi N. and Sayyad Sameer U. (2014) did study to evaluate the performance of sewage treatment plant located at Adharwadi, Kalyan of Thane district of 25 MLD capacity. The plant is based on SBR process. The treated effluent from the plant is discharged into river Ulhas. Samples were collected from inlet, SBR tank and chlorine contact tank (outlet). 36 samples (12 sets of 3 samples) were collected from December to February. Collected inlet samples were analyzed for pH, BOD5, COD, TSS, TN and TP. The samples from SBR Tank were analyzed for BOD5, COD, TSS and DO. And the samples from chlorine contact tank were analyzed for same parameters as that of the inlet. The BOD5 and TSS removal efficiencies were 96% and 92.74% respectively [9]. The removal efficiencies for TN and TP were 75.67% and 71.79% respectively [9]. Proper maintenance of degritor tank is suggested.

K. Sundara Kumar et. al., (2010) done a research to evaluate the performance efficiency of the Nesapakkam sewage treatment plant of Chennai city. The average wastewater flow to the plant is 23 MLD. The grab samples were collected at the inlet and outlet of all the treatment units and were analyzed. The samples were analyzed for various parameters like pH, COD, BOD5, TSS and TDS. Correlation between influent BOD5 and influent TSS is established by regression analysis. Sampling was done for a period of six months from June 2009 to November 2009. The overall removal efficiency of BOD5 observed was 94.56% and that of TSS was 93.72% [4]. Daily variations of the parameters are represented graphically. To characterize the wastewater, averages, standard deviations alongwith maximum and minimum values were calculated for the parameters. It is concluded that the treatment plant is working efficiently with the individual units also performing well with satisfactory removal efficiency.

Ravi Kumar P. et. al., (2010) conducted a comparative study of two sewage treatment plants located in Bangalore city The STP at Nagasandra handles an average flow of 20 MLD while the STP at Mailasandra is of 75 MLD. Composite samples were collected in clean plastic container of 5 liter capacity from three different units of the treatment plant, namely, influent to the treatment plant, effluent of aeration tank and final effluent from secondary clarifiers for seven days. The primary parameters analyzed were pH, BOD5, COD, TSS, TDS, DO, chlorides and sulphates. While the secondary parameters analyzed were Mixed Liquor Suspended Solids (MLSS) and Sludge Volume Index (SVI). In Mailasandra STP, TDS, TSS, BOD, and COD removal efficiency was 20.01, 94.51, 94.98 and 76.26 % and respectively, while in Nagasandra STP, TDS, TSS, BOD, and COD removal efficiency was 28.45, 99.0, 97.6 and 91.60 % respectively [8]. The order of reduction efficiency was TDS < COD < TSS < BOD and TDS <

COD < BOD < TSS respectively in Mailasandra and Nagasandra STPs [8]. It is concluded that both the plants are working efficiently. In order to achieve better performance, it is suggested to recycle fresh sludge with higher microorganism populations.

Gulnur Coskuner and Nur Seher Ozdemir (2006) conducted a performance evaluation of the wastewater treatment plant of Cumhuriyet University, Sivas, Turkey. The performance of different units of the treatment plant was investigated and a particular attention was given to the performance of the extended aeration system based on various operational parameters. The possibility of modifying the existing treatment plant is also checked. Fifteen grab samples were collected from different treatment units, once in a month starting from October 2003 to September 2004. Parameters analyzed were BOD5, TSS, nitrates, nitrites, F/M ratio, hydraulic retention time, sludge age, organic loading, temperature, pH, MLSS. Temperature was measured on site. It is concluded that the extended aeration provides combined removal of BOD5 and NH3N effectively. Average BOD5 and TSS concentration of effluent wastewater determined during one year analysis period were 7.1 and 13.5 mg/l respectively [1]. Average NH3N concentration of effluent wastewater was found to be 0.48 mg/l.

CONCLUSION

It is concluded that efficiency of the existing treatment plants can be increased by proper selection of treatment process, proper control over the treatment process and adequate operation and timely maintenance of the treatment facility. 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 alongwith nutrient removal.

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