

Characterization and Performance Evaluation of Sewage Treatment Plants based on different technologies: A case study of Delhi, India

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Sewerage Treatment plants (STPs) are considered as an important system in city infrastructure. Delhi NCR (in India) has a large number of STPs consists mainly of Extended Aeration, Activated Sludge Process (ASP), Sequencing Batch Reactor (SBR) and Densadeck/BIOFOR technologies. In order to compare and evaluate the performances of them, present study was carried out in Delhi NCR on various STPs based upon different wastewater treatment technologies. The samples were analysed for both influent and effluent for different physico-chemical parameters from the STPs and the effluent qualities were compared with Central Pollution Control Board (CPCB) standards in India. The study reveals that effluents from most of the STP's are meeting the permissible limits of CPCB and STP technologies played a significant role on its performance. Moreover, variation in monthly concentration in influent and effluent, which were depicted in the form of heat map graphs, indicates that most the physico-chemical parameters are highly correlated. Impact of seasons on the removal efficiency of the physico-chemical parameters were also performed and the plots indicate that the STPs based on Densadeck/BIOFOR technology shows less variations (over the seasons) while ASP technology shows the most. Finally, plots were also generated for integrated removal efficiency (using spider maps) which reveals that Densadeck/BIOFOR technology attained the highest rank followed by Extended Aeration and ASP technology respectively. Overall, analyses presented in this paper, may help in identifying the suitable STP technologies in Delhi NCR and elsewhere.

Keywords : *Sewerage Treatment Plants (STP's), Influent characterization, Removal Efficiency, Performance Evaluation*

1. Introduction

Sewerage Treatment plants (STPs) are considered as an important system in city infrastructure. Delhi National Capital Region (NCR) has a large number of STPs consists mainly of Extended Aeration, Activated Sludge Process (ASP), Sequencing Batch Reactor (SBR) and Densadeck/BIOFOR technologies. As the population of Delhi increasing rapidly (World Population Report 2018), effluent discharged from the STPs has increased substantially over the last couple of decades (Delhi Pollution Control Committee Report 2016). The disposal of effluents has adverse impacts on the receiving water body as well as on the surrounding environment (Environmental Protection Agency Report 2004, Amrisen et al. 2006). Moreover, effluent from STPs cannot be reutilized directly as it contains harmful organisms such as *E. Coli*, bacteria, but if treated nicely it can be used for irrigation, gardening purposes. (Sharma et al. 2013, Singh et al. 2014).

Studies carried out for evaluating the effectiveness of STPs in Delhi show that effluent from most of the STP's were improving gradually excluding Pappankalan, Coronation Pillar

and Timarpur STP's which are based on SBR, ASP and Oxidation Pond technologies respectively (Gautam et al. 2013). Further studies revealed that the discharge of the effluents, which are not appropriate in terms of their physicochemical parameters, is majorly responsible for the pollution in River Yamuna in Delhi (Foundation for Greentech Environmental Systems 2004, NRCD 2005, Yamuna action plan 2006a, Yamuna action plan 2006b). Hence, it is important to know the effectiveness of different wastewater treatment technologies in a city to get effluent having desirable physiochemical parameters (Sato et al. 2006). Jamwal et al 2009, carried out performance evaluation of various STPs in Delhi emphasizing on Faecal Coliform, Most probable Number (MPN) and *E. Coli* removal efficiencies. Garrido et al. 2011, made a comparison of wastewater treatment technologies in Spain based on DEA meta-frontier model and revealed that the ASP technology was best in terms of technological and economic viability. But the study did not consider the latest wastewater technologies like Densadeck/BIOFOR. In Chandigarh India, some studies have performed comparative analysis of the STPs with different technologies and showed that the STP based upon MBBR

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