ABSTRACT

A case study for the performance analysis of conventional Activated Sludge Process (ASP) of Sewage Treatment Plant (STP) Delawas, Jaipur and use of excess sludge as a flocculent in the Primary Settling Tank (PST) was carried out to enhance the operational efficiency of secondary treatment unit and improve the settling characteristics in PST. The performance was assessed through a critical analysis of the existing records in order to bring out certain issues resulting in low efficiency. Primary experiments were carried out at the STP site by adding different types of sludges in raw sewage at PST (in different sets) to come out with an efficient solution. The assessment of energy consumed by different units of the STP showed that energy consumed for aeration was lower than the designed value, primarily due to low dissolved oxygen (DO) levels being maintained in the aeration tank. This was reflected in the lower power consumption by about 20% than the designed guaranteed power requirement of STP. As a consequence, microbiological quality of the treated effluent suffered adversely, affecting the environment and possibly, a significant increase in the cost of tertiary treatment including disinfection in future.

A unique methodology was developed during this study for gaining insight into the performance of the STP using routine records of organics removal and the apportionment of power consumption to individual units. The performance kinetics for oxidation in aeration tank showed that the performance in terms of biochemical oxygen demand (BOD) removal was satisfactory despite lower hydraulic retention time (HRT) of 4 h being maintained than the designed value of 6 h. This was due to the fact that solid retention time (SRT, θ_c) varied in the range of 6.66 to 12.95 days against the designed value of 8 days. Lower SRT resulted in impaired performance leading to poor settleability and low secondary sludge biomass concentration. The PST performance data showed that BOD_5 removal was about 40% indicating scope for improvement. This approach can help develop protocols for continuous assessment and diagnostics for troubleshooting at STPs and optimize the process both in terms of organics removal as well as energy demand.

A comprehensive study was designed to improve the performance of PST through controlled mixing of excess secondary sludge in different proportions to raw sewage entering to PST to enhance settling of colloidal particles of raw sewage.

Digested sludge from anaerobic and aerobic sludge digesters of STP Delawas (Jaipur South) and STP Brahmapuri (Jaipur North) respectively were tried for this purpose, with the latter giving excellent results. Encouraged by these results, part of the thickened secondary excess sludge from STP Delawas was then aerobically digested and the process was repeated with the municipal sewage entering STP Delawas indicating higher benefits of sludge conditioning in improvement of PST efficiency. Use of secondary return sludge @ 30 mL/L of sewage as a flocculent in the PST resulted in improvement in total suspended solids (TSS) and BOD_5 and filtered BOD_5 removal compared to the existing system, where this return sludge was going to the aeration tank directly. The results for similar experiments with anaerobically digested sludge did not yield encouraging results and thickened sludge from STP Delawas showed a marginal benefit over return sludge. Use of return sludge from STP Brahmapuri, functioning on extended aeration process with aerobic sludge digestion showed some improvement in the system (Repeated). Addition of the thickened sludge from the STP Delawas in volumetric concentrations of 1% to 5% after a brief aeration of 20 min was tried; 1% volume used as a flocculent removed 3% and 5% higher TSS and BOD_5 as compared to the existing system.

This resulted in extra energy savings of about 15% through extra generation of energy using primary sludge and reduction in aeration demand. This may have been caused by migration of dissolved organics in to the microbial akin to a contact tank of contact-stabilization process. The results of these experiments can be used with high benefits in optimizing energy use in STPs wherever energy generation is carried out from waste sludges.