Abstract

In Palestine, most rural areas, government and private schools, universities, hotels and housing projects are still lacking central sewage facilities. According to a report prepared by the World Health Organization (WHO) in 1989, waste stabilization ponds (WSP) proved to be the most cost-effective wastewater treatment methodology for such communities. The following paper is an integration of the above-mentioned methodology. It evaluates the performance and process optimization of a newly erected WSP system in Talita Kumi school compound located in Beit Jala City, south of Jerusalem.

Talita Kumi WSP consists of a series of ten ponds having an equal surface area of 22.5 m^2 each, and located on an inclined land at the west side of the compound. The effluent of the treated wastewater, produced by the WSP, is meant for irrigation purposes.

The ponds were monitored during three different time intervals: the star-up period, summer and winter seasons. Measurements were taken, and laboratory analysis was performed, all in accordance with the Standard Methods (APHA/1995).

It was observed that the inlet structure of the system is improperly constructed and is not up to the Standard. It was found that the present condition of the inlet structure is the main source of the odor that was realized during the research period.

Flow measurements indicate that the average incoming daily flow rate coming into the system is 38.1 m^3/day, and the maximum daily flow rate is 47.8 m^3/day. Moreover, zero flow rates were recorded during nighttime, summer and winter holidays.

The results of the analysis indicate that the concentrations of total BOD and total COD of the influent are 363 mg/l and 621 mg/l, respectively. Moreover, the concentrations of phosphorus, nitrate and ammonia are 34.5 mg/l, 43.3 mg/l and 83.1 mg/l, respectively. Meanwhile, the analysis of untreated wastewater in Talta Kumi reveals extremely high concentration of total solids, being at a ratio of 1528.5 mg/l.

It was found that no measures were taken to minimize the start-up period in Talta Kumi WSP. Hence, it took the system 10 weeks, from the commissioning date, to reach the steady state conditions.

Pond number 1, which is designed to function as an anaerobic pond, was found overloaded with a retention time of 1.2 days, and achieved a substantial total BOD removal of 38% and filtered BOD of 45%. It also achieved a removal of 42%, 46%, 39% and 9% for ammonia, nitrate, suspended solids and phosphorus, respectively.

The short retention time of 1.6 days per pond was the reason for the poor performance in the remaining facultative and maturation ponds that are connected in series. Analysis of the facultative and maturation ponds effluent shows that negative results in the concentrations of total BOD, as well as total and filtered COD, were obtained. In the meantime, site measurements indicate that anaerobic conditions remained in the ponds throughout the research period. As such, algae were washed out and, consequently, the concentration of the total solids in the effluent was adversely boosted.

To that end, a conclusion has been reached to upgrade the existing facilities of Talita Kumi waste stabilization pond by constructing a $20m^3$ regulating tank and two covered anaerobic tanks, with a retention time of 2 days each. Additionally, re-arranging the existing ponds by connecting the first 7 ponds in parallel to have a total surface area of 157.5 m^2 of facultative ponds with a retention time of 5.7 days has been classified as essential upgrading measures. Moreover, a scheme of parallel connection between the last three ponds is also needed to increase the total surface area of maturation to 67.5 m^2, with a retention time of 3 days. Finally, installing a pilot filter media, for the sake of improving the effluent quality, is equally recommended.