

Abstract

In Rural Palestine, the implementation of onsite wastewater treatment plants has focused during the last decade. A fairly wide range of technologies suitable for onsite wastewater treatment plants have been developed. This thesis aimed to evaluate and monitoring the technical issues of different technologies of onsite wastewater treatment plants. A questionnaire has been designed and distributed into different Palestinian rural areas in order to provide a specific technical data about existing onsite wastewater treatment plants.

Fourteen onsite wastewater treatment plants at different levels consist of household, collective, and community were evaluated over a period of 6 months distributed in different Palestinian rural areas in West Bank. At household level, four plants used Activated sludge process and six plants used Up-flow gravel filters. At collective level, one plant used extended aeration process; one plant used Duckweed pond and another used aerobic and anaerobic gravel filters followed by polishing sand filters. At community level, one plant used constructed wetland process. The study compares the observed effluent quality and the removal efficiencies in terms of BOD, COD, TSS, TKN, and TC/FC with typical values reported in the technical literature. In view of the large performance inconsistent observed, the existence of a relationship between design/operational parameters and treatment performance was verified.

The highest values of general efficiency (EG) were found in UFGF._{Sr} plant using technology of aerobic and anaerobic gravel filters followed by polishing sand filter at collective level with efficiency indicator value of 74.2%. On the other hand, the plants using Activated sludge systems at household level had values of EG in a range of 32.5–70.03%, while the plants using up-flow gravel filter technology at household level had a values of EG in a range of -10.08-59.07%. The plants which have a values of EG in a range of 50-60% are AS._H, AS._{B.O.}, UFGF._{B.L.}, UFGF._{B.A} and UFGF._{B.S} . The plant EAP._N using Extended Aeration Process at collective level had values of 63% EG. While the Duckweed-based pond systems and up-flow Anaerobic Sludge Blanket following by Horizontal Flow Constructed Wetlands at community level were found with general efficiency indicator values less than 40%. The differences of values of EG among the different technologies reflect the status of environmental and the operational conditions for each plant.

Turning to the operational performance evaluation in case of activated sludge systems at household level, the different F/M ratios and HRT values did not influence substantially the performance of the aeration zone for AS._{B.O.}, AS._H and AS._{N.}, but observed a clear decline in the performance of the aerobic zone at AS._{B.}. This is a result of the operating at underloading conditions with high BOD₅ effluent concentration. The difference shown between the influent flows of AS._{B.O.}, AS._H and AS._{N.} did not influence significantly the plants' performance, considering the effluent quality. No plants operating at overloading due to lack of water consumption, while AS._H and AS._N operating at critical loading, as for AS._{B.O} and AS._B are operating at underloading conditions. In case of septic tank – up flow gravel filters systems at household level, the performance of the septic tanks need to regular desludging which estimated every 36 months which is never happened for any plant, and the performance of filters are expected to operate without maintenance for 18-24 months, then the filter medium needs to washed out by fresh water which also did not happened for any plant, which is affect on the voids space of filter medium leading to clogging it preventing to provide sufficient HRT like in case UFGF._s plant which is consider completely destroy inside because of its long life cycle period without maintenance. CW._{N.} at community level was found its theoretical design data which calculating depending on the actual design

capacity as reported and the reported design data was not similar with the origin one. Moreover, the sewage that reaches the constructed wetlands infiltrates into the surrounding layers and does not reach the effluent storage tank because of the enormous pressure of overloading of wastewater on the wetlands lagoons leading to destroying its surrounding wall. From the results obtained from all systems and levels, no stationary relationship between loading rates and effluent quality was found. The influence of loading rates differed from plant to plant and from technology to other, and the effluent quality was indicated by several factors related to design and operations parameters. Only a sharp significantly downloading or overloading influenced the effluent quality like in case AS_B, DWP_{Ar}, and CW_N.

The good point that found through the analysis of the questionnaire that, 13% of the existing onsite wastewater treatment plants in Palestinian rural areas which are working well, while 39% working with moderate efficiency, the plants which work with less efficiency estimated as much as 15%, whilst the rest of the plants had been stopped. Where, the plants which were working on bad situation affected by the periodic follow up of operation which is the main factor that affecting on the failure of these plants. The most important result was deduced by this studying is that the availability of experienced engineering designer, skilled personnel, spare parts for repair, and effective operation, maintenance and monitoring are more crucial than the type of technology.