Integrated Fixed Film Activated Sludge (IFAS) Process for Treatment of Municipal Wastewater of Yangon City

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Introduction

Nowadays, in Yangon City, the amount of municipal wastewater generated from municipalities is higher than that of the previous decades due to the rapid population growth rate of this city. If the untreated municipal wastewater is discharged into the surface water bodies such as streams, lakes, rivers, etc., the receiving surface water bodies will face the problems of water contamination. Therefore, the municipal wastewater should be treated by using the appropriate technologies before disposing it into the surrounding water bodies. In Yangon City, a wastewater treatment plant was established and operated by Yangon City Development Committee (YCDC) since 2005. This treatment plant have been collecting and treating the sewage generated from six downtown townships and the septic wastewater originated from other townships of Yangon City. The mixed wastewater (sewage and septic wastewater) is the influent of this treatment plant and it applied the conventional activated sludge process as the treatment technology.

In this study, the lab-scaled Integrated Fixed Film Activated Sludge (IFAS) process was operated for the treatment of municipal wastewater of Yangon City. The influent required for the lab-scaled IFAS process was collected from the influent tank of YCDC wastewater treatment plant. This research aims to reduce the concentration of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and Ammonia (NH_3) of municipal wastewater by using IFAS process with new type of dispersed media.

Material and Methods

The methodology of this research includes three steps which are fabrication of lab-scaled IFAS process, collection of municipal wastewater sample, operation of the lab-scaled IFAS process and evaluation of the treatment efficiency of that IFAS process.

The first step is the set-up of lab-scaled IFAS process with dispersed media named marimo which is the product of a Japanese Company. The IFAS process consists of three components that are one aeration tank with dispersed media and two sedimentation tanks. The lab-scaled physical models were designed based on calculation for geometric similarity of distorted scale models for hydraulic structures. From the design calculation, the length, width and depth and volume of scaled model were obtained as 0.2 m, 0.15 m, 0.4 m and 0.012 cu-m, respectively. For making the physical models for IFAS process, some design parameters such as Yield of growth (Y), Endogenous Decay Coefficient (K_d), the Sludge Retention Time (SRT), the Food to Microorganisms (F/M) ratio were assumed according to the design criteria described in (Qasim, 1985). About 2 L (0.002 cu-m) of dispersed media named marimo, was used as the substrate for aerobic microorganisms for inoculation process in the aeration tank. The primary and secondary sedimentation tanks were placed after the aeration tank. The length, width, depth, freeboard and volume of the primary sedimentation tank are 0.3 m, 0.1 m, 0.2 m, 0.25 m and 12.71 L (0.0013 cu-m), respectively. This tank was designed so that about 7.5 L (0.0075 cu-m) of wastewater in the primary sedimentation tank can overflow into the secondary sedimentation tank with smaller flow rate than that of the primary tank. The length, width, depth and volume of the secondary sedimentation tank are 0.3 m, 0.1 m, 0.24 m and 5 L (0.005 cu-m), respectively. The bed slope angle of the primary and secondary tanks are 20 degree and 25 degree from the horizontal surface line, respectively.

The second step is the collection of municipal wastewater sample that is used as the influent of the lab-scaled IFAS process. The wastewater sample was gathered from YCDC wastewater treatment plant that is located in Botahtaung Township of Yangon City.

The third step is the operation of the lab-scaled IFAS process. After the time of inoculation process, about 5 L (0.005 cu-m) of municipal wastewater was discharged into the aeration tank with the flow rate of 12 L/h (0.012 cu-m/h). The concentration of BOD, COD, Mixed Liquor Suspended Solids (MLSS) and Sludge Volume Index (SVI) of the wastewater in the aerobic tank were determined in order to know the F/M ratio and the settling characteristics of activated sludge. At the current time, about 7 L of wastewater is treated based on the treatment efficiency of the lab-scaled treatment process. The volumetric ratio of Returned Activated Sludge (RAS) from the primary sedimentation tank and influent (mixture of sewage and septic wastewater) is about 0.75.

The final step is the evaluation of the treatment efficiency of the lab-scaled IFAS physical model. The concentration of BOD, COD, TSS, NH_3 of the influent and effluent of this process were determined in order to know its treatment efficiency.

Results and Conclusions

According to the results of this research, the Sludge Retention Time (SRT) increases from 3.14 days to 18 days and the F/M ratio varied from 0.17 d^{-1} to 1.82 d^{-1} within the three weeks of research period. The yield of growth in aeration tank rise from 0.56 (g/g) to 0.77 (g/g) and then, the K_d value ranges between 0.08 d^{-1} and 1.05 d^{-1}. Consistent with the value of the F/M ratio and the concentration of soluble BOD_5 of treated effluent, the substrate concentration at one-half of the maximum growth rate (K_s) is about 718.5 mg/l and the maximum rate of substrate utilization per unit mass of microorganisms is about 50 d^{-1}. Depending on the current condition of this research, the optimum removal efficiency percentage of BOD, COD, TSS and NH_3 are 98.6%, 98.1%, 99.8% and 94.7 %, respectively at 10 days of SRT with about 1.82 d^{-1} of the F/M ratio. The figure 1 shows the different removal efficiencies of BOD, COD, TSS and NH_3 at different SRT and the F/M ratio comparatively.

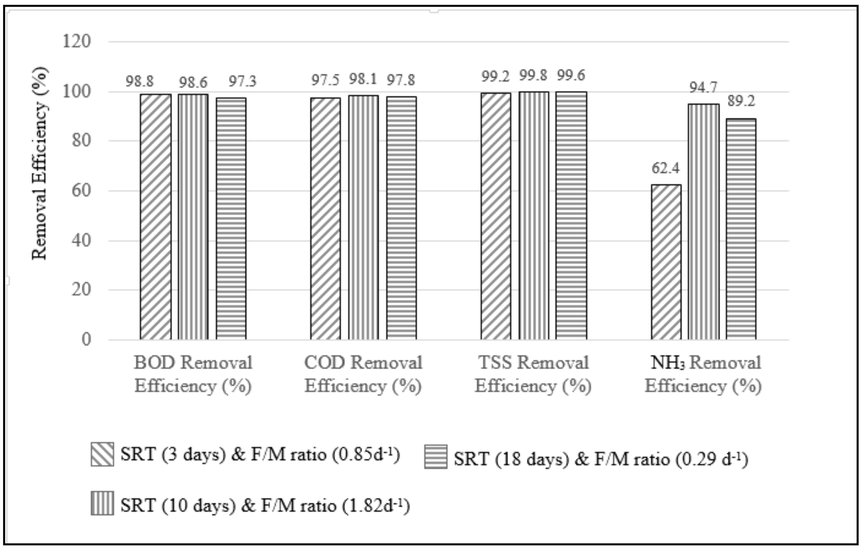

Figure 1 Removal Efficiency of lab-scaled IFAS process

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