Appropriate Lab Scale Oxidation Ditch Tank for Cafeteria Building Wastewater Treatment

Manisthawadee Jayasvasti, and Chavalit Ratanatamskul

***Abstract*—**This study provided the appropriate lab scale Oxidation Ditch Tank for cafeteria building wastewater treatment. In the first step, studying of the appropriation of divided three zones within the tank was investigated. The result of continuous monitoring Dissolved Oxygen (DO) and Oxidation-Reduction Potential (ORP) measurements were showed that anaerobic zone can be appeared at the inlet channel, but the anoxic zone cannot be appeared along with aerobic zone at the outlet channel of the ditch. The next step of the experiment was to investigate the appropriate aeration devices for the tank. The result showed that air pump was more appropriate than diffusion aerator. Moreover, the problem of cover's weight revealed that although stainless steel was the appropriate material to construct the wastewater tank because of its characteristics such as rustproof and sun-proof, the cover of the tank should not be made of the same material because of the weight problems.

***Keywords*—**Cafeteriabuilding, DO and ORP measurements, lab scale Oxidation Ditch Tank, wastewater treatment

I. Introduction

Oxidation ditch,one of the activated sludge systems, compose of nitrification and denitrification reactions in aerobic zone and anoxic zone, respectively, to achieve nitrogen removal. To achieve phosphorus removal coupled with nitrogen removal so called "nutrient removal" anaerobic zone must be performed to have anaerobic digestion produced volatile fatty acids (VFAs) such as acetic and propionic acids for phosphorus uptake and release in aerobic zone and anoxic zone, respectively.

Dissolved Oxygen (DO) was heterogeneity distributed along the oxidation ditch due to the shape of the ditch, as in [1]. DO is the parameter which influence the distribution of aerobic and anoxic zones in the ditch, where the processes of nitrification and denitrification are take place, respectively, as in [2]. As discussed by [3], in order to ensure the oxygen supply for nitrification, DO concentration was always maintained over 2 mg/L, so the lowest DO in the ditch was not below 0.5 mg/L, which means that no macroanoxic zone existed in the ditch, but if the turbulence inside the ditch was controlled to be weak, this will helpful for the sludge to form large flocs and limit oxygen diffusion. Therefore, it is possible to create a microanoxic zone inside the sludge flocs although the DO outside was higher than 0.5 mg/L. This attribute can solve the problem of the difference between DO demand for nitrification and denitrification. Some control strategies using only DO measurement to control nitrification. Oxidation-Reduction Potential (ORP) was the recommended parameter along with DO controlling activated sludge systems in low DO concentration, as in [4] and in intermittent aeration mode (aerobic alternate anoxic), as in [5]. During aeration periods ORP ranging from 0 mV to -50 mV and when ORP is lower than -200 mV nitrification is not effectively occurring, as in [4]. This study discusses results of the appropriate lab scale Oxidation Ditch Tank treating cafeteria building wastewater.

The treatment of cafeteria building is the option to reduce wastewater volume and cost of water production and decrease environmental impact. From the past to the present, wastewater treatment by using Oxidation Ditch was paid attention to various group of researchers for nutrients removal.

Most of the studying of nutrients removal by Oxidation Ditches were in pilot-scale and full-scale, so controlling of parameters and conditions was rather difficult and slowly notice the results, therefore, this research operated in the lab-scale to easily study the conditions of appropriate Oxidation Ditch tank treating cafeteria building wastewater due to short-term condition control. The specific objective of field research is to find out the optimum design and operating conditions.

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II. Experimental

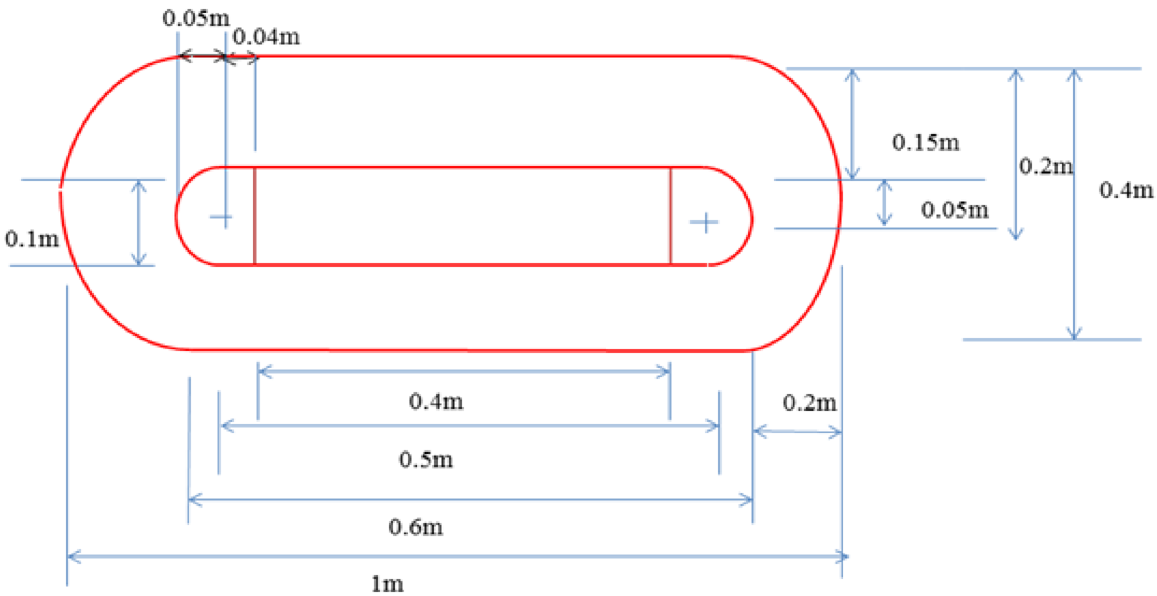
A. Oxidation Ditch Tank

The ditch and its cover were made of stainless steel to prevent from the rust and the sun. The volume of the ditch was 197 liters. The ditch layout was showed in Fig.1 and wastewater flow direction was showed in Fig.2.

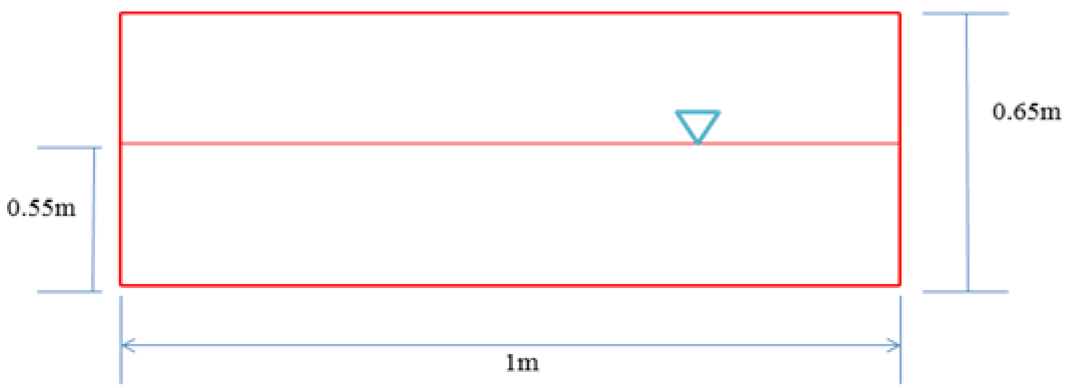
Seed sludge from return sludge of activated sludge system was fed in the ditch. Wastewater from cafeteria building was fed in the ditch later and its characteristics were showed in Table I.

B. Measurements

All of the steps in this experiment grab sampling was usedtoevaluate the effluent for DO and ORP.



(a) Top view



(b) Side view

Fig. 1 Oxidation Ditch layout

TABLE I
WASTEWATER CHARACTERISTICS

Parameters	Data Range
COD (mg/L)	300-500
pH	5-8
NO_3^-(mg/L)	1-5
MLSS (mg/L)	320-760

DO meter used in this experimental was YSI 5000/5100 Laboratory BOD and DO Meters.

ORP probe used in this experimental was InLab® Redox Electrode with Platinum Ring Indicator; Reference electrolyte: 3 mol/L KCl

Air pump used in this experimental was Linear air pump HIBLOW: XP- 80; Flow: 80 Lit/min; Pressure: 14.7 Kpa.; Power : 71 w.; 220v; 1ph; 50Hz.

In the first step, studying of the appropriation of divided three zones within the tank was investigated. Aerobic zone; by taking diffusion aerator and anoxic zone; on the other side of aerobic zone were provided at the outlet channel of the ditch and anaerobic zone was provided at the inlet channel of the ditch. Data were obtained from continuous DO and ORP measurements.

The next step that investigated the appropriate aeration devices for the tank in this study was operated by using diffusion aerator and air pump and the data were obtained from continuous DO and ORP measurements.

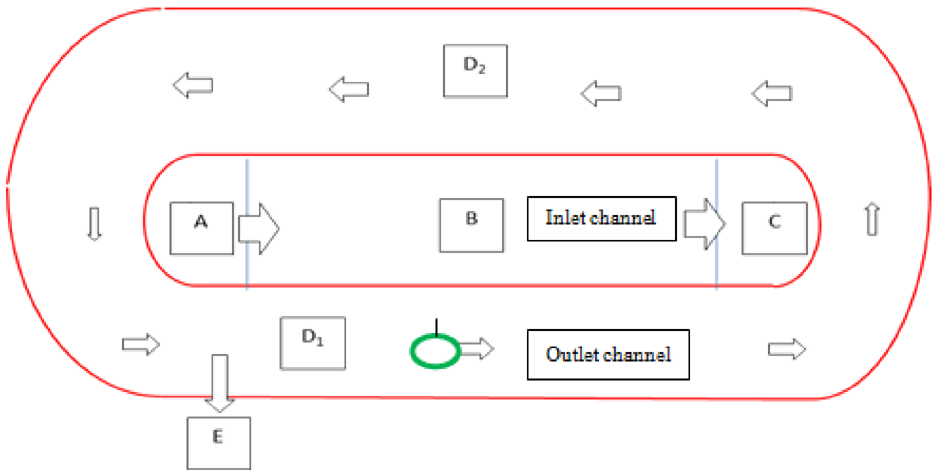
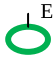


Fig. 2 Flow direction and zones within Oxidation Ditch

A = wastewater inlet
B = anaerobic zone
D_1= aerobic zone
D_2= anoxic zone
E = wastewater outlet
 = diffusion aerator

III. Results

In the first step, the results of continuous monitoring DO and ORP measurements in Table II were showed that anaerobic zone can be appeared at the inlet channel, but the anoxic zone cannot be appeared along with aerobic zone at the outlet channel of the ditch observed from the range of DO and ORP parameters .

In the next step of the experiment, the results of continuous monitoring DO and ORP measurements in Table III were showed that air volume was not enough to ensure the oxygen supply for nitrification (over 2 mg/L) when using diffusion aerator as an aeration device, whereas using air pump, oxygen was enough for nitrification to be appeared observed from the level of DO and ORP.

Moreover, the grab sampling method to collect the sample from the tank for parameter analysis was difficult because ofthe cover of the tank's weight.

TABLE II
Average DO and ORP Monitoring per Month for Divided Appropriate Zones

Month/Zone	DO (mg/L)	ORP (mV)
1/D_1	1.47	298
1/D_2	1.61	320
1/B	0.08	-101
2/ D_1	1.8	272
2/D_2	1.85	283
2/B	0.06	-103
3/D_1	0.06	-149
3/D_2	0.08	-125
3/B	0.01	-187

*

D_1 = aerobic zone
D_2 = anoxic zone
B = anaerobic zone

TABLE III
Average DO and ORP Monitoring per Month for Appropriate Aeration Devices

Month/Aeration Devices	DO (mg/L)	ORP (mV)
1/D	1.23	289
2/D	0.91	275
3/D	1.9	293
1/A	3.1	187
2/A	2.7	194
3/A	2.8	191

*

D = diffusion aerator
A = air pump

IV. Conclusion

Based on the results obtained from this study, we can conclude that the appropriate lab scale Oxidation Ditch Tank for cafeteria building wastewater treatment in this study was composed of two zones; anaerobic zone at the inlet channel and aerobic zone at the outlet channel or composed of three zones by using intermittent aeration mode (aerobic alternateanoxic) or controlled the turbulence inside the outlet channel to create microanoxic zone inside the sludge flocs of aerobic zone. Using air pump instead of diffusion aerator was appropriate too.

We also observed from the cover of the tank's weight problem that although stainless steel was the appropriate material to construct the wastewater tank because of its characteristics such as rustproof and sun-proof, the cover of the tank should not be made of the same material because of the weight problems. The more weight of the cover, the more difficulties of grab sampling and maintenance in the future, so changing the material from stainless steel into the lighten material such as plastic or acrylic and painting color to have rustproof and sun-proof characteristics will be better.

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