Recovery of Organic Carbon from Sludge by Radiation and it's Application for Advanced Wastewater Treatment

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1. Introduction

In order to get successful operation of advanced oxidative biological wastewater treatment system, adding of proper amount of carbon source which is an essential component for the microbial growth in the system is necessary.[1] Sewage sludge is mainly composed by organic carbon. Many studies have focused on the recover of carbon source from waste sludge as well as reduction of sludge volume.[2,3,4] Ozone, UV and chemical application have been adopted to recover the carbon source from waste sludge. Recently radiation process has been proposed to sludge reduction and disinfection owing to high energy power onto microbial disintegration. Radiation energy has shown us another potential possibility which is to get carbon source from the waste sludge. The aim of this study is to confirm that carbon source can be recovered from waste sludge by irradiation and how much percentage of nitrogen removal efficient can be improved in an advanced biological oxidative sewage treatment system(MLE).

2. Methods and Results

In this study we use the advanced biological oxidative sewage treatment system which is consisted of anoxic(8.1 L), oxic(15 L) and settling tank. Generally it is called by MLE process (Modified Ludzack-Ettinger).[5] The target wastewater was taken from sewage treatment plant.

2.1 Electron Beam Irradiation

The electron beam accelerator (1.5MeV, ELV-4 Model) installed in EB Tech. Co. Ltd. was used. Irradiation was performed at room temperature (around 20 °C). The total absorbed dose was around 20 kGy for sludge disintegration.

2.2 Characteristics of Sewage

Sewage was obtained from general sewage treatment plant. Water quality parameters such as COD_{cr}, TSS, T-N, NH_3-N and NO_3-N were characterized in accordance with standard analysis methods. The contents of soluble materials in the sewage was defined by the filtration through Whatman GF/C glass fiber filters which were also used to assess SS and VSS parameters. Quality of sewage were characterized, Table 1.

Table 1. Characteristics of the sewage

Component	Conc. mg/l (avg.)
S-COD_{cr}	109 ~ 200 (167)
T-N	35.8 ~ 43.8 (39.3)
NH_3-N	29.6 ~ 45.7 (36.6)
NO_3-N	0.3 ~ 0.7 (0.7)

2.3 MLE Process

The continuous operation was carried out with the MLE process(Fig. 1) under operation condition(Table 2).

Table 2. Operation conditions of MLE process

Item	Conditions
DO	anoxic 0 mg/l
	oxic 1.7 mg/l
pH	avg. 6.8
MLSS	anoxic 2,000 mg/l
	oxic 2,000 mg/l
HRT	anoxic 4.3 hour
	oxic 8 hour

The MLE process was operated with flow rate of 45 l/day. The hydraulic retention time(HRT) of anoxic and oxic tank were 4.3 and 8 hours, respectively.

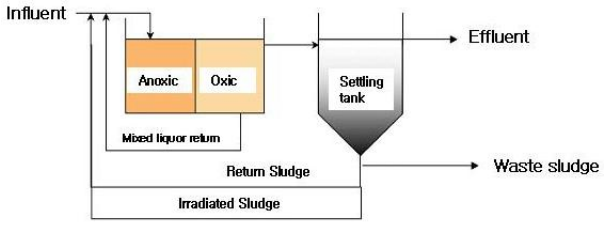

Figure 1. Schematics diagram of the MLE process.

2.4 T-N Removal

After 50 day of operation, tendency for variation of total nitrogen(T-N) removal efficiency was obtained in figure 2. The T-N removal efficiency from system without anoxic tank was around 10 % and about 40 % of T-N removal efficiency was obtained from MLE process. However, its removal efficient could be rapidly increased to almost 80% by adding of irradiated sludge as shown in figure 2 .

Such differences in the T-N removal efficiency can be explained by addition of soluble organic carbon source from the irradiation.

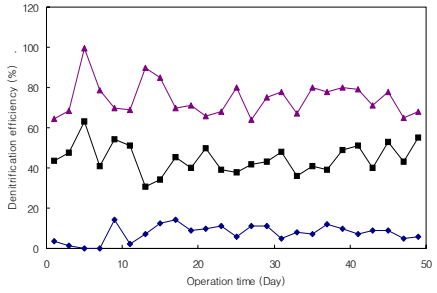

Figure 2. Total nitrogen removal efficiency at different process : (▲)MLE process with disintegrated sludge by electron beam irradiation, (■)MLE process without disintegrated sludge, (♦)Traditional process without anoxic tank.

3. Conclusion

1. It was seemed that organic carbons could be obtained from irradiated waste sludge
2. Around 80% of T-N removal efficient could be obtained steadily in the MLE process by using of irradiated sludge

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