Non-heating methane fermentation system of cold region incorporated with powerful wastewater treatment system using electrochemical method

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Methane fermentation is an effective method for treating livestock manure, by which the energy as biogas can be recovered, and odors from the livestock manure is also reduced. In cold regions such as Hokkaido(Japan), a heating system is required because fermentor must be kept at mesophilic(35°C) or thermophilic(55°C) conditions, but the operating cost is high. Therefore, an on-site 40 m3 fermentor in the cold region which could operate in the winter season having an outdoor temperature of –20°C was developed. The operation of dairy manure fermentation was made possible in the methane fermentor at 20°C. To improve its thermal insulation performance, fermentor was buried half below the ground level. The setup has a methane fermentor of 40 m3, a gas holder of 8 m3, it can be used to treat the wastewater from 40 dairy cattle. Hydraulic retention time (HRT) is 15 days. The shape of the methane fermentor is cylinder having 2.5 m in diameter, 11.9 m in length. The ground temperature was used by semi-buried setup because groundwater level was at –2.5 m. The fermentor basements were not submerged, the thermal insulation materials, temperature maintaining by soil covering up, was easily achieved.

On the other hand, as the regulations for environment become critical, it is required to develop a high performance process for treating the livestock manure with relatively low operating cost. In recent years, electrochemical treatment has gained increasing interest because it is relatively economical and gives higher treatment efficiency. It is expected to completely convert the organic pollutants into gases (N2, CO2, etc). Although the electrochemical method for treating a variety of industrial wastewaters has been intensively reported in previous works [1], [2], [3], there are few reports on practical uses due to the lifetime of electrode. Based on a series of fundamental researches, we have successfully developed electrochemical treatment system in practical use, and incorporating with the methane fermentor for high performance treatment of the effluent from methane fermentor. As a result, the final removal ratio of T-N, T-P and COD in the effluent were 80~90%.

Conclusions

In the semi-buried system for cold region, the temperature was kept at around 20°C. The methane production was approximately 6m3/day. Furthermore, the effluent from methane fermentor was treated efficiently by electrochemical system.

References

[1] Chin, D.T., Cheng, C.Y. Oxidation of phenol with AC electrolysis. J., Electrochem. Soc: Electrochemical Science and Technology, 132(11), 1985, pp2605-2611.
[2] Israilides, C.J., Vlyssides, A.G., Mourafeti, V.N., Karvouni, G. Olive oil wastewater treatment with the use of an electrolysis system. Bioresource Technology, No.61, 1997, pp163-170.
[3] Vlyssides, A.G., Israilides,C.J. Electrochemical oxidation of a textile dye and finishing wastewater using a Pt/Ti electrode. J. Environ. Sci. Health, A33(5), 1998, pp847-862.