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Research Article

Experimental Study on Anaerobic Digestion of Remaining Sludge in Municipal Wastewater Treatment Plant

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Abstract: Along with the development and progress of environmental protection management, it is necessary to pay full attention to the disposal of excess sludge in the process of urban sewage treatment plant management. It is necessary to ensure effective integration of management mechanisms and management paths. To a certain extent, it can improve the actual efficiency of digestion and treatment work and lay a foundation for the optimal operation of environmental protection management. In this paper, the treatment of excess sludge in a sewage treatment plant is studied. The method and results of anaerobic digestion test of excess sludge in a sewage treatment plant are discussed for reference only.

Keywords: *urban sewage treatment plant; excess sludge; anaerobic digestion test; method; result*

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0 Introduction

For sludge treatment process, anaerobic digestion itself is a key stabilization process. On the basis of reducing the amount of sludge, a harmless and resource-based treatment process can be established to ensure the rationality of data processing and control mechanism. This method has established the corresponding process and process system in foreign countries since the 1960s, which has certain reference value.

1 Test methods for anaerobic digestion of remaining sludge in municipal wastewater treatment plants

In this paper, the remaining sludge of a municipal sewage treatment plant is taken as the basic research object to carry out the anaerobic digestion test of the remaining sludge of a municipal sewage treatment plant, and the basic test results are investigated, to provide corresponding suggestions for the treatment of sludge anaerobic digestion process for research departments and enterprises.

1.1 Sludge test and analysis

Taking the excess sludge from a municipal sewage treatment plant as the research object, the inverted A2/O treatment process is adopted. The sludge is treated by centrifugal thickening, dewatering, and transportation. The parameters of the basic excess sludge are shown in Table 1.

According to Table 1, the pH value of sludge basically meets the requirements of anaerobic digestion, and the alkalinity of sludge is about 275. However, the C/N ratio is significantly lower than that of the areas where the anaerobic bacteria are more active, and the data and management requirements are not in the optimal range[1].

1.2 Basic process of sludge test

To ensure the rationality of the experimental process of anaerobic digestion of excess sludge in municipal sewage treatment plant, a complete data processing

mechanism should be established and perfected in combination with the basic parameters.

1.3 Gas production measurement

In the process of gas production, the main components of biogas produced by sludge include methane gas and carbon dioxide gas. If the digestion process runs normally, nitrogen, hydrogen, and hydrogen sulfide gas will appear, and the content is not large. Based on this, some of the gas parameters which are not sufficient for data analysis can be ignored in the process of estimating. Assuming that some of the carbon is lost during sludge digestion, it is converted into methane and carbon dioxide gases in biogas. It should be noted that on the basis of the conservation mechanism of carbon materials in sludge before and after digestion, the linear relationship between the actual content parameters and the decomposition rate of organic matter in sludge system structure under the condition of medium temperature digestion should be determined by the Mohr curve, and the data processing process should be effectively integrated so as to integrate the sludge theory with the sludge and mud quality. Gas production is estimated. In general, speaking, when organic matter content is kept between 85% and 95%, the decomposition rate of organic matter can be over 80%.

1.4 Digestion test process

In the process of data analysis and processing, to enhance the consistency between the data and the actual operating system of the project to a certain extent, it is necessary to establish a complete data analysis and application mechanism. Moreover, management processes to ensure effective analysis of specific data[2]. First, the reactor is mainly divided into inner barrel and outer barrel, the inner barrel is mainly filled with sludge, the application volume of this paper is 15 L, the upper end of the umbrella plate structure can effectively remove the dross caused by the operation of the equipment, and the lower end of the motor stirring structure so as to effectively forms a good mechanism of action. The outer bucket is the basis of the water bath environment, which can effectively establish the dual mechanism of water-sealed buoy and sludge heating, and maintain the safety of the whole structure. It is worth mentioning that the heating device below and the temperature probe, relay, and temperature control meter in the inner drum should establish a complete automatic control system, rationally optimize the processing mechanism and operational integrity. Most importantly, the buoy itself is an overtime collection and metering device; therefore, the actual temperature of the buoy will rise with the increase of sludge gas production, mainly the use of scale can be read as well as gas temperature structure for comprehensive analysis and data processing, effectively determine the effect of data application is reasonable. The top view of the device structure is shown in Figure 1:

After the start of the actual experiment, the anaerobic digestion treatment should be carried out in combination with the medium temperature conditions. The basic scale of the treatment is 15 L, the specific reaction period can reach 30 days, and the effective centralized treatment is carried out.In this research, the actual gas production rate and gas production during anaerobic digestion under different conditions were investigated with 9% inoculum volume of the first-stage digester mud[3].

2 Results of anaerobic digestion of excess sludge from municipal wastewater treatment plant

Combined with the actual test process, the results of anaerobic digestion of excess sludge from municipal

Table 1. Sludge basic parameters

Basic indicators	Basic parameters
Sludge moisture content (%)	96.76
Organic matter ratio in sewage sludge (%)	57.11
VSS content	18.49 mg/L
COD content	23.38 mg/L
pH value	7.3
Fatty acid content	250 mg/L
Carbon-nitrogen ratio	4:6

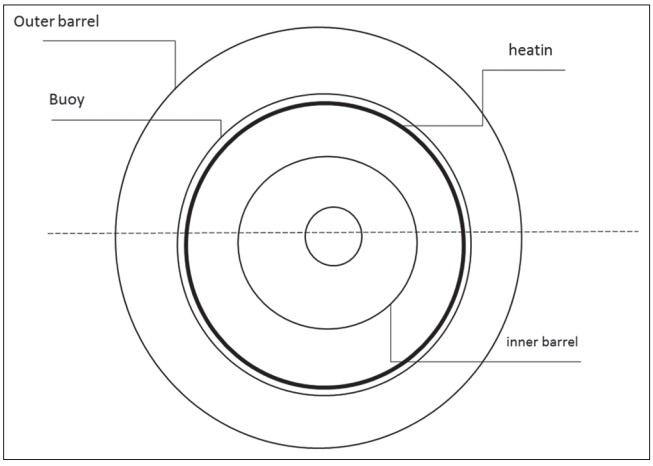

Figure 1. Top view of device structure

sewage treatment plant should be analyzed as a whole, and the data judgment and treatment effect should be upgraded comprehensively. It also lays a foundation for the follow-up test management and process supervision to ensure that the data analysis and integration process can be completed to ensure the integrity of the test process.

2.1 Sludge digestibility

The content of carbon in methane and carbon dioxide is >0.5 g/L. In actual biogas, the content of methane is about 65% and the content of carbon dioxide is about 35%. According to the analysis of the basic information and properties of the sludge, 57% of the sludge organic matter decomposition rate has reached over 40%, and the content of TOC in the sludge VSS will be regulated. The theoretical sludge gas yield should be taken as the basic component to ensure the optimal treatment effect[4].

2.2 Biogas production from sludge

During the experiment, the anaerobic digestion cycles of substances in inoculated and non-inoculated conditions were significantly different, which were 26 days and 32 days, respectively, and the rising effect of the final buoy was also different, in addition, the gas production would no longer increase immediately. In the process of experiment, it is necessary to analyze the change of sludge daily gas production and establish real-time data processing and analysis mechanism.

On the one hand, no inoculation conditions are as follows: (1) Between 0 and 4 t/d, the gas production is about 50 mL/dL mud–100 mL/dL mud. (2) Between 4 t/d and 8 t/d, the gas production is about 50 mL/dL mud–150 mL/dL mud. (3) Between 8 t/d and 12 t/d, the gas production is about 80 mL/dL mud–200 mL/dL mud. (4) Between 12 t/d and 16 t/d, the gas production is about 160 mL/dL mud–250 mL/dL mud. (5) Between 16 t/d and 20 t/d, the gas production is about 100 mL/dL mud–150 mL/dL mud. (6) Between 20 t/d and 24 t/d, the gas production is about 160 mL/dL mud–250 mL/dL mud. (7) Between 24 t/d and 28 t/d, the gas production is about 50 mL/dL mud–100 mL/dL mud. (8) Between 28 t/d and 32 t/d, the gas production is about 0–50 mL/dL mud.

On the other hand, inoculation conditions are as follows: (1) Between 0 and 4 t/d, the gas production is about 150 mL/dL mud–310 mL/dL mud. (2) Between 4 t/d and 8 t/d, the gas production is about 230 mL/dL mud–290 mL/dL mud. (3) Between 8 t/d and 12 t/d, the gas production is about 150 mL/dL mud–230 mL/dL mud. (4) Between 12 t/d and 16 t/d, the gas production is about 50 mL/dL mud–150 mL/dL mud. (5) Between 16 t/d and 20 t/d, the gas production is about 20 mL/dL mud–80 mL/dL mud. (6) Between 20 t/d and 24 t/d, the gas production is about 0 mL/dL mud–50 mL/dL mud. (7) Between 24 t/d and 28 t/d, the gas production is about 0 mL/dL mud–20 mL/dL mud[5].

According to the relevant data, the overall trend of sludge gas production rate without inoculation in an anaerobic digestion cycle is slow before and after, and fast in the middle. For the inoculated sludge, the gas production rate of the former part is obviously higher than that of the latter part. Combining with the actual situation, the gas production rate of the former part experienced a high peak on the 12th and 22nd days under the condition of no inoculation. Based on this, the variation of the movement time and the total sludge production under the condition of inoculation and inoculation were investigated while maintaining the rationality of the management process[6].

2.3 Sludge digestibility

According to the actual data, the basic properties of anaerobic digested sludge were changed after inoculation and non-inoculation, and the parameters after inoculation and digestion were shown in Table 2.

It should be noted that the mud data are significant in both inoculated and non-inoculated conditions. The pH value of digested sludge can be maintained between 6.5 and 7.5. Among them, the anaerobic digestion state of sludge under inoculated condition is more stable, and the pH value and anaerobic digestion state of sludge under inoculated condition are closer to the optimal treatment range. It has certain advantages in application. The reason for this is that the adjustment of digestive system by fresh sludge during the digestion process is affected to a certain extent. If the C/N ratio in excess sludge cannot meet the reproductive requirements of microorganisms, the integrity of anaerobic digestion process will be limited and the residence time will be prolonged. Most importantly, the performance

Table 2. List of sludge parameters after digestion

Basic indicators (vaccination)	Basic parameters
Sludge moisture content (%)	97.23%
VSS content	49.01 mg/L
COD content	17.64 mg/L
pH value	7.85
VSS gas production	0.22 L/g
COD degradation rate (%)	24.4

management in the process of anaerobic digestion is closely related to the process flow in engineering[7].
Therefore, inoculation before anaerobic digestion of sludge can greatly promote the digestion reaction, and lay a solid foundation for the overall upgrading of sludge production efficiency and treatment level, to ensure that the timeliness of various biological treatment substances can be truly played, and to lay a foundation for the comprehensive development of follow-up application and management.

3 Conclusion

In a word, in the process of anaerobic digestion test of excess sludge in municipal sewage treatment plant, the specific conditions should be analyzed in combination with the operation conditions, so as to achieve the sludge gas yield rationally and to integrate the required amount of treatment effect. To a certain extent, it is necessary to improve the application management process to ensure that gas production meets the requirements.

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