PROBLEMS OF DRY ANAEROBIC DIGESTION OF CHICKEN MANURE

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According to the European trends of waste management[1], waste must be firstly be recycled, if it's possible, or be utilized with energy production. Such an approach can be achieved by methane fermentation. In addition, biogas plant effluent is a high-quality organomineral fertilizer. On the other hand, in case of the absence of government standards for this type of fertilizer and the seasonal functioning of the agrarian sector, there is a problem of the formation of an excess amount of wastewater[2]. Regulation of their amount is possible by conducting dry fermentation or recycling of liquid phase of effluent. However, providing both this methods for the poultry waste may cause nitrogen accumulation problems. The results of our previous studies indicated the possibility chicken manure dry fermentation providing, but it was characterized by significantly lower performance than liquid phase fermentation. Some repeats of dry fermentation were characterized by a significantly higher yield of biogas and methane compare the mean value, which may indicate the possibility of a methanogenic consortium to adaptation. Previous studies of organic waste dry fermentation prove a number of it's advantages. Thus, dry fermentation provide reducing the size of biogas plant, reducing the operational coast and higher volumetric methane output [3]. Dry fermentation of chicken manure is poorly understood and relevant to study it. According the literature the process was unstable both in thermophilic and mesophilic conditions, so we decided to study this phenomenon. Most of researchers were conducted in the mesophilic mode(30-55C), as in thermophilic it is especially unstable. Methane yield in previous researches was in range of 0 to 247 ml/g VS\. Theoretically it is possible to improve process by reduction influence of an ammonium nitrogen[4].

Materials and methods

The research was carried out in plastic reactors of a total volume of 50 ml in a thirteen repetitions. The substrate content was 20 g with 10% of inoculate content. Humidity of the substrate was 78%, 80%, 82% and 84%. For dilution to the required humidity, tap water was used. The reactors were placed in a thermostats. The reactors were operating in mesophilic (35 ° C) and thermophilic conditions (50 ° C). The experiment was conducted in batch mode for 160 days.

The biogas output was measured daily. The methane content was measured when the required for analysis amount of biogas was accumulated.$V = \frac{\sigma}{\bar{K}}$ -The coefficient of variation formula.

Results and discussion

The coefficient of variation of methane production in mesophilic and thermophilic mode was used to assess the stability of the process. The coefficient of variation of methane production was varied from 14.84% to 35.17% in mesophilic mode and from 14.4% to 78.21% in thermophilic mode. Thus, the process was unstable both in thermophilic and mesophilic conditions. In addition, the normal distribution of values was not typical for the methane and biogas production, which also indicates the low stability of the process. Consequently, providing of dry chicken manure fermentation is not appropriate to reduce water consumption in the utilization of poultry waste.

Conclusions

1. The process is unstable both in thermophilic and mesophilic conditions. The process in the thermophilic condition is more unstable than methopilic process. The research of stability of chicken manure methane fermentation process in solid-phase conditions was conducted for the first time.
2. Dry fermentation of chicken manure is not appropriate to reduce water consumption in the utilization of poultry waste.

[1] Directive 2008/98/EC [e-commerce recourses] // eur-lex. – 2008. –http://eur-lex.europa.eu/legal-content/En/TXT/?uri=celex:32008L0098.

[2] Nie H., Jacobi, F., Strach, K., et al., 2015. Mono-fermentation of chicken manure: Ammonia inhibition and recirculation of the digestate. Bioresource Technology, 178: 238-246.

[3] Karaalp D., Caliskan G., Azbar N. Performance evaluation of a biogas reactor processing chicken manure with high solids content: digital proceeding of the ICOEST Cappadocia 2013. Nevsehir, Turkey, June 18-21, 2013. P. 768-773.

[4] Methane fermentation of chicken manure at the lowered concentration of inhibitors in Ukraine/ . Salyuk, A., Zhadan, S., Shapovalov, Ye., Tarasenko, R.. // International Scientific Journal for Alternative Energy and Ecology (ISJAEE). – 2017. – №4. – С. 89–98