Available online at www.sciencedirect.com

ScienceDirect

Procedia Environmental Sciences 31 (2016) 59 – 64

Procedia Environmental Sciences

The Tenth International Conference on Waste Management and Technology (ICWMT)

Experience of starting the pilot scale anaerobic reactor treating hydrogen production residue from sludge and kitchen waste

Chunshan Wu [a], Zhilong Lin [a], Ximei Chen [a], Youcai Zhao [b], Hongxin Luo [a], Yuyi Zheng [a]

[a] *Institute of Environmental Science and Engineering, Fujian Normal University, Fuzhou 35000,*

[b] *National Laboratory of Pollution Control and Resource Reuse, Tongji University, Shanghai 200092*

Abstract

As more and more water treatment plants were built, the amount of sludge in China increases rapidly. The main method of disposing is landfill, but it will occupy a large number of lands. Co-digestion with kitchen waste is an effective way to treat sludge, but there are some problems, such as acidification. Dividing the anaerobic digestion into hydrogen production process and methane production process can solve these problems properly. In this study, a 300L continuously stirred tank reactor treating the hydrogen production residue from sludge and kitchen waste had been running for about 110 days. The reactor was operated at a temperature of 36°C. Due to equipment problem, the reactor failed to maintain suitable temperature from the 82nd day.PH and the concentration of TVFA were measured everyday after equipment breakdown. Total sugar, TCOD, soluble sugar, total protein and soluble protein of the feedstock were compared with that of the effluent to evaluate the performance of the reactor after breakdown. On the 102th day, the concentration of TCOD decreased from 71009 mg/L to 53296 mg/L, and the degradation rate was 24.9 %, the concentration of total sugar and total protein respectively decreased from 9721 mg/L,23373 mg/L to 5357 mg/L,14475 mg/L, the degradation rates were 44.9 % and 38.1 %.

Peer-review under responsibility of Tsinghua University/ Basel Convention Regional Centre for Asia and the Pacific

Keywords: anaerobic digestion; hydrogen production residue; sludge

* Corresponding author. Zheng Yuyi. Tel: +86 01 182 5906 1949
E-mail address: 332892742@qq.com

Peer-review under responsibility of Tsinghua University/ Basel Convention Regional Centre for Asia and the Pacific
doi:10.1016/j.proenv.2016.02.008

Nomenclature

VS	volatile solid
TS	total solid
TVFA	total volatile fatty acid
NH4-N	ammonia nitrogen

1.Introduction

Nowadays, there are about twenty million tons sludge generated in China every year[1]. Due to high moisture content, landfill and incineration are not proper ways for treating sludge. Anaerobic digestion is an ideal disposal method. However, due to the low content of organic matter, single digestion of sludge is not efficient.

Kitchen waste has a high content of organic matter. If was not dealt well, it will breed bacteria which is harmful to the environment. The main disposal methods of kitchen waste are landfill, incineration, composting and producing feed. Landfill and incineration sounds not appropriate due to the physical character of the kitchen waste. Composting and producing feed are also limited on account of product outlet and homologous virus problem.

It aroses more and more attention that kitchen waste is added into anaerobic digestion system of sludge as a co-digestion matter. Co-digestion of sludge and kitchen waste has many benefits, such as shorten lag time, adjust the C/N ratio. Co-digestion of sewage sludge and sterilized solid slaughterhouse waste was investigated by Peep Pitk[2]. Results showed that solid slaughterhouse waste addition in the feed mixture up to 5% (w/w) increased methane production 5.7 times, without any indication of process inhibition. Duan N.N[3] treated the sludge and kitchen waste using dry digestion method. Comparing to wet digestion method, dry digestion method has a higher organic load and a lower energy cost. Besides, dry digestion method can reduce the concentration of free ammonia and Na+, thus improving the stability of system. Mixing ratio can also influence the anaerobic digestion performance. Li D.L[4] found that when sludge and kitchen waste were mixed at the ratio of 1:1, gas production of system reached the highest level. Wang Y.H[5] investigated the performance of co-digestion of kitchen waste and sludge with different mixing ratio. It was found that when kitchen waste and sludge was mixed at the ratio of 1:1, the methane production potential, dehydrogenase activity and the concentration of F_{420} were optimal.

In general, co-digestion of the sludge and kitchen waste not only promotes the efficiency of the anaerobic digestion of the sludge but also offers a new method to dispose kitchen waste. But there are also some barriers for its wide use. The most important one is system acidification.At the beginning of anaerobic digestion, large molecule organic matter is broken into small molecule organic matter. These molecule organic matters were used by hydrogenogens and were converted into hydrogen and acid. Methanogens were sensitive to acid. When acid was accumulated, methane production rate will be influenced. In this study, hydrogen production and methane production were separated. After hydrogen production procedure, the pH of hydrogen production residue was adjusted to 7 and inoculated with treated sludge. Then it was poured into methane reactor and generated methane.

2.Materials and methods

2.1 Reactor

R_1,R_2,R_3 and R_4 were four kinds of reactor. R_1 is used for preheating kitchen waste. R_2 is used for preheating sludge. The mixture of kitchen waste and sludge generates hydrogen in R_3.And the effluent from the R_3 continue to generate methane in R_4

2.2 Substrate

Kitchen waste was gathered from the college's restaurant. Bones, plastic and other refractory material was removed by hand. Dewatering sludge was from a water treatment plant in Fuzhou. Kitchen waste was broken using crusher and its moisture content was adjusted to 90 %. Then it was preheated at 80 °C for 10 min in R_1.

Sludge's moisture content was adjusted to 90 %. Then it was preheated at 75 °C for 10 min in R_2. After