

Thesis Title	Effect of Organic Acids on Microorganism Involved in Biogas Production.
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Abstract

During the anaerobic digestion of organic substances to methane, acetic, propionic and butyric acids are found to be the intermediate products. The accumulation of these acids lead to a decrease in pH and stability of the digester. In this work, we investigated the toxicity of each acid on the microorganisms from an anaerobic digester fed with pineapple peel. The work has been carried out in serum vial bottles using digestion fluid as a basal media supplemented with acetic, propionic and butyric acids as a sole carbon source.

With single substrate, rate of utilization depended on the type and concentration of organic acids. In general, the initial rate increased with increasing substrate concentration. However, the maximum rate for acetic acid was at 30 millimolar in which the rate declined at 40 millimolar. For a comparison butyric and acetic acids at an initial concentration of 7 millimolar were completely utilized in 13, 26 day. After 26 days, only 5.88 millimolar of propionic acid was utilized.

The rate of utilization changed with time depended on the concentration of remained substrate, amount of microorganism and the concentration of produced products. In the first phase of acetic acid utilization led to an increase in the number of acetic acid utilizing microorganism thus the utilization was faster after 7 - 10 days. The amount of acid consumed and the presence of growth factor such as yeast extract affected amount of growth.

Acetic acid was produced from the degradation of butyric and propionic acids. From this work, acetic acid up to 30 millimolar showed no effect on the degradation of butyric acid. In contrast, acetic acid at 3.3 millimolar inhibited the propionic acid utilizing bacteria. The inhibition was temporary as propionic acid started to degrade further when

acetic acid was consumed.

When acetic acid was added with propionic acid as cosubstrates, the inhibitory effect of acetic acid on propionic was the same. In addition, increasing acetic acid concentration affected the utilization of propionic acid more than on increase in propionic acid concentration. With pure substrate, propionic acid at 7.2 millimolar was utilized 66% within 22 day where as the utilization was only 44% in the presence of 21 millimolar acetic acid. In another case with constant amount of propionic acid (12 millimolar) and increasing acetic acid from 10.5 to 28 millimolar, propionic acid was utilized by 48% and 28%, respectively.

Propionic acid was found to inhibit the butyric acid utilizing bacteria. Though , acetic acid was not directly involve in the inhibition of butyric acid , but in the presence of propionic , acetic and butyric acids the utilization of butyric acid was slower.

The result of organic acids on the groups of microorganism involved in biogas production suggested that acetic acid was the most toxic on propionic acid utilizing bacteria at concentration as low as 3.3 millimolar. Due to the fact that , acetic acid is an intermediate product from the degradation of sugar as well as C_3 and C_4 organic acids and be the substrate for methane bacteria, in the last step of anaerobic reaction. The information could be used to increase the efficiency of the process such as to increase the number of acetic acid utilizing bacteria. This could remove the inhibitory effect from the accumulation of acids and to stimulate the production of biogas.

Keywords : Biogas / Acetic acid / Propionic acid / Butyric acid