

KINETICS OF ANAEROBIC DIGESTION OF SELECTED C1 TO C4 ORGANIC ACIDS

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ABSTRACT

Anaerobic digestion involves multiple bacterial and archaea species to convert organic matter into volatile fatty acids and finally into methane and carbon dioxide. In this study, the effect of six selected C1 to C4 organic acids on biogas production and microbial growth in anaerobic digestion was evaluated using batch assays. These C1 to C4 compounds included formic acid, acetic acid, propionic acid, lactic acid, pyruvic acid and butyric acid. Each organic acid was tested as a sole substrate in individual batch experiment at different concentrations range from 250 mg COD/L to 8000 mg COD. The cumulative biogas volume was recorded automatically by a respirometer every ten min. The biogas generation rate was calculated from the cumulative biogas generation curve while the specific microbial growth rate was estimated using Monod and Andrews equations based on the coupled stoichiometric reactions between biogas production and microbial growth. The tested organic acids were divided into two groups based on substrate self-inhibitory characteristics in anaerobic digestion. Anaerobic digestion of acetic acid and propionic acid presented self-inhibition at high acid concentrations while formic acid, lactic acid, pyruvic acid and butyric acid did not inhibit anaerobic digestion at the highest concentrations tested. The microbial growth rates using butyric acid, pyruvic acid and acetic acid were 0.170, 0.167, and 0.396 d⁻¹, respectively. For comparison, the growth using propionic acid, lactic acid and formic acid was relatively slower with the growth rates of 0.136, 0.133 and 0.133 d⁻¹, respectively.