Abstract

The SMA assay is one of widely used methods in the anaerobic treatment processes and still not a standard one, which means that there is no fixed procedure to conduct the test, many researchers conducted the tests based on empiric developments and previous experiments.

The scope of this thesis is to optimize the SMA test through a comparative assay based on batch experiments. This research concerns only anaerobic processed (non-granular) sewage sludge under slightly psychrophilic and mesophilic conditions and originated from domestic sewage collected in separate sewers.

To optimize the test, the influence of several factors were studied. These factors are: initial substrate concentration, initial sludge concentration, the ratio of the initial substrate concentration to the initial sludge concentration (S_o/X_o), frequency of substrate feeds applied during the assay, addition and concentration of media, absence of both the buffer and the yeast extract from the culture-media, effect of shaking and the influence of the size scaling factor. In addition, two proposed methods for determining the SMA were used; the zero order model (ZOM) and the modified Gompertz model (GM).

Based on the results of the batch tests, it was found that the initial substrate and sludge concentrations have a contradicting effect regarding the SMA and the lag phase. The first has a positive effect on SMA and a negative effect on the lag phase, while the other is the opposite. Nutrients addition unexpectedly was found to cause toxicity rather to improve the growth and enhance the SMA. Same as to buffer, found to have an adverse effect on the SMA and the behavior of the methane production curve, while the yeast extract seems to be not a crucial demand of methanogens. Shaking plays a major role in enhancing the activity of the system. The ratio of S_o/X_o influence the physical characteristics of the

activity bottles contents; within the ranges studied, the more the ratio, the high the pH achieved, the long lag phase, but SMA could increase or decrease. Methanogenic activity assay by using acetate as substrate was found to be a self-alkalizing system.

To determine the SMA, two methods were utilized, the ZOM and the GM. ZOM, a simple model to determine the SMA, which depends on several straight points representing the initial methane production rate after the lag phase. GM requires the complete S-shape to calculate the SMA with a minimum error due to data fitting procedure, hence the GM needs a longer incubation time and more complicated calculation techniques.