Ⅶ-8 STUDY ON PREPARATION OF SEED SLUDGE FOR HYDROGEN PRODUCTION IN ANAEROBIC ACIDOGENESIS PHASE

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Introduction

It is generally considered that the methanogenic bacterial growth is very slow compared to acidogenic bacteria suggesting a rate-limiting step in the overall fermentation must depend on activities of methanogenic bacterial activities. In this context, attempt has been made to separate those bacterial activities in the fermentation process. This was done by proper control of the dilution rate during the acclimatization process. To confirm the revealing results, 24 hours batch culture experiments was also done.

Material and methods

a. Acclimatization Process

The seed sludge was taken from Koriyama City Sewerage Treatment Plant. Anaerobic cultivation condition was set (at 35℃ and pH < 5.5) with a glucose medium as table 1.0. Part of the sludge was replaced once in 2 or 3 days.

Glucose	:	11,700 mg/l
Trace elements	:	5 ml/l
Yeast Extract	:	100 mg/l
pH buffer $NaHCO_3$	:	2~3 gm/l

Table 1.0

b. Fed-batch feeding adjustment

Initially, methane and carbon dioxide biogas produced from the above medium was allowed to evolve until the production rate become stable after which the feeding volume and timing was adjusted. About 25% of the sludge was replaced by the glucose medium everyday (for the relatively high dilution rate of 3.5 day^{-1}) for about 2 months and the biogas evaluation was analyzed more thoroughly as shown in figure 1.

c. Batch experiments

To confirm the acidogenesis microbial activities in the medium, batch culture experiments was done and the results was used in the kinetics parameters calculations.

Results and discussion

Figure 2a, 2b and figure 3a, 3b show biogas production volume, composition and the pH variations in the batch experiments for tank B and tank C. Methane gas was almost zero (< 0.1%) throughout the 24 hours experiments.

Figure 4a and 4b show the variations of the glucose concentration degradation and biomass growth during the 24 hours fermentation process for tank B and C respectively. The biomass growth was not observed after about 12 or 14 hours of feeding (almost about the same time as the glucose was completely depleted) suggesting a substrate limiting process. Methane gas was not observed throughout the experiments but the hydrogen gas was produced even after the disappearance of the glucose concentration.

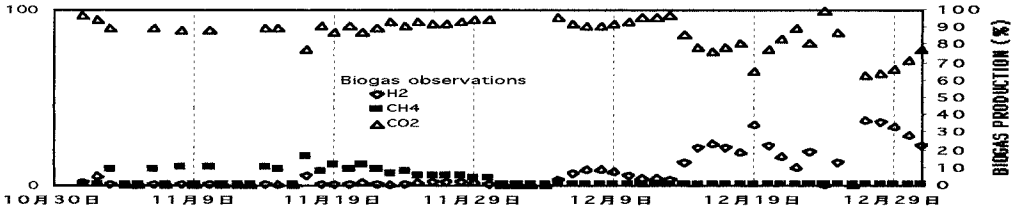
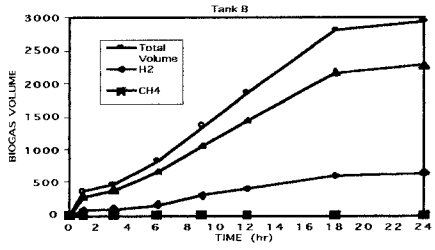


Figure 1 Daily biogas composition



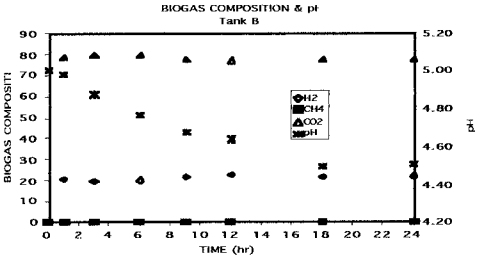
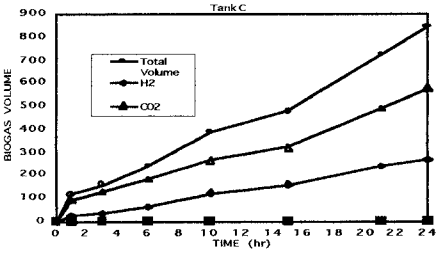


Figure 2a and 2b Biogas data - tank B



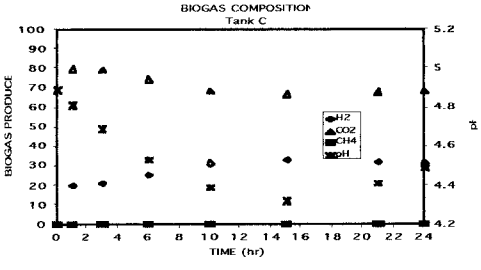


Figure 3a & 3b Biogas data - tank C

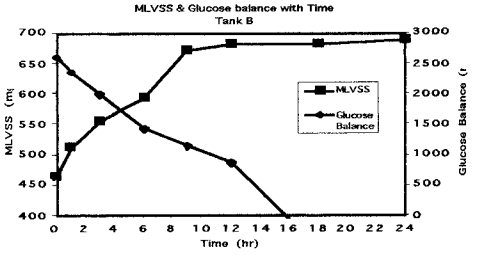


Figure 4a Biomass and glucose - tank B.

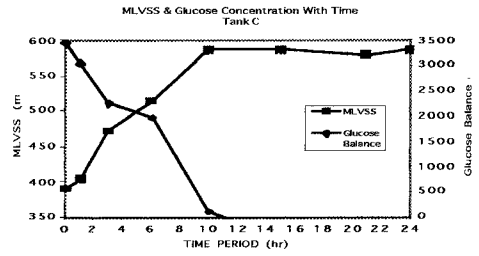


Figure 4b Biomass and glucose - tank C

Table 2.0 shows kinetics parameters derived from calculations and plotted graph of the batch experiments result.

	Y	Ks	μ max
	mgVSS/mg	mg/l	1/d
Tank B	0.26	1162	2.5
Tank C	0.17	588	2.9

Table 2.0 Kinetics parameters

Conclusion

* The results shows that proper acclimatization and control of the retention time could develop the acidogenesis phase in the glucose fermentation.
* The dilution rate value calculated in the fed-batch culture is reasonable because the methanogenic activities was found by other researches to be very low at retention time less than 14 hours[1].
* The batch experiments (even with its numerous constraints) and regardless of its transient state, could produce a limited results which is useful in the examining the basic conditions of anaerobic process.
* The kinetics parameters should be confirmed by setting a chemostat experiments.

References

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