

Accepted Manuscript

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Sławomir J. Jabłoński, Marcin Łukaszewicz

PII: S0960-8524(14)01410-2

DOI: <http://dx.doi.org/10.1016/j.biortech.2014.09.151>

Reference: BITE 14041

To appear in: *Bioresource Technology*

Received Date: 9 May 2014

Revised Date: 9 September 2014

Accepted Date: 13 September 2014

Please cite this article as: Jabłoński, S.J., Łukaszewicz, M., Mathematical modelling of methanogenic reactor start-up: importance of volatile fatty acids degrading population, *Bioresource Technology* (2014), doi: <http://dx.doi.org/10.1016/j.biortech.2014.09.151>

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Mathematical modelling of methanogenic reactor start-up: importance of volatile fatty acids degrading population

Sławomir J. Jabłoński, Marcin Łukaszewicz

University of Wrocław, Faculty of Biotechnology, ul. F. Joliot-Curie 14a, 50-383 Wrocław, Poland

KEYWORDS: Anaerobic Digestion Model No.1; ADM1; volatile fatty acids; specific anaerobic activity; FISH; microorganisms' community

Abstract

Development of balanced community of microorganisms is one of the obligatory for stable anaerobic digestion. Application of mathematical models might be helpful in development of reliable procedures during the process start-up period. Yet, the accuracy of forecast depends on the quality of input and parameters. In this study, the specific anaerobic activity (SAA) tests were applied in order to estimate microbial community structure. Obtained data was applied as input conditions for mathematical model of anaerobic digestion. The initial values of variables describing the amount of acetate and propionate utilizing microorganisms could be calculated on the basis of SAA results. The modelling based on those optimized variables could successfully reproduce the behaviour of a real system during the continuous fermentation.

1. Introduction

Anaerobic digestion is a multistage process in which organic matter is decomposed to biogas, water, ammonia and other mineral compounds. Since biogas consists of carbon dioxide and methane, it may be used as fuel. Decomposition of substrate involves many groups of microorganisms. The stability of the process depends on the equilibrium between individual groups of microorganisms involved in the digestion of organic matter. The bioreactor is particularly susceptible to failure during start-up process, especially when easily biodegradable substrates are applied. The start-up procedure may be optimised with the use of

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