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Biogas production according to the waste categories

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ABSTRACT

The aim of the present work is to model the production of a biogas according against Numerical simulation measured biogas production and data which are obtained from the literature.to the different categories of the biodegradable materials. The simulation model that predicts biogas production from a plug-flow anaerobic digester is developed. This model is based on the kinetic equation of the methanization. A first-order kinetic model is used to predict the chemical reactions in the digestion process. A model prediction is validated.

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1. INTRODUCTION

Biogas production models have evolved from a simple model to a complex's ones [2-5]. For the simple models, if any of the assumed parameters such as digester volume and the temperature is changed, the models become no more valid. The complex model (Scott and Minott, 2002) [6] contains more input parameters compared to the simple ones. The inputs include: the amount of biodegradable waste, the initial volatile solids concentration, the bacterial growth rate, the digester temperature and the digester volume. However, these models are one-dimensional. It is also known that the biogas production is sensitive to the digester temperature, pH of the solution, and non-uniformity of flow pattern of liquid inside the digester. In a previous studies [7-12], these parameters were assumed to be constants.

In this context, in order to understand the internal phenomena that occur within the digester, we have established a biokinetic model based on production potential, types of biological waste, methane production and production time. The model is simulated on Matlab software introducing experimental parameters of the literature.

2. RESEARCH METHOD

2.1. Transportation of Biogas and Biomethane

The biogas that has been upgraded to biomethane by removing the H2S, moisture and CO2, biomethane must be stored for future use (the production of biofuels and to produce Electricity...)

This paragraph discusses the kinetic modeling for the biogas production and waste classification for the biomethane as well as modes of the biomethane transportation.

2.2. Modelisation

The biogas production kinetics for the description and evaluation of methanogenesis was based on the kinetic equations and various parameters, such as Biogas production rates, time in the day for digestion and cumulative biogas production. The equation of the biogas production rate in the ascending and descending limb can be expressed by Eq. (1) [11-15].

$$\frac{dC}{dt} = -\frac{kC}{k_c}X \quad (1)$$

Where K is the maximum rate of the substrate used for microorganism mass (mass per volume), kc is the waste concentration (mass per volume) at the equivalent use rate to one-half of the maximum rate.

In addition, cumulative biogas production was simulated using logistic kinetic model, exponential rise to maximum and modified Gompertz kinetic model. Logistic kinetic equation is shown in Eq. (2):

$$\zeta_P = \zeta_0 e^{-\vartheta t} \quad (2)$$

We obtain the production rate by substituting equation 2 in equation 3:

$$\Omega = \vartheta\, \zeta_0 e^{-\vartheta t} \quad (3)$$

The cumulative production ζc will be the difference between the initial production potential and the production potential at time t:

$$\zeta_c = \zeta_0(1 - e^{-\vartheta t}) \quad (4)$$

To solve this equation, the initial production potential must be known. This potential is different for each landfill. It is linked to the waste composition and to its age. In addition, the kinetic constant ϑ must be determined according to the half-life definition which is the time for which half of the organic matter is degraded. Finally, there are several types of waste that degrade at very different rates.

3. RESULTS AND DISCUSSIONS

To study the influence of the biogas production times, we have defined a mathematical model of kinetics. The results obtained using Matlab software are presented in the figures 1 and 2:

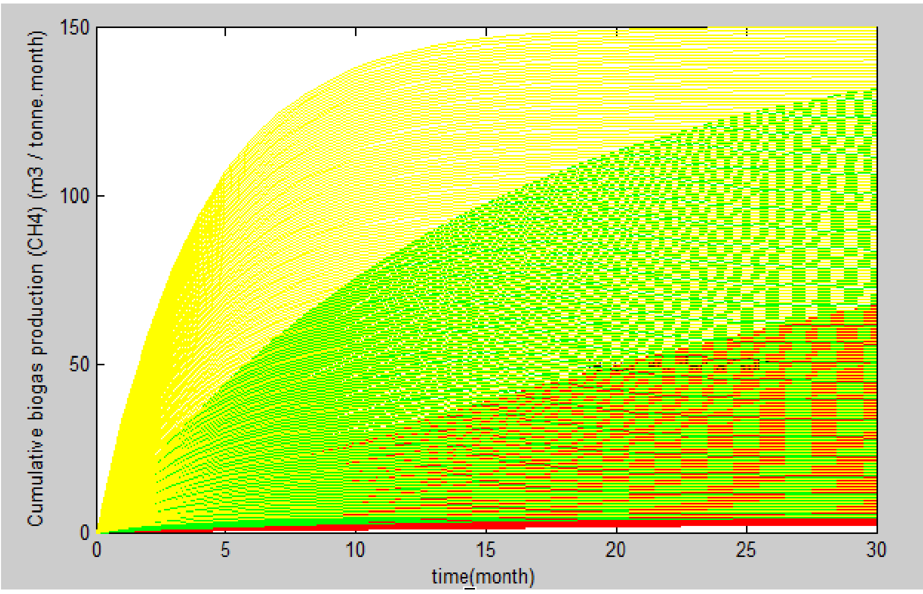

Figure 1. Evolution of cumulative biogas production to waste function

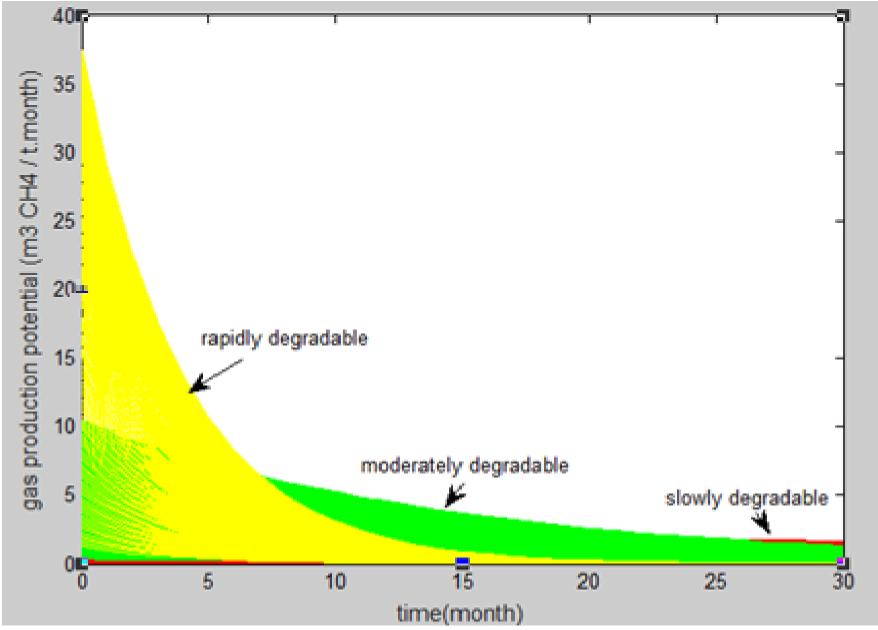

Figure 2. Evolution the biogas production potential according to the wastes categories

In order to find the maximum methane potential and methane production rate, the right balance between the substrate and organisms are needed [16]. As stated by. [17-18], theoretically, methane yield depending on the waste which is; rapidly degradable, moderately degradable and slowly degradable, only affects the kinetics of the production. However, the results obtained by numerical simulation using Matlab software show that rapidly degradable waste can have an influence on the production potential due to the strong evidence that the ratio directly affects the growth patterns of microorganisms [19-22].

4. CONCLUSION

The overall objective of the present work was to deepen the knowledge relating to anaerobic digestion processes. It is shown that anaerobic digestion is an efficient, easily exploitable and economical method of treating organic waste. It is also remarked that modeling can play an important role in the realization of a reduced prototype experimental bioreactor which can be a solution to the problems of gas supply in the rural environment. This work will be followed by other more in-depth studies which will make it possible to fully understand the phenomena of anaerobic digestion and therefore the production of the biogas.

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