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Robust, reliable and controlled bio-methane production

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TOWARDS RELIABLE AND ROBUST ANAEROBIC DIGESTION

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Anaerobic digestion, employed for methane generation, is one of the sources of renewable biofuel that are cost-effective and can be energetically positive in that more energy can be produced that is used for biogas production. In the current context of the need to find and establish renewable energy sources, as well as preservation of national energetic independence, anerobic digestion offers great potential in where large-scale farming occupies a centrale role in the country's economy.

On the oxidizing surface of our planet, dominated by its exposure to air containing 20.9% O_2 by volume, all carbon present in organic matter is destined to be eventually converted to CO_2. Anaerobic digestion provides a natural loop where approximately half of this carbon can be first converted to methane (CH_4) and then converted to CO_2 though combustion and generation of useful heat and energy. The end result is the same in that all the organic carbon is converted to CO_2, but not before some of the carbon is used to generate renewable energy.

Energy generation through anaerobic digestion is already adopted in many countries and it is mainly applied on dairy and pig farms and on municipal waste treatment plants. Generally, the technology works well under such conditions, but it is susceptible to changes in the nature of the feed, such as during vacation periods when the nature and volume of the domestic sewage changes, or during particularly cold spells when the mesophilic conditions required for optimal digestion are perturbed. Anaerobic digestion remains relatively fragile.

Anerobic digestion consists of several biochemical processes: hydrolysis, acidogenesis, acetogenesis and methanogenesis. Each of these processes are performed by specific consortia of bacteria and archaea. The delicate balance of each consortium's population is one of the reasons for the fragility of the overall anaerobic digestion process. Each of the above processes has its own optimal conditions but all the processes can occur in the same bioreactor by establishing a compromising set of conditions.

This presentation outlines the work performed to study each of the processes individually in order to develop a cascade model of anaerobic digestion where each process occurs under its ideal conditions. A new and simple experimental system (Fig. 1) for the study of each of the processes separately was developed and the results used to construct a simple mathematical model (Fig. 2) that predicted the overall rate of anaerobic digestion of spent coffee.

Future work will concentrate on the assembly of a laboratory scale anaerobic digestor consisting of a bioreactor for each biochemical process and a control system to pilot methane production continuously and reliably.

Fig. 1. Experimental set-up

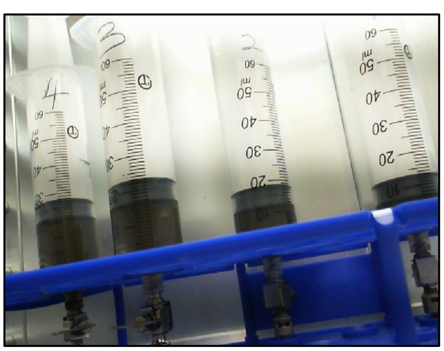

Fig. 2. Actual and model results of anerobic digestion of spent coffee