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Extended Abstract

Biogas Production by Anaerobic Digestion Coupled with Wastewater Treatment †

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The aim of this paper is to present the laboratory scale installation for biogas production from indigenous feedstock coupled with treatment of the liquid digestate side flow by microalgae cultivation, developed for Complex Project 32PCCDI/2018. Besides the efficient production of biogas with high yield in methane, we also aim to prove the possibility of efficiently reducing nutrient content of liquid digestate, by growing microalgae on this side flow as an alternative to the specific nutrient rich medium currently used for cultivation.

Microalgae cultivation in wastewater is an integrative approach which offers a cost effective and eco-friendly method for sustainable production of valuable biomass, since it greatly reduces costs caused by the requirement of a large volume of fresh water, nutrients, and trace elements for its cultivation [1]. Liquid digestate, a side flow from biogas industries, is rich in nitrogen, phosphorus, micronutrients, and other organic compounds that can be used by microalgae growth, thus providing a cost effective way for liquid digestate treatment and biomass production for value-added products.

The anaerobic digestion process uses agricultural waste as feedstock: Cattle and poultry manure, silage maize, fodder beet and low quality potatoes. The digester has the capacity to process 30 L of substrate, calculated with a 10% dry matter content. The biogas obtained from this process is rich in methane, with a maximum of 73% methane. When the methane content of the biogas decreases significantly, part of the fermentation substrate (10%) is replaced daily by a fresh substrate portion, in order to maintain a high methane yield. The substrate replaced, the digestate, is further separated into liquid and solid digestate. The solid part is valued by pyrolysis to produce bio-char, bio-oil and bio-hydrogen, and the liquid digestate is processed to be used as nutrient medium for microalgae growth, thus adding value to this side flow from biogas production.

The cultivation process of microalgae on liquid digestate is conducted in an open pond with a volume of 30 L. The liquid digestate is diluted until a N and P concentration can sustain microalgae growth (too high concentration of these nutrients can be toxic to the microalgae strain). The open pond is inoculated with *Chlorella vulgaris* (AICB 329) microalgae strain, from ICECHIM's own strain collection. When the microalgae strain reaches the plateau state of growth, part of the microalgae suspension (10%) is replaced with a new portion of liquid digestate collected from the anaerobic digester and diluted accordingly, so as to maintain the necessary level of nutrients required for growth. The microalgae suspension is further concentrated by electro-flocculation and sedimentation,

the supernatant is separated and recycled in the process, and the concentrated microalgae suspension is further processed for obtaining value-added products.

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