Qualitative and quantitative characteristics of the wastewater and ethanol produced from dehydrated household bio-waste using the drum-drying method and the SSF process respectively

A. Sotiropoulos*, N. Kalogiannis*, K. Moustakas*, S. Vakalis*, D. Malamis*
*National Technical University of Athens, School of Chemical Engineering,
Unit of Environmental Science and Technology, Greece
9, Heroon Polytechniou Str., 15773 Zographou Campus, Athens;
Email: angeluoi81@gmail.com

Keywords: Bio-waste, ethanol, biofuels, wastewater, SSF

INTRODUCTION

The organic fraction of Municipal Solid Waste (MSW), is biodegradable and hence it is required to prevent its decomposition, in order to handle this fraction properly (Sotiropoulos et al., 2016). Drying of the source separated organic fraction of MSW at a decentralized or central level, can assist towards this direction and hence a new resource can be created in order to be used in various processes to produce bio-based chemical products such as ethanol. The wastewater produced during the dehydration process may be further used for the production of ethanol through a bioconversion process or it should be further treated for the production of a new clean water resource.

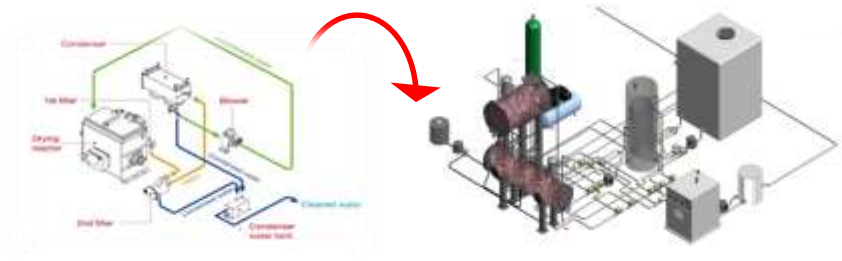

Figure 1: The innovative bio-waste management and treatment scheme

The aim of this research was to investigate the possibility that the wastewater derived through the dehydration technique could be used for the production of bioethanol in a bioconversion process - Simultaneous saccharification and fermentation (SSF) using dehydrated material in combination with the produced from the waste drying technique wastewater. Moreover, some of the wastewater physicochemical properties were examined in order to characterize it and investigate the possibility to be further treated. This properties among others included: pH, Conductivity, COD, BOD, NO_3-N, TC, and PO4. The waste management and treatment scheme used are presented in the following diagram:

MATERIALS AND METHODS

A 100Kg/day commercialized waste dryer was used for the dehydration of the household bio-waste. The wastewater was collected after the dehydration process (9 hours drying time) and analysed in regard to its properties. The way the dehydration process was performed is described by Sotiropoulos et al., 2016. The dehydrated material was characterized in terms of its lignocellulosic properties while it was used in combination with the wastewater produced for the production of ethanol using Novozymes enzymes. The exact conditions used are not within the scope of this communication letter.

RESULTS

The basic physicochemical properties of the produced waste are recorded in Diagram 1.

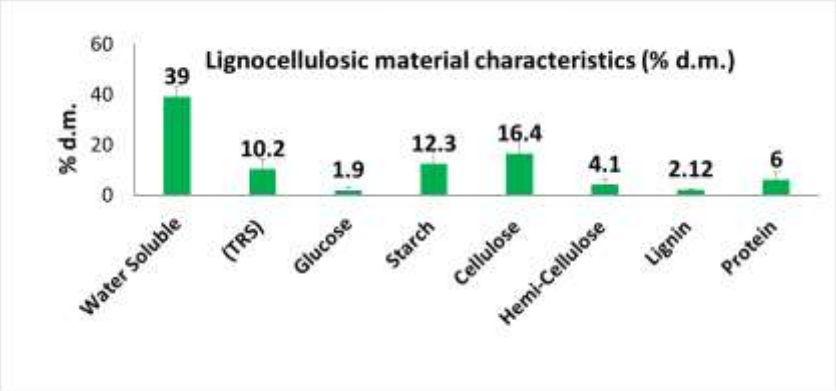

Diagram 1: Lignocellulosic material properties

The basic chemical properties of the produced wastewater are recorded in Table 1.

Table 1. Chemical properties of wastewater derived from the dehydration process

Parameter	Unit of Measurement	Value
pH	-	3.06
Conductivity	μS	230.3
TC	mg/l	2746
NO_3-N	mg/l	30.1
PO_4	mg/l	4.26
COD	mg/l	19,166.6
BOD_5	mg/l	8,143.3

The quantity of ethanol produced with the use of the wastewater in a proportion of 60%w/w with the dehydrated material is presented in Diagram 2.

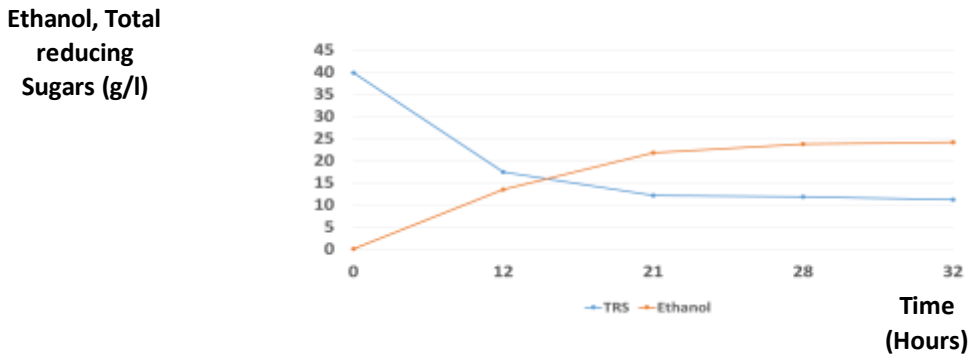

Diagram 1. Ethanol production using dehydrated bio-waste combined with wastewater

KEY FINDINGS

- Production of pure dehydrated biomass with significant carbohydrate content and stabilized properties;
- Success to the use of the wastewater mixed with the dehydrated material using the SSF process. A quantity of 24.12 g/l of ethanol was produced;
- The high values of COD and BOD in the wastewater suggest its further treatment before it is disposed or used;
- Further research towards this section needs to be done.

REFERENCES

- Sotiropoulos A, Vourka I, Erotokritou A, Novakovic J, Panaretou V, Vakalis S, Thanos T, Moustakas K, Malamis D. (2016). Combination of decentralized waste drying and SSF techniques for household biowaste minimization and ethanol production. Waste Management, doi:10.1016/j.wasman.2016.03.047