International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 12 No. 3 Aug. 2015, pp. 756-760

http://www.ijias.issr-journals.org/

Anaerobic digestion of olive mill wastewaters to produce biogas

Fatima Ebich[1], Hassan Elbari[2], Nabil Cheikhi[1], and Azzouz Essamri[1]

[1]Laboratory of Agroresources and Process Engineering, University Ibn Tofail, Faculty of Sciences, Kénitra, Morocco

[2]Biotechnology Laboratory, Environment and quality, University Ibn Tofail, Faculty of Sciences, Kénitra, Morocco

ABSTRACT: The olive oil industry in Morocco produces an important amount of olive mill wastewater (OMWs) which poses serious environmental problems, anaerobic digestion is the most interesting technique of olive mill wastewaters treatment. In this study anaerobic digestion of OMWs was performed in a semi continuous mesophilic anaerobic digester for 30 days, during the experiment, the volume of biogas produced was measured by the water displacement method. The pH was around neutrality throughout the experiment and the maximum of biogas yield coefficient was 2277 ml / g VS.

KEYWORDS: Olive mill wastewaters, treatment, anaerobic digestion, digester, biogas.

1 INTRODUCTION

The olive oil industry generates a large amount of wastes consisting of olive cake (solid waste) and olive mill wastewaters (OMWs), liquid effluents of complex composition, that will be dealt to face potential pollution risk because they have great power contaminant, mainly due to high concentrations of organic matter. Their harmful effects derive largely from their polyphenol content (**1**). The production of olive oil in the world achieved the 2.5 million tons per year (**2**) which is equivalent to 3.750.000 liters of olive mill wastewaters. The toxicity of OMWs is attributed to the presence of free fatty acids with long chain and recalcitrant compounds difficult to degrade as phenolic compounds, in high concentrations (4-15 gL -1). (6), which are responsible for phytotoxic and antimicrobial effects (**3**) (**4**) (**5**).

Anaerobic digestion is one of the most promising technologies for disposing OMWs (**6**). The objective of this study is to evaluate the biogas production of OMWs by semi continuous anaerobic digestion; the experience of anaerobic digestion is carried out in semi-continuous mode in the mesophilic conditions using an inoculum originating from active digester that treats the sludge purification station in Marrakech (RADEMA).

2 MATERIALS AND METHODS

SUBSTRATE AND INOCULUM

The treated substrate in the digester is the raw OMWs, outcome of pressure system, that has not undergone any prior pretreatment, table (1) shows the physicochemical characteristics of the substrate. The inoculums used is originating from active digester, table (2) shows physicochemical characteristics of the inoculums

Table 1. physicochemical characteristics of the substrate

Parameter	Value
pH	5,4
Alcalinity (mg/l)	300
Total solid (g/l)	102,8
Volatile solid (g/l)	61,12
Mineral solid (g/l)	41,68

Table 2. physicochemical characteristics of the inoculum.

Parameter	Value
pH	6,9
Alcalinity (mg/l)	1720
Total solid (g/l)	30,2
Volatile solid (g/l)	20,97
Mineral solid (g/l)	9,23

LABORATORY DIGESTER

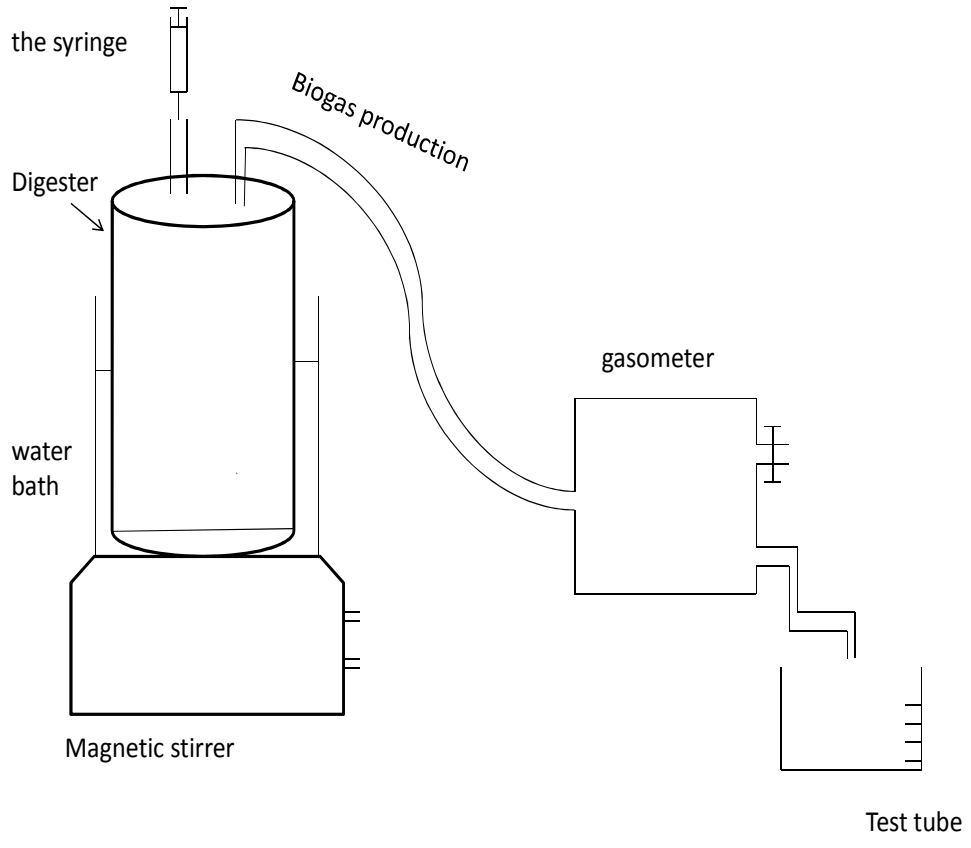

Figure 1. Experimental digester

This study was performed using a mesophilic (37°C) batch laboratory digester with a total volume of 5 liters, the useful volume of the reactor was maintained at 4 liter. The reactor is provided with two suitable devices for taking samples for analysis and the production of biogas, it is fully stirred by means of an electromagnetic stirrer connected to a motor (7).

EXPERIMENTAL PROCEDURE

The experience of anaerobic digestion is performed in semi-continuous mode in the mesophilic conditions. In early the digester is fed with GAL, synthetic solution composed of glucose, lactic acid and sodium acetate, this is the inoculation digester phase, and then it is supplied simultaneously with OMWs and GAL (25% OMWs + 75% GAL) and (75% OMWs + 25% GAL) phase of adaptation , and the last phase is the substrate treatment phase or the digester is fed with the substrate alone with the charges 1, 2, 3, 4 and 5g / L VS. The biogas produced is calculated by the water displacement method.

3 RESULT AND DISCUSSION

BIOGAS PRODUCTION

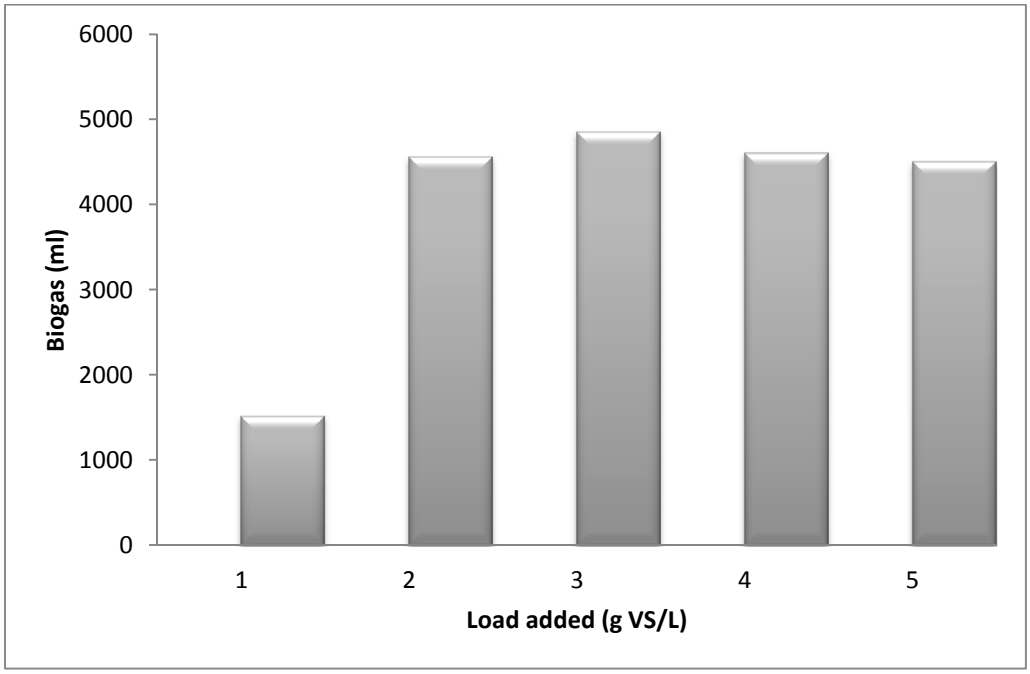

Figure2: The biogas production during the anaerobic digestion of OMWW for different loads (from 1.00g to 5.00g SV)

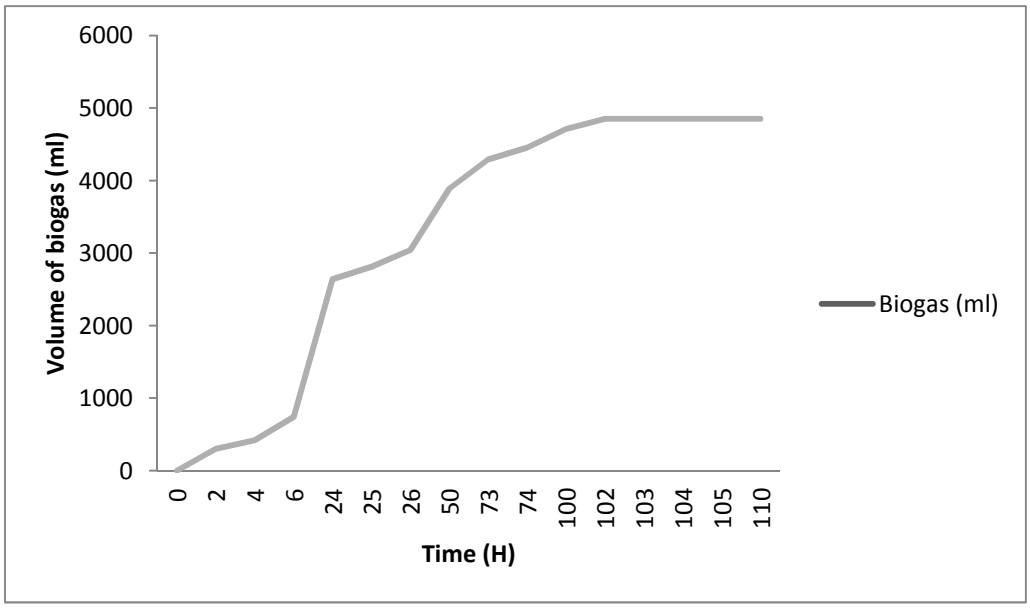

Figure3: Variation of volume of biogas accumulated for the load 3.00g SV/L

The experiment was performed in semi continuous mode for 30 days, the volume of biogas was measured as a function of time by the water displacement method. Fig (**2**) shows the production of biogas for different loads in the digester (from 1 to 5 g VS / L), the maximum of biogas was produced for the load 3 g VS / L, dice load 5 g VS / L biogas production begins to stabilize. The biogas yield coefficient for the loads 1, 2, 3, 4 and 5gVS/L is respectively 1520, 2277, 1616, 1150 and 900 ml / g VS, We note that the biogas yield coefficient decreases in the load 3g VS with a maximum recorded for the load 2 g VS / L.

Fig (3) shows the evolution of biogas production over time, we note an increase in biogas produced between 2h and 102h then it begins to stabilize, This is due to substrate depletion, thus the organic matter is degraded into simpler compounds (amino acid, simple sugars ...) and organic acids, alcohols and acid by fermentative bacteria Generating ... After These items are converted into biogas qui contains CO_2 and CH_4 (8), **(**9).

PH VARIATION IN THE DIGESTER

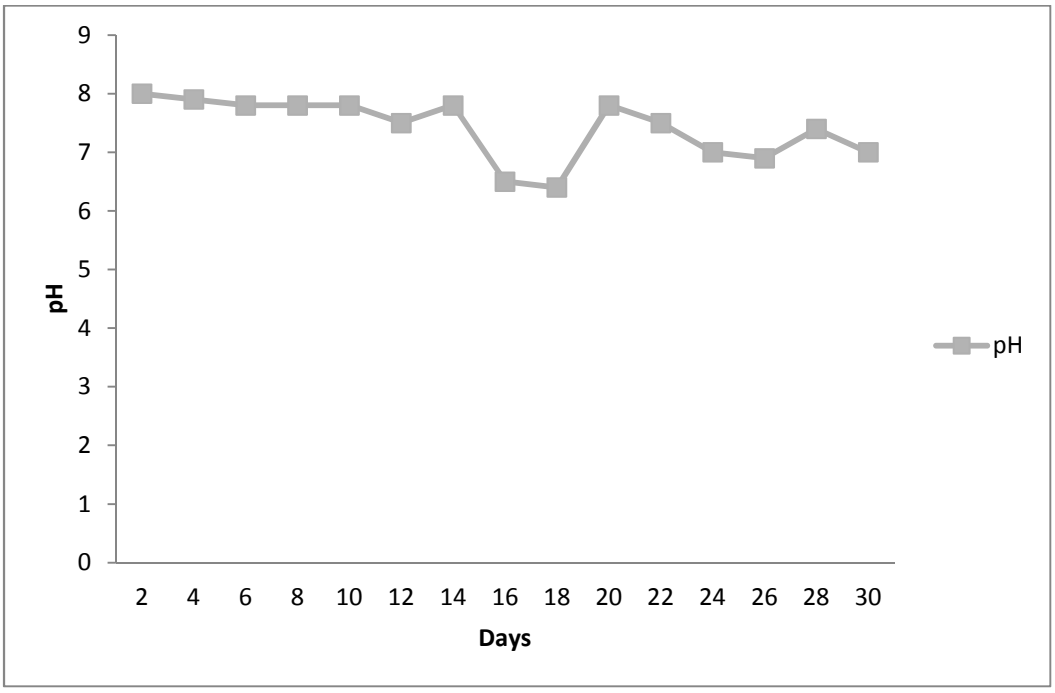

Figure 4: PH Variation during the experiment

Figure (4) shows pH variation in the digester throughout the period of the process of anaerobic digestion, the pH is around neutrality during this experiment, Thus the stability of the process of anaerobic digestion in mesophilic phase will be at pH values between 6.5 and 7.5 (10), also, we note that there is a decrease of pH in 16^{th} days caused by the acidity of OMWs added.

4 CONCLUSION

Anaerobic digestion is a very effective treatment method for resolving pollution olive mill wastewaters which are very acidic effluents and is charged with organic matter dificult to degrade, this experiment was performed in a mesophilic digester (34- 40°C) in semi continuous mode, the biogas produced is flammable, and the digestate remaining in the digester can be used as fertilizer in agriculture or as inoculum to make easy starting other experiences of anaerobic digestion.

REFERENCES

[1] ANNAKI, *Traitement et valorisation des margines*, Thèses de docteur d'état, Université Sidi Mohamed Ben Abdellah, Faculté des sciences Dhar Elmehraz Fès. 1998

[2] : F.A.O., 2003. Graines, noix et amandes oléagineuses *Bulletin FAO de statistiques,* 42, 75.)

[3] Ait Baddi G., Hafidi M., Gilard V., Revel JC. Caractérisation des acides humiques produits lors du compostage des déchets de moulin à huile: analyses élémentaires et spectroscopiques (FTIR et 13 CRMN), Agronomie, 23, pp 1-6, 2003

[4] Sayadi S., Allouche N., Jaoua M., Aloui F. Detrimental effects of high molecular mass polyphenols on olive mill wastewater biotreatment. Process Biochemistry. 35, pp 725-735, 2000.

[5] Zenjari B., El Hajjouji H., Ait Baddi G., Bailly J.R., Revel J.C., Nejmeddine A., Hafidi M. Reduction of toxic compounds during the composting of olive mill wastewater straw mixture. Journal of Hazardous Materials. A138, 433-437, 2006.

[6] Lorenzo Bertina, Sara Bersellia, Fabio Favaa, Marco Petrangeli-Papinib, Leonardo Marchettia, Anaerobic digestion of olive mill wastewaters in biofilm reactors packed with granular activated carbon and ''Manville'' silica beads, Water Research 38 (2004) 3167–317.

[7] Fatima Ebich ,Nabil Cheikhi,Er-riyahi Saber, Siham Belhadj، Hassan Elbari ,Azzouz Essamri, Biogas Generation from Batch Anaerobic Digestion of Kitchen Waste'' International journal of advanced renewableenergy reasearch (AJASR), (2015).

[8] Batstone, D. J., Keller, J., Angelidaki, I., Kalyuzhny, S. V., Pavlostathis, S. G., Rozzi, A., Sanders, W. T. M., Siegrist, H. and Vavilin, V. A. (2002). "The IWA Anaerobic digestion model no 1. (ADM1)" Water Science and Technology, 45, (10), 65-73.

[9] Suh, Y. J. et Roussaux, P**.** (2002). "An LCA of alternative wastewater sludge treatment scenarios", Resources, Conservation and Recycling, 35, 191-200.

[10] Moletta, R. (2002). «Procédés biologiques anaérobies, Dans Gestion des problèmes environnementaux dans les industries agroalimentaires » Technique et documentation -Editions Lavoisier, Paris.