Production Of Biogas With Bioconversion Of Organic Solid Waste (Manure) And Food Industry Waste

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The production of biogas from organic solid waste represents a good challenge for the production of energy from biomass. Biogas represents an example of fuel gas obtained by biomass anaerobic fermentation of manure, sewage sludge, biodegradable waste and municipal waste. Due the amount of waste, biogas production represents a very promising way to solve the problem of waste treatment thanks to the production of bio-energy, as thermal as electric. Furthermore, the solid residuals of fermentation might be reused as fertilizers. The process is biocatalysed and steps of biomass fermentation might be reassumed as the following sequence: Hydrolysis, Acetogenesis and Methanogenesis.
Aim of this paper was the experimental study in a pilot-scale fermentor where mixture of solid organic and vegetable residuals are tested mixed in order to optimize the biogas production. Experimental results permitted also to evaluate the optimal feed composition and to scale-up the process.

1. Introduction

Biogas is a fuel gas (CH_4 and CO_2) obtained by anaerobic fermentation of biomass like: manure, sewage sludge, municipal solid waste, (Zupancic et al., 2008)., biodegradable waste and feedstock, (Nallathambi Gunaseelan, V. ,2003).
By-product of the process should be fertilizer and irrigation water.
Biogas is usually used as fuel gas, can be burned directly for cooking, heating, lighting or can be used for generating electrical and thermal energy reused in the farm or supplied to the national energy net.
Research activity is actually addressed to the study of the possibility to use as substrate both manure and solid or liquid effluents coming from agro-food industry, like olive mills, namely wastewaters and husks (Erguder et al., 2000), or orange juice production, like peels, also named "pastazzo", (Bouallagui H., et al. 2005). This opportunity will permit as to solve an environmental problem as to produce energy: the problem became an opportunity, (Aversa et al., 2008).
Some interesting results have been obtained as in lab-scale as in pilot scale, looking for the evaluation of the range of composition in which the biogas might be produced.

The pre-treatment has been also tested to remove antioxidant compounds that can reduce the performance of the anaerobic digester or can inhibits the bacterial activity.

2. Experimental

Manure supplied from Azienda Agricola Coretto has been used as organic feed. Orange peels and husks, supplied from local factory have been added as vegetal substrate.
Two kinds of digestor have been setting up, as depicted in Fig. 1: a lab-scale of 15 liters and a pilot-scale of 100 liters. Both were gently mixed; temperature was measured and controlled by a heating system; pH was controlled by adding usually a basic solution..

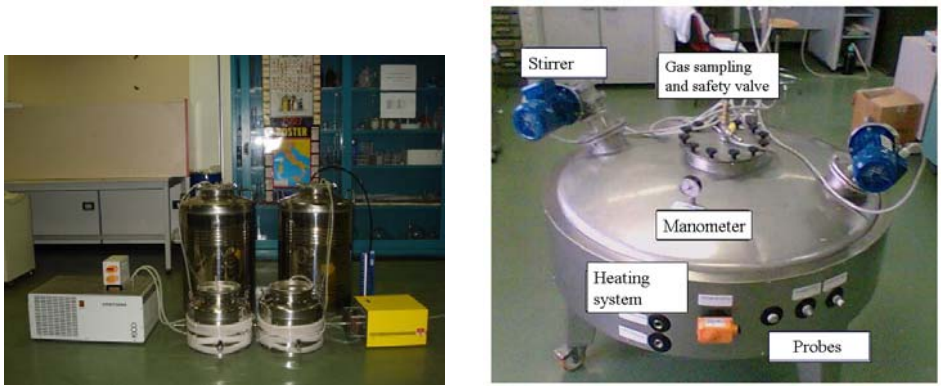

Fig.1.a) Laboratory set-up: two steel tank mixed simultaneously, biogas collected in two separated storage tank; b) Pilot-scale set-up: steel tank mixed and controlled.

Experimental tests have been carried out testing the amount of vegetal waste that should be added to the manure in order to improve the amount and the yield of biogas. To make a comparison simultaneous tests have been effected feeding the two reactors with manure (bioreactor 1) and manure with vegetal waste (bioreactor 2). Regarding the husk the range of composition was 5-15%, orange peels (pastazzo), 5-50%, vegetation wastewater 5-50%.
During the tests an increase of acidity has been observed. To correct pH as ammonia as bicarbonate has been added, by simulating a real possibility of pH correction in the factory.
Biogas production and composition have been compared in order to individuate the maximum ratio of vegetal wastes that can be supplied.

3. Results and discussion

When 15% of husk is supplied no biogas production has been observed., probably because the high level of acidity and antioxidants. Instead when 5% of husks is fed, an increase of biogas and methane has been observed as show in Fig. 2.
When pilot scale has been operated with “pastazzo”, a pH correction has been necessary to carry out the reaction. In Fig. 3 the pH and methane composition have been reported when 40% of “pastazzo” has been added to manure.

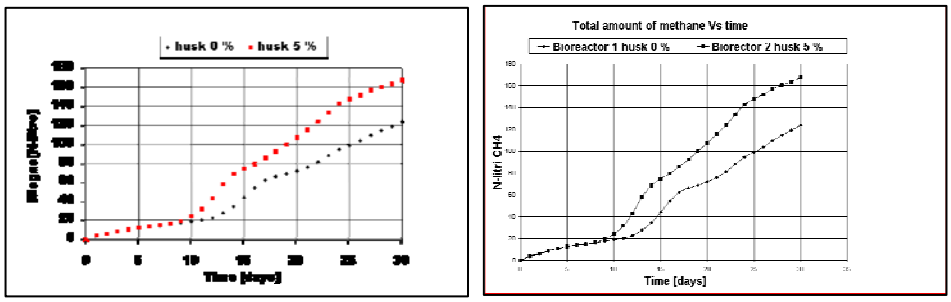

Fig. 2. Biogas and methane production in the lab-scale tank as function of husks percentage in the feed.

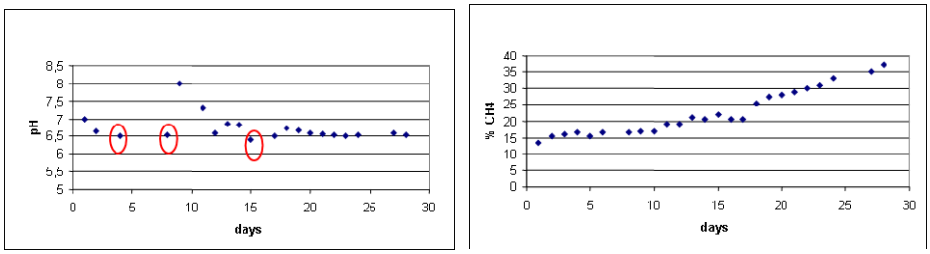

Fig. 3. pH and methane production in the pilot-scale digestor when 40% of "pastazzo" is fed as co-substrate of manure.

4. Conclusion

In the present work some results concerning anaerobic digestion of vegetal wastes and manure have been presented. Results evidenced an increase of biogas and methane production when 5% of husks or 40% of orange peels was added, confirming the possibility to produce bio-energy from wastes.

References

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