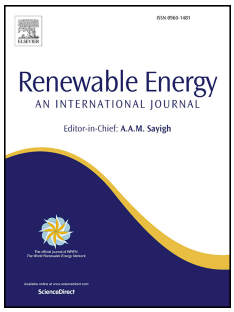
Accepted Manuscript



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PII: S0960-1481(17)30781-4

DOI: 10.1016/j.renene.2017.08.027

Reference: RENE 9125

To appear in: *Renewable Energy*

Received Date: 2 February 2017

Revised Date: 2 July 2017

Accepted Date: 11 August 2017

Please cite this article as: Paladino O, Neviani M, A closed loop biowaste to biofuel integrated process fed with waste frying oil, organic waste and algal biomass: Feasibility at pilot scale, *Renewable Energy* (2017), doi: 10.1016/j.renene.2017.08.027.

A Closed Loop Biowaste to Biofuel Integrated Process Fed with Waste Frying Oil, Organic Waste and Algal Biomass: Feasibility at Pilot Scale

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ABSTRACT: Nowadays, the importance of recycle and energy savings is increasing due to the current economic and environmental situation. Many different technologies were developed to exploit biowaste to produce biofuels but they are not always easily available and economically advantageous, especially at small scale. A possible solution could be to couple them in a closed loop process. In this paper, we discuss the technological feasibility of a pilot plant producing biofuels from waste frying oil, solid organic wastes and algal biomass. The crucial point of this work is to the find the best layout and operative conditions in order to use organic wastes and by-products in a closed loop process. The study is carried out through a complete experimental campaign at both lab and pilot scale on the integrated process, consisting of three parts: I) biodiesel and glycerol production by transesterification of waste frying oil added with oil extracted from algal biomass; II) syngas production by gasification of biowaste, added with glycerol to increase the total LCV; III) algal biomass production in airlift photo-bioreactors, fed by the recycled process wastewater rich in glycerol, and capable of capturing carbon dioxide from flue gases and of producing valuable biomass to be reintroduced in the process cycle. Waste oil and organic waste were provided by the University Campus canteen and wood pellets were collected in the Campus park. Quality levels of biodiesel cetane number ranged from 47.7 to 58.4 and LHVs ranged from about 36080 kJ/kg to 36992 kJ/kg. A better syngas quality was found by adding glycerol, and flue gas composition was suitable to partially feed the airlift reactors. On the basis of this first step of experimentation, the technological feasibility of the proposed closed loop integrated process was verified.