

Codigestion of municipal sludge with olive oil press effluent and other residues

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The treatment and disposal of some typical Mediterranean agricultural wastes and residues, resulting from olive oil production, tomato and wine processing, constitute a serious environmental and social problem, due to the high pollutant load, seasonal discharge, type and quality of the pollutants and difficulties to find technical and economical favourable solutions. The recent promulgated environmental regulations, more stringent in terms of pollution loads, seriously difficult the continuity of activities of many small industries. To overcome the problem of the pollution generated by the agro-industrial effluents the municipality of Abrantes and INETI implemented a global approach methodology, at regional scale.

This project pretends to show the feasibility of joint treatment of many of the wastes existing in the region, in the heated municipal digester, to define the conditions and the optimal mixtures of wastes to do it, and to apply and reuse the treated waste in the agricultural and forestry land. The methodology and the guidelines assessed by this project can constitute a useful tool reference, for others similar Portuguese or European municipalities.

Project description

The municipality of Abrantes being apprehensive about the future of the small industrial factories, which are quite important for the regional economy and employment, was interested to give a positive contribute. The application of centralised co digestion treatment plant concept seemed the good answer in this case, propitiating several advantages from wastes treatment, as follows:

- 1 - Optimal management condition due to the large-scale operation and capability to treat seasonal wastes by joint treatment
- 2 - Production of large quantity of electric energy and heat from biogas, to be used in different ways.
- 3 - Land application of sludge with controlled quality in terms of odours and nuisance and pathogen content, which are reduced by the temperature of digestion and by the time of storage.
- 4 - Economy and flexibility of storage of the effluent due to large-scale operation.

Centralised co digestion plants provide better conditions for application and reuse of the principal by-products generated during the processing: biogas and treated residues. In order to reduce the risks involved with the cost of a centralised system, the existing municipal cold digester was upgraded into a centralised demonstration plant, for joint treatment of sludge, residues from septic tank, some farm manure, olive and milk processing residues, green wastes from restaurants and shops, and any other possible organic waste. Afterward a methodology to integrate adequately the treatment and the disposal of residues generated into natural resource of regional territory has been started-up. Four main consecutive steps constitute the project:

1 – Storage and pre-treatment of the wastes. The seasonal wastes are stored in two large covered concrete tanks and sent gradually to the treatment. The olive oil producers support the cost of storage, transportation and treatment, which is about 0,03 euros, for litre of olive oil, corresponding at 0,75 % of its price. Green wastes, collected from large commercial area and restaurants will be previously macerated. About 80 % of olive producers signed a protocol and agreed to this project.

2 – Joint anaerobic treatment of municipal sludge, olive oil pressing wastewater and others residues, which are not easily biodegradable if treated alone, mixed in adequate proportions. Laboratory tests defined safe and optimised mixture for co-digestion of the different component, to guarantee a stable performance of the process. The selection of mixtures will depend on the environmental control of the system and also on the application of the treated effluent into the agriculture.

Full-scale operations are actually under start-up. The existing full-scale municipal digester has been heated and modified to produce electric energy for the treatment plant by cogeneration system, composed by two 75 kW motor-generator. The cost of the up-grade, including the engines, was about 400 000 Euros. The amortisation period is about 4,5 year. The municipality received a 50 % financial support by the Portuguese Energy Program to heat the digester, recover the gas and produce energy to be used in the wastewater treatment plant.

3 – Study and implementation of the complementary treatment to apply to the liquid fraction separated from the anaerobic digester, which is returned to the existing, activated sludge system. An anaerobic-aerobic sequence has been studied at laboratory and is to be implemented at full scale.

4 – Integration of the residues in the regional territory. Studies on regional scale to select the possible agricultural or forestry land area for disposal and reuse of digested sludge application are carried-out. The foreseen cultures, which can be predestined, are: Forage, apple trees, eucalyptus, pinewoods and other local forest trees.

Technologic Aspects

The proposed technology for digester, studied by INETI's Renewable Energy Department, want demonstrates that is possible to up-grade existing digesters in an efficient, quick, flexible and cheap way. The designed system has the following characteristics: Internal heat exchanger, to facilitate the two submersible mixers, upward spiral flow movement, multiple inlet and outlet ports, in order to get a good distribution of the feed and minimise dead volumes. A flexible plastic membrane, equipped with a constant pressure control system by air pumping, placed over the secondary digester carries out biogas retention and storage.

Results and perspectives

The solution implemented this year allowed the continuity of the activities of the small olive oil companies, meanwhile municipality reduced treatment costs by using the generated electric energy in the treatment plant, by receiving incomes for the waste treatment and from the sell of treated wastes as fertiliser

The project valorises existing infrastructures and supports the Municipality to local industry to find a favourable alternative and to solve the regional pollution problem and to control the activities in its territory.

Constitutes a positive and useful experience on study of waste treatment, energy production and nutrients recycling on land. Show that anaerobic digestion can be today a powerful technology to produce renewable energy, reduce pollution and to generate environmental benefits trough the recycle of waste material in efficient land application

Implements a management system for treatment and disposal of the residues adapted to local conditions and residues.

Demonstrates, at acceptable risks, that joint treatment can be an effective tool to treat "complex" Mediterranean wastes.

This first plant, which is monitored, is important to show the feasibility of the system and to overcome important technical problems, arising from wastes mixtures, and non-technical barriers, as the general fault of credit in the biogas technology, and the economic feasibility of the centralised systems.