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enhanced material recovery and environmental sustainability

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DELIVERABLE n. 21

Report of the benefits of the interaction of the biological processes – Action B6

Contents:

- This deliverable contains the report about the benefits achievable by the integration of the anaerobic digestion with the composting process, instead of the composting alone, both from the energetic and material recovery point of view.

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1. Introduction

The organic fraction of municipal solid waste (OFMSW) and bio-waste in a more wide meaning, represents the larger fraction of the municipal waste generated in EU and in other non EU states. If not properly managed bio-waste can represent a serious threat for the environment. On contrary, if properly managed can represent an important source of materials and energy.

The largest exploited solution for managing the OFMSW is represented by the composting for the production of a amendment/soil improver in accordance with the EU and single member states legislation. Composting is based on aerobic biological process able to stabilize and to transform the organic components, mainly organic carbon, nitrogen and phosphorus, in humic similar substances. In this way the compost can be exploited as organic fertilizer for agricultural needs.

One of the main drawback of composting is the high energetic consumption ranging from 30 up to 50 kWh per single tonne of OFMSW processed. Another important aspect highlighted by many researchers is the quite high mineralization of the organic carbon due to the aerobic process.

Another suitable biological process for the treatment of the OFMSW is represented by the anaerobic digestion (AD). AD is able to produce a quite efficient stabilization of the bio-waste and to extract from about 150-300 kWh of electricity per each tonne of OFMSW treated. Furthermore AD causes also to a partial transformation of the organic matter able to enhance the organic carbon concentration in the final compost. This is a relevant aspect also considering the role that the organic fertilizer generated from bio-waste can have in the carbon sink restauration and in the carbon storage in solis.

The LIFE 12 EMaRES performed some full scale and pilot activities for assessing the benefits achievable both from energetic and fertilizer point of view by the integration of AD and composting for managing the bio-waste.

2. Materials and methods

The analysis of the integrated process was performed on the basis of:

1) Full scale facility for the aerobic process of GESENU associated beneficiary;
2) Pilot scale equipment for the integrated AD+composting process of the UNIPG-DIIN beneficiary.

Full scale facility

The facility of GESENU associated beneficiary processes about 70,000 tonnes per year of OFMSW arising from source segregated collection. The OFMSW is firstly shredded and then sieved for removing bulky components and other impurities. Successively it is mixed with wood chips and the conveyed to the active composting time (ACT) section (see Deliverable 9). After the ACT the material undergoes to a curing phase lasting from several weeks until the chemical and physical features required by the Italian legislation for organic fertilized resulted achieved.

As already reported in the Deliverable 9, the amount of energy consumed for processing the single tonne of OFMSW is of about 25 kWh. If the energetic consumption is referred to the single tonne of fertilizer generated it resulted of about 275 kWh/tonne. As analyzed and reported in the Deliverable 9, this is mainly the consequence of the generation of residues represented by compost not in compliance with the legal requirements as stabilization level and chemical features. Biostabilization, for example, can be enhanced by increasing the treatment period. This means can be obtained by the enlargement of the current facility or by introducing an adequate pre-treatment before the composting process.

Pilot scale equipment

The integrated process was performed in a pilot apparatus of DIIN-UNIPG beneficiary. The apparatus consist of an AD of 100 liters volume equipped for temperature, gas production and composition control and measure (Fig. 1). The apparatus reproduces operating conditions of batch AD with high solids concentration (*i.e.* >25% w/w).

Fig. 1. AD pilot apparatus.

After a treatment period of 30 days in the AD the OFMSW is moved to the aerobic pilot section (Fig. 2). In this section an aerobic process is simulated inside a pilot apparatus in which both the amount of air inject and the process temperature are controlled and monitored. The aerobic phase is performed for 60 days for achieving a total length of the integrated treatment of 90 days, minimum value required by the Italian legislation.

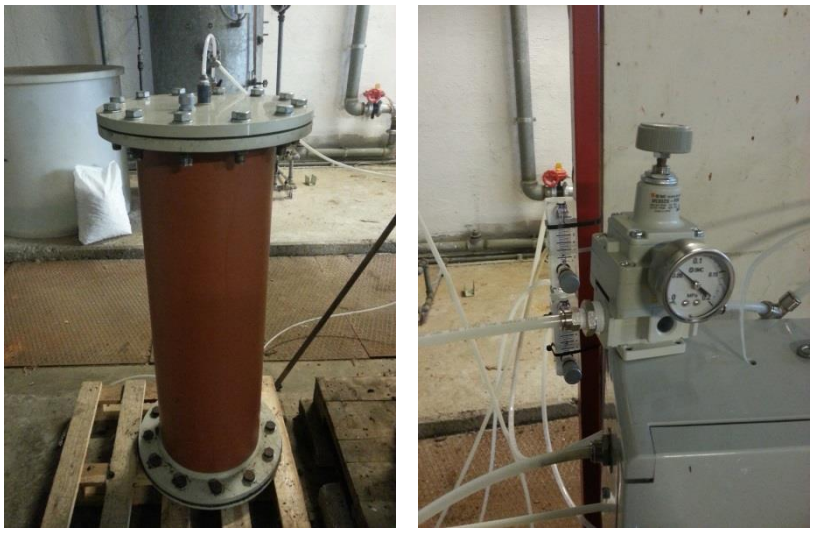

Fig. 2. Composting pilot apparatus.

During the treatment biogas quality and quantity were measured together with the chemical and physical composition of the OFMSW at different periods of treatment.

3. Results

The benefits achievable by the integrated process concerns both the energy efficiency, the increase of bio-waste treatable and the environmental benefits. The pilot runs of the AD demonstrated that it is possible to generate about 120 kWh/tonne of treated OFMSW. This means that per each tonne of OFMSW treated there is an energetic surplus of about 70-90 kWh. Furthermore the 30 days of anaerobic treatment can lead to an increase of the whole process treatment length of about 30%. This will lead to a similar increase of the amount of fertilizer producible.

The integrated treatment showed also positive effects on the concentration of organic carbon is the samples withdrawn after 90 days of treatment. On average (Fig. 3) the sample processed only by aerobic treatment showed a lower organic concentration of organic carbon of about 3-5% on dry basis if compared to the sample processed firstly anaerobically and successively aerobically.

This means that the fertilizer obtained by the integrated treatment is able to play a more relevant role in the carbon sink reconstitution giving also an important contribution to the reduction of GHG emissions from the specific sector.

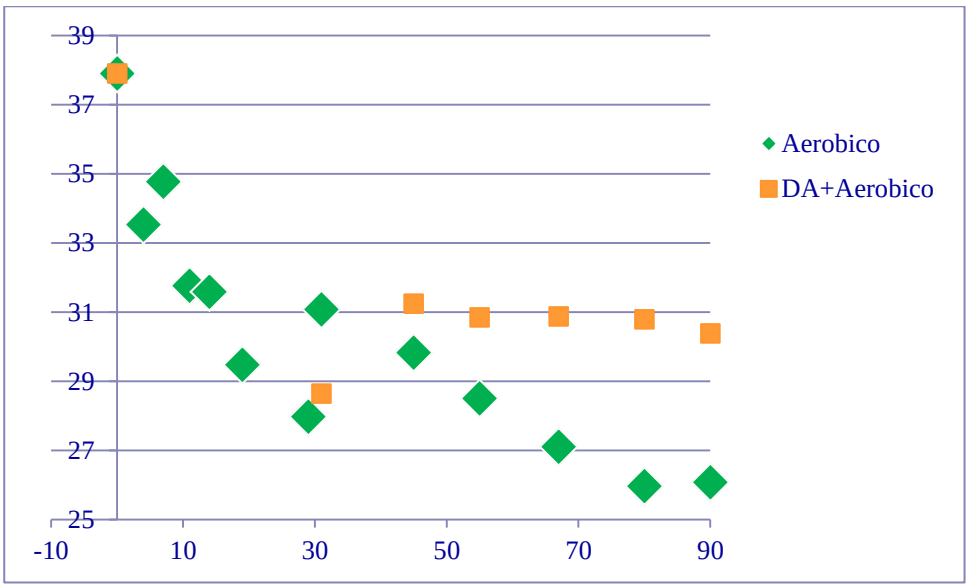

Fig. 3. Evolution of the organic carbon concentration of the OFMSW for aerobic and AD+aerobic treatment.