EVALUATION OF ENVIRONMENTAL PERFORMANCE OF A MATERIAL/ENERGY RECOVERY PLANT FROM OF-MSW THROUGH LIFE CYCLE ASSESSMENT

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The valorization of the organic fraction of municipal solid waste (OFMSW) plays a key role in sustainable resource management. Indeed, OFMSW recycling is important for transforming the linear economy model into a circular one. In this context, the combined technology of anaerobic digestion and composting of OFMSW (Chatterjee, 2016) is configured as one of the best available technologies (BAT). Anaerobic digestion produces biogas, which can be used to generate electricity/heat or upgraded into biofuel, and digestate, which can be turned into soil improver through a composting process (Atelge, 2020).

This work presents the environmental performance evaluation of the combined treatment plant of AMIU Puglia that handles the organic waste produced in the municipality of Bari. This plant was designed to process 40000 tons/year of organic waste and to produce 10 thousand tons of compost and 3.8 million m^3 of biogas.

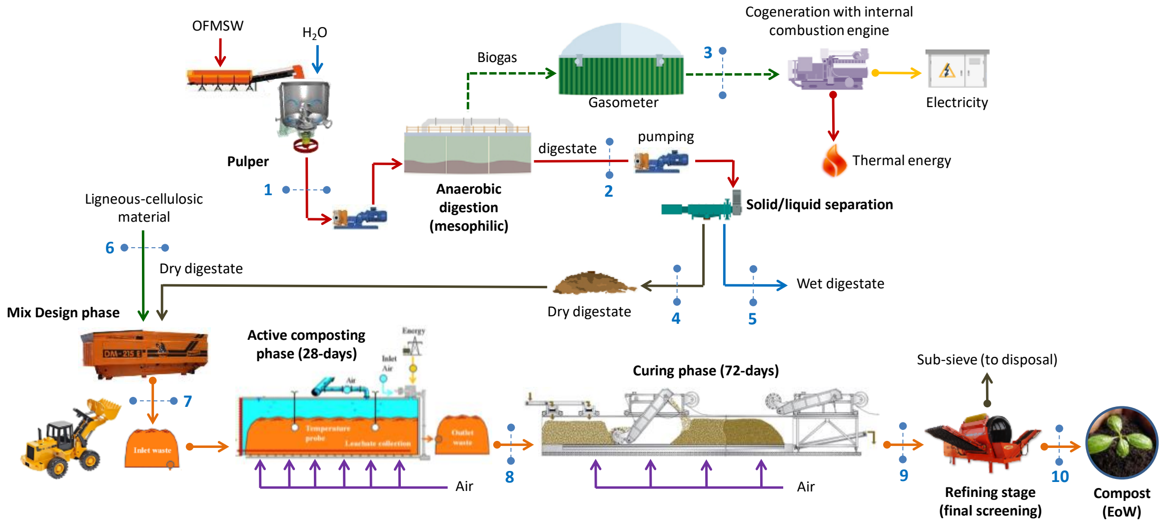
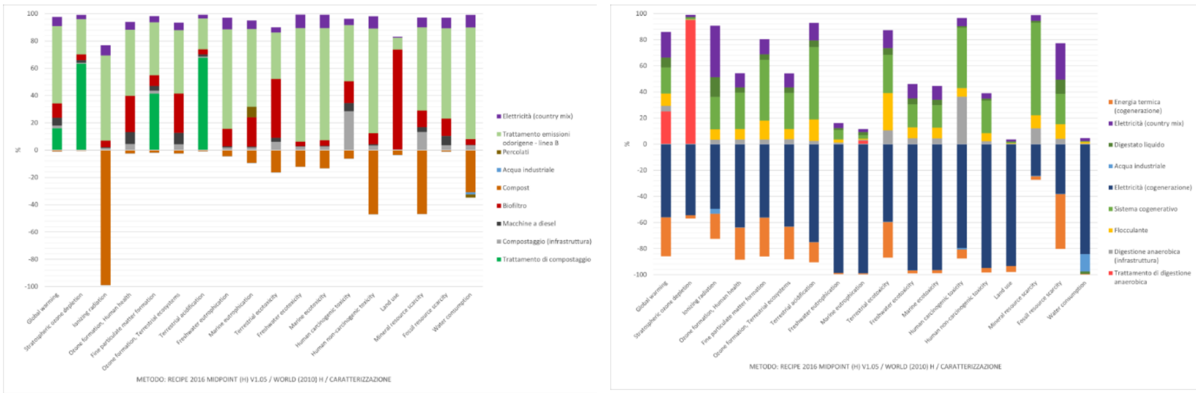


Figure 1. Flowchart of a combined anaerobic digestion and composting treatment plant for municipal solid waste

LCA (life cycle assessment) study was developed according to the ISO 14040 (2006) to evaluate the environmental impacts of organic waste treatment in AMIU Puglia plant. During the study, a mass balance was performed to quantify the energy produced and compost recovered, as well as the process losses.

The link between the waste characteristics and the technical-operational parameters of this plant was studied to maximize the production of biogas and compost. Indeed, the chemical composition of the substrate plays a crucial role among the factors responsible for digestion performance and cumulative methane production (Ren, 2018).

LCA results show that composting is characterized by major impacts due to the energy consumption associated with the treatment of exhausted air (fig. 2a). Overall, the environmental benefits from the production of a good quality compost helped to decrease the impact. Anaerobic digestion shows environmental advantages from the production of electricity and thermal energy (fig. 2b).



a) b)

Figure 2. a) Midpoint characterization of composting treatment; b) Midpoint characterization of anaerobic treatment.

Another important element to consider among the factors responsible for digestion performance and overall methane production is the composition of the input waste, which plays a crucial role.

It is noted that the increase of impurities in the OFMSW determines a consequent increase in the amount of residues produced in the pre-treatment section. Moreover, as a result of chemical-physical analysis, these residues are characterized by a high organic content with values of potentially fermentable solids over 70% (fig. 3).

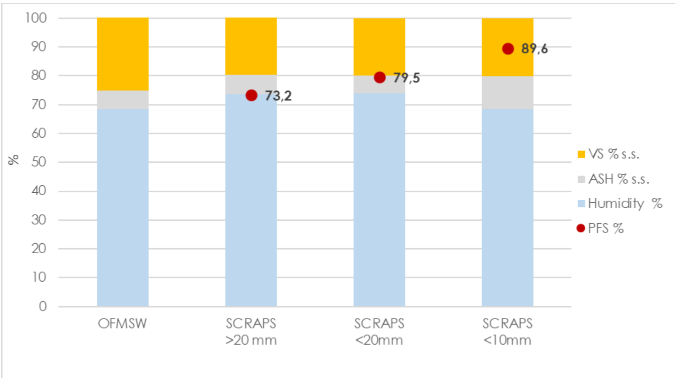


Figure 3. Chemical-physical analysis of incoming OFMSW and outgoing scraps from pretreatments

Overall, increased performance can be achieved with the development of new technologies oriented toward reducing process residues, because the efficiency of impurity removal at the beginning is essential to ensure the proper operation of the following sections and the achievement of a good quality compost.

Furthermore, sensitivity analysis in the LCA will be conducted to identify parameters that can considerably change the result, which might need further investigation.

References

CHATTERJEE, Biswabandhu; MAZUMDER, Debabrata. Anaerobic digestion for the stabilization of the organic fraction of municipal solid waste: A review. Environmental Reviews, 2016, 24.4: 426-459.

ATELGE, M. R., et al. Biogas production from organic waste: recent progress and perspectives. Waste and Biomass Valorization, 2020, 11: 1019-1040.

REN, Yuanyuan, et al. A comprehensive review on food waste anaerobic digestion: Research updates and tendencies. Bioresource technology, 2018, 247: 1069-1076.