ASSESSING THE PERFORMANCES OF PAPER VS. BIOPLASTIC BAGS FOR FOOD WASTE DELIVERED TO ANAEROBIC DIGESTION

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Abstract: This ongoing research is aimed at assessing how the food waste source separation is affected by the types of bags used for the collection. Despite the vast majority of bags used in Italy is made of plastic (mostly compostable bioplastics, but with still a relevant amount of fossil plastic), there is a growing concern on their behavior inside anaerobic digestion plants. A possible alternative is the use of paper bags, that are more compatible with AD processes and can deliver better performances to the whole collection and treatment chain. In this paper, the results of the first part of the research are presented, that include the assessment of the weight losses during the household storage of food waste, and the laboratory BMP tests.

Key words: Anaerobic degradation, BMP, Waste collection, Bioplastic, Paper.

1. Introduction

The organic fraction is the most relevant among the separately collected waste materials in Italy. Anaerobic digestion (AD) is rapidly increasing and overtaking composting, with more than 2,600,000 tonnes annually treated as of year 2017 in both combined anaerobic/aerobic plants as well as in purely anaerobic ones. This trend is also driven by the existence of financial subsidies for upgrading the biogas to biomethane.

This project aims to analyse the environmental performances of the organic waste treatment chain, with particular reference to the types of bags used for the collection. In Italy the collection is mainly based on bioplastic bags, both dedicated and second-use shoppers, with a significant amount of conventional plastic ones still present, despite their use has been banned since a few years. As an alternative, a peculiar type of paper bag is manufactured using recycled fibers, properly designed to suit the needs of food waste collection, i.e. to manage the high water content without affecting the functionality of the bag (avoiding breakages, etc.) Currently the market share of such paper bags in negligible (< 1%) compared to plastic and bioplastic ones, despite their potential to improve the system performances thanks to multiple benefits.

2. Materials and methods

In the research project, first of all the weight losses during the storage phase inside the household have been experimentally assessed by considering different households and different seasons of the year. Both bioplastic and paper bags are placed inside an aerated containers to help water evaporation. The defined methodology was based on continuous weighting of the waste bin, in order to follow the weight losses as a function of the progressive filling.

To estimate the behavior of the bag materials during the anaerobic digestion processing, Biochemical Methane Potential (BMP) tests were carried out under different conditions (temperature, inoculum) at the Fabbrica della Bioenergia laboratory in Cremona (Italy).

3. Results and discussion

The breathable fabric of the paper allowed to achieve higher weight losses during the household storage, ranging between +20% and +80% with respect to bioplastic. Such results translate in potential benefits regarding waste collection, with much lower amount of material to be transported by the trucks to the treatment plants, and potential for optimizing the collection frequency.

The methane generated by paper bags during the BMP tests, referred to one kilogram of contained waste, resulted between 2 to 2.4 liters of CH_4 per kg of food waste, a value 6 to 15 times higher than what measured for bioplastic bags.

Coming to more operational aspects at the AD plants, it was observed that generally the anaerobic process requires the removal of bioplastic before the reactor. This is especially true when wet technologies are adopted, and it implies the dragging of a non-negligible amount of organic waste trapped in the bags, leading to a lower production of biogas and to an increase in the generation of process residues requiring disposal. On the contrary, the paper removal is not required. Therefore, the core of the project will be the analysis at the full scale on industrial plants, by means of material and energy balances and with a comparative Life Cycle Assessment. Such evaluations are currently under way, and will be presented in the future.

4. Conclusions

Since source separation of waste becomes more and more relevant, the choice of the proper type of collection bag has to be addressed, so that it will not affect the sorting and treatment processes or, even better, that can improve its performance. This is especially true for food waste, where different materials have different interaction with the biological processes. The results acquired so far indicate a better performance of paper bags vs. bioplastic ones with respect to the weight losses during the storage at the households and to the potential generation of methane during the AD process. This can lead to interesting potential economic savings on the treatment of food waste, because of a lower collection cost, a higher revenue from the sale of biomethane and a lower cost for the disposal of residues at the plants.

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