A NEW ANAEROBIC FERMENTATION PROCESS TO PRODUCE DIGESTATE WITH LOW AMMONIUM CONTENT

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INTRODUCTION

Ammonia is a major problem in anaerobic digestion of municipal biowaste, manure and wastewater treatment (WWT). Depending on source, concentration ranges from < 0.1 g/L to > 5 g/L. Ammonia poses problems for disposal and/or use of wastewater and digestate from urban and agriculture source. The 91/676/EEC Nitrate Directive restricts input of mineral nitrogen on farmland, aiming to protect the ground and surface water from pollution. A number of processes for ammonia removal have been developed to meet stringent discharge norms. Among these, the Anammox process removes ammonia in absence of oxygen, but requires supplying nitrogen oxide and anammox bacteria difficult to cultivate. These processes have high CAPEX and OPEX costs. Recently, soluble biobased polymeric substances (SBO) isolated from the alkaline hydrolysates of municipal biowaste compost have been reported to decrease ammonia content in the anaerobic digestate from urban biowastes and cow manure, when added at 0.05-0.2 % concentration in the fermentation slurry feed (Francavilla et al., 2016; Riggio et al., 2017). Compared to the control fermentation producing ammonia in excess of the initial content, the SBO assisted fermentation yields a digestate slurry containing 90 % lower ammonia production or lower ammonia than that in the feed slurry. Based on these findings, and within the funded LIFECAB LIFE16 ENV/IT/000179 project, SBO will be prepared form different origin composts and added to biogas production plants in order to check their capacity to reduce the ammonia content ijn both digestate and biogas. In this first part of the project the cross-country variation of the composition of raw biowaste, compost and the resulting SBO have been investigated.

MATERIALS AND METHODS

Composts

Two different compost were considered:

-compost A prepared by ACEA pinerolese from an anaerobic digestate mixed with gardening wastes;

-compost B prepared by SBLA (Cyprus) from a mixture of leaves, pruning, grass, soil and saw dust over four seasons.

Each compost preparation lasted 12 weeks and was replicated four times (from September 2017 to April

2018)

SBO synthesis

The composts were reacted 4h with KOH solution at pH 13, 60°C and 4 v/w water/solid ratio. The liquid/solid hydrolysate mix was allowed to settle to separate the supernatant liquid phase containing the soluble substances (SBO) from the insoluble substances (INS). SBO phase was ultrafiltrated on a 5 KDa membrane and concentrated by evaporation.

Compost and SBO characterisation

Composts and SBO were characterized by determination of pH, salinity, volatile solids, total carbon and nitrogen contents (Regione Piemonte, 2012). Surface pressure of the SBO was measured with a platinum plate based tensiometer.

RESULTS AND DISCUSSION

As far as the ACEA composts were concerned, the seasonal variations slightly affected the properties of the starting materials, in particular the C/N ratio of the green wastes, which varied from 21 to 40, due to the variations of the N content. The digestate was not strongly affected by the sampling period except for some minor variations of carbon and nitrogen contents. The composts obtained after 12 weeks composting were high quality composts, exhibiting more than 25 % C and more than 2.5 % N and did not resent the seasonal variations.

More differences were observed in the case of the SBLA composts, mainly due to the change of the nature and percentage of the starting materials. In the first composting season, the nitrogen content was too low from the beginning, leading therefore to a compost with a C/N ratio up to 35. After improvement of the composting conditions, good quality composts were obtained.

The soluble hydrolyzates (SBO) obtained from the composts were richer in carbon and nitrogen than the sourcing composts. More inside investigations pointed out that they were high molecular mass polyelectrolytes with surfactant properties and a chemical composition close to the hydrolyzates obtained in previous experiments. These SBO are therefore good candidates to be tested in the biogas plant for their capacity to reduce the ammonia production during the digestion process.

CONCLUSION

Based on these findings, and within the funded LIFECAB LIFE16 ENV/IT/000179 project, a prototype SBO production facility is under construction to be installed in the Pinerolo (TO) Acea waste treatment plant. The prototype will produce enough SBO to be added to the 2600 m^3 Acea anaerobic bioreactor and validate the SBO effect under real operational conditions. Replicates of the Acea anaerobic reactors are under construction in Cyprus and Greece.

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