Modelling anaerobic digestion and compost of organic residues: towards organic matter fate prediction in soils

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MODELLING ANAEROBIC DIGESTION AND COMPOST OF ORGANIC RESIDUES: TOWARDS ORGANIC MATTER FATE PREDICTION IN SOILS

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EXECUTIVE SUMMARY

In a context of environmental biorefinery, organic residues such as sludge, biowaste, manure are no more considered as wastes but as potential resources for some targeted services. These services encompass the energy production through the methane produced by their anaerobic digestion, the cropped soils fertilisers and amendments production from digestates, and other value-added compounds production (e.g. organic acids and hydrogen obtained during fermentation). There are currently only few studies focused on combined optimization of energetic and agronomic values of organic wastes. One way to optimize both objectives is through process modelling. However, input variables from all existing models are different and there is a need to find relevant and shared input variables to model the fate of organic residues during their treatments. Recently, a new promising methodology of organic matter characterization has been successfully used to predict anaerobic and aerobic biodegradability and bioaccessibility of a broad range of organic residues (Jimenez *et al.,* 2015). This methodology is based on the combination of chemical fractionation simulating organic matter accessibility and of a 3D fluorescence spectroscopy highlighting fraction's complexity. The fractions obtained were used as models input variables. Existing models (Batstone et al., 2002, Zhang et al., 2012, Garnier et al., 2003) have been modified to take into account these new variables. In order to calibrate and validate the models, a lab scale reactor of anaerobic digestion was operated to treat wastewater sludge. Biogas, methane proportion, pH and input and output digestate quality were monitored. After 60 days of steady state operation, the digestate was then centrifuged to separate the liquid from the solid part. The solid part was then added with green waste into a lab scale compost reactor. Temperature, CO_2 production, moisture and compost quality were monitored. Finally, the final compost was used as substrate for cropped soil incubation. First results showed that, the new anaerobic digestion model was successfully able to predict biogas and digestate quality when model and experimental data were compared. The final quality of the solid part of the simulated digestate was then introduced with the green waste fractionation to model composting. The modified compost model also fitted the quality of compost during the different steps of the composting. Concerning soil incubation modelling, experimental results are still ongoing but will be part of the oral presentation. Overall, the obtained results constitute a strong basis for the development of a decision support system to optimize the design and operation of organic wastes treatment plants.

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