BIOREFINERY TO PRODUCE ACTIVATED CARBON FROM BIOMASS – AN APPROACH FOR A BIOGAS REFINING PROCESS

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Waste management has become a critical issue in terms of global warming and contamination of natural resources. Specifically, the Organic Fraction of Municipal Solid Wastes (OFMSW) is produced worldwide in high amounts, while maize, the most produced cereal in the world, generates wastes that often exceed the organic-C needed for soil fertility. Anaerobic Digestion (AD) offers the opportunity to generate biogas from those feedstoks, which is a renewable energy source suitable (i) for electricity and heat production, (ii) grid injection, or (iii) to be used as a fuel in transportation sector. The last two options are possible after biogas conditioning and upgrading to biomethane (CH4 > 97% v/v).

This work applies a biorefinery concept (Figure 1) to valorize the mentioned wastes by submitting them to a co-AD, producing activated carbon (from the solid fraction of the digestate) capable of being used to develop a refining process to upgrade biogas (AD gas fraction) to biomethane.

Firstly, the co-AD efficiency (after proper optimization of the process conditions) is assessed by the (i) efficiency of the pre-treatment the maize cob waste (co-substrate); (ii) efficiency of the conversion of the organic substrate fed to the anaerobic digester (hydrolysed OFMSW from a Portuguese company of waste treatment and valorization, plus maize cob from Coruche Portuguese county) into biogas; (iii) biogas volume produced; and (iv) biogas quality. A bench-scale anaerobic digester with a biogas storage system is used for this purpose. H_2S mitigation in the biogas produced is studied by using a pre-conditioning guard bed placed before the biogas upgrading process.

Secondly, the solid fraction of the digestate obtained is converted into carbon material (by carbonization) and used in 2 distinct routes of product production: a nutrient–rich biofertiliser (biochar) and an adsorbent (after activation) for usage in the biogas upgrading to biomethane. The activated carbon textural characterization and the study of its adsorption properties towards CO_2 (the main biogas contaminant) and CH4 are carried out to assess its performance as adsorbent in the packed columns of a Pressure-Swing Adsorption (PSA) upgrading process. Thirdly and finally, the PSA ability to clean biogas with a carbon produced within the biorefinery will be assessed. This work is being developed within the scope of an ERANet-LAC Research and Innovation EU (FP7) project.

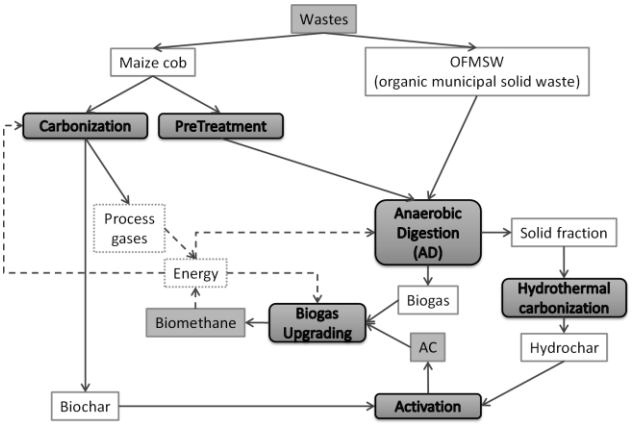

Figure 1 – Simplified biorefinery flowchart (dashed lines: energy flows; solid lines: mass flows).