Evaluating the effect of post-treated solid recirculation via BMP tests and simplified AD model.

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The biogas production through anaerobic digestion (AD) of agricultural residues, animal manure, energy crops and combination thereof (codigestion) has become an important aspect of the agricultural sector of the European Community. Within this context, technologies/strategies improving the energetic efficiency of AD plants are expected to have a great impact on the productivity/profitability, and the environmental footprint of this industrial sector. The recirculation of the solid separated fraction of the digestate (DigSS) would result in the reduction of undigested solid residues and in the increase of the energy recovery of the AD process. To enhance the DigSS biodegradability, a post-pretreatment step could be applied prior to digestate recirculation. The overall impact on the biogas plant would be a higher specific methane production and higher operational costs for solid/liquid separation, mixing and pumping. The optimal amount of DigSS to be recirculated is plant-specific and would depend on the effectiveness of the post-treatment in terms of anaerobic degradability (ultimate biochemical methane potential, BMPu) and degradation kinetics. A simplified AD model was then implemented to be used for scenarios analyses.

In this work both the DigSS used in the post-treatment experiments and the data used for calibration and validation of the simplified AD model came from a full-scale mesophilic AD fed with a mixture of animal manure (cow and turkey), whey and corn silage. A methodology for calibration is presented based on simple experimental measurements, widening the applicability of the model. In view of maximizing economical sustainability, the types of post-treatment considered in this study were limited to those seen as most easily and economically applicable at farm scale, such as mild thermal treatment (40-80ºC), dilute-alkali treatment and combination thereof.

Post-treatments were proven to increase the biodegradability characteristics of the solid fraction of digestate indicating the recirculation of post-treated digestate as a potentially attractive simple way of increasing the energy recovery of AD systems. Nevertheless, the overall effect of this action on the AD process is rather difficult to predict and a simulation tool would be therefore be of utmost importance for a correct cost/benefit evaluation. A simplified model was developed to evaluate the effect of increasing recirculated fractions as function of the effectiveness of the post-treatment applied.