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DRY ANAEROBIC FOOD WASTE & CARDBOARD CODIGESTION: EFFECT OF INITIAL CHARGE ON SUBSTRATE CONVERSION

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EXECUTIVE SUMMARY

Nowadays, about 1.3 billion tons of food is wasted every year. This number, which is expected to increase greatly in the next decades, evidences the urgent need of improving the efficiency of the current food processing systems, supply chains, prevention policies and food waste (FW) disposal alternatives. Indeed, new FW treatment methods must be developed. At present, most of the FW is disposed in landfills or incinerated, whereas these organic matters could participate further in the recycling of resources. Anaerobic processes appear as a well-stablished alternative that allows, not only an effective waste treatment, but also its valorization by the generation of different added value products (i.e. methane, hydrogen, volatile fatty acids, lactic acid, ethanol, soil improver…). Due to the high total solids (TS) content of FW (around 20 %), it is possible to treat it by dry anaerobic digestion (AD) (>20 % TS), a process with advantages when compared to traditional wet digestion (i.e. lower water requirement, lower digestate production and smaller reactor volume) (Karthikeyan and Visvanathan, 2013). In this study, the influence of the initial FW charge on the performance of a batch dry anaerobic codigestion system using FW and cardboard (CB) as substrates was evaluated. To do that, the FW charge was modified by varying three independent parameters: the initial TS content (20-35 %), the substrate to inoculum ratio (S/X) (0.25-4 g $VS \cdot g\ VS^{-1}$) and the FW:CB proportion in the substrate (50:50-80:20 g $TS \cdot g\ TS^{-1}$). The experiments were carried out under mesophilic conditions (35 °C) and 13 different conditions were defined. The biogas production and composition were analyzed throughout an experimental period of 98 days and the concentrations of soluble metabolites and main ions were measured when the operation finished. The obtained results showed that the S/X ratio is a crucial parameter, determining the working pH of the system and therefore the final products. In fact, only the reactors working at an S/X ratio of 0.25 (lowest FW charges) produced methane. The other conditions lead to accumulation of metabolites (volatile fatty acids-VFAs, lactate…) and hydrogen production. In addition, greater substrate conversions were achieved at low initial charges of FW. Moreover, the hydrogen yields were found to decrease when increasing the initial charge. This occurred because at high loadings, the acidification effect was more intense, inducing the accumulation of VFAs and lactic acid. This affected significantly the pH, decreasing the hydrogen and VFAs yields. This research suggested that dry anaerobic treatment of FW & CB could be an interesting technology for the production of different added value compounds, such as methane, hydrogen, VFAs and lactic acid. The generation of one product or another was found to be dependent of the initial charge of substrate. While low charged conditions lead to methane production and an efficient waste stabilization, high charged reactors produced hydrogen, VFAs and lactate. In those last cases, the waste stabilization was incomplete, with more than the 50% of the input COD remaining in the digestate. However, the high yields of products suggested that this option could be interesting for a first reactor in a potential 2-stage system with a final stage for waste stabilization by methane production.

REFERENCES

Karthikeyan, O.P. & Visvanathan, C., (2013): *Bio-energy recovery from high-solid organic substrates by dry anaerobic bio-conversion processes: a review*. Rev. Environ. Sci. Bio/Technology 12, pp. 257–284.