Achieving high efficiency of anaerobic digestion by soil

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Abstract

Shaping the microbial community involved in anaerobic digestion (AD) systems to achieve highly efficient methane production is a major challenge, which inhibits the development of AD for treating biowastes. Soil, with the potential of inter-species electron transfer, buffer capacity, and nutritional elements for microbial growth, was used to improve the AD efficiency. The results show that the process performance of methane production was better compared with control. The level of daily methane production and the process stability were improved. The time required for reaching steady state was shorted. This approach is useful for lignocellulose and nitrogen-rich wastes. High-throughput sequencing of the 16S ribosomal RNA gene and synthetic solution with cations equivalent to those of soil revealed that soil addition mainly stimulated the growth of bacterial genera *Ochrobactrum* and *Clostridium* and archaeal genera *Methanosaeta* and *Methanosarcina*. The method of ion extraction was used to extract ions from the soil, and the ions were verified to be a main contributor to methane production improvement. By mimicking the cation components of soil, a synthetic solution was prepared and used in the AD system. The results showed that the cations contained in the ion liquid played a key role in improving methane production, meaning the cations in soil played a key role in enhancing AD efficiency. Therefore, the simplified, low cost, and efficient approach used in this study had good practicability and could be used for treating various biowastes with high energy recovery, which has the potential of promoting the development of AD technology.