

## Three-Stage Anaerobic Co-digestion of High-Solids Food Waste and Horse Manure

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**Abstract :** Hydrolysis and acidogenesis are the rate-controlling steps in an anaerobic digestion (AD) process. Considering that the optimum conditions for each stage can be diverse, the development of a multi-stage AD system is likely to improve the AD efficiency through individual optimization. In this research, we developed a highly integrated three-stage anaerobic digester (HM3) to combine the advantages of dry AD and wet AD for anaerobic co-digestion of food waste and horse manure. The digester design comprised mainly of three chambers - high-solids hydrolysis, high-solids acidogenesis and wet methanogenesis. Through comparing the treatment performance with other two control digesters, HM3 presented 11.2 ~22.7% higher methane yield. The improved methane yield was mainly attributed to the functionalized partitioning in the integrated digester, which significantly accelerated the solubilization of solid organic matters and the formation of organic acids, as well as ammonia in the high-solids hydrolytic and acidogenic stage respectively. Additionally, HM3 also showed the highest volatile solids reduction rate among the three digesters. Real-time PCR and pyrosequencing analysis indicated that the abundance and biodiversity of microorganisms including bacteria and archaea in HM3 was much higher than that in the control reactors.

**Keywords :** anaerobic digestion, high-solids, food waste and horse manure, microbial community

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