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Effect of the Organic Loading Rate Increase and the Presence of Zeolite on Microbial Community Composition and Process Stability During Anaerobic Digestion of Chicken Wastes

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Abstract

© 2015, Springer Science+Business Media New York. This study investigates the effect of the organic loading rate (OLR) increase from 1.0 to 3.5 g VS L⁻¹ day⁻¹ at constant hydraulic retention time (HRT) of 35 days on anaerobic reactors' performance and microbial diversity during mesophilic anaerobic digestion of ammonium-rich chicken wastes in the absence/presence of zeolite. The effects of anaerobic process parameters on microbial community structure and dynamics were evaluated using a 16S ribosomal RNA gene-based pyrosequencing approach. Maximum 12 % of the total ammonia nitrogen (TAN) was efficiently removed by zeolite in the fixed zeolite reactor (day 87). In addition, volatile fatty acids (VFA) in the fixed zeolite reactor accumulated in lower concentrations at high OLR of 3.2–3.5 g VS L⁻¹ day⁻¹. Microbial communities in the fixed zeolite reactor and reactor without zeolite were dominated by various members of Bacteroidales and *Methanobacterium* sp. at moderate TAN and VFA levels. The increase of the OLR accompanied by TAN and VFA accumulation and increase in pH led to the predominance of representatives of the family Erysipelotrichaceae and genera *Clostridium* and *Methanosarcina*. *Methanosarcina* sp. reached relative abundances of 94 and 57 % in the fixed zeolite reactor and reactor without zeolite at the end of the experimental period, respectively. In addition, the diminution of Synergistaceae and Crenarchaeota and increase in the abundance of Achaeplastmataceae in parallel with the increase of TAN, VFA, and pH values were observed.

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Keywords

Ammonia inhibition, Biogas, Microbial diversity, Organic loading rate, Pyrosequencing, Zeolite