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EVOLUTION OF HUMIC SUBSTANCES DURING ANAEROBIC SLUDGE DIGESTION

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Abstract

A comparative study of humic substances (HS) extracted from raw sludge and its digested product was carried out in order to analyze HS evolution during sludge anaerobic digestion. HS content, elemental composition, functional groups, infrared spectra and ultraviolet absorbances were analyzed by means of chemical and spectrographic methods. The extracted HS were also fractionated by ultrafiltration in order to obtain their molecular weight (MW) distribution. The results showed that humic acids (HAs) were the major constituent of sludge HS. During anaerobic digestion of sludge, 16.3% of HAs and 27.0% of fulvic acids (FAs) were degraded, and simultaneously, limited humification processes occurred. After anaerobic digestion, the O/C ratio of HAs increased from 0.32 to 0.39 and the C/N ratio decreased from 9.06 to 6.41. The total acidity of HAs increased from 2.32 mmol/g to 3.29 mmol/g, and the ratio of carboxyl hydroxyl to phenolic hydroxyl increased from 0.15 to 0.25. The proportion of FAs with MWs higher than 50 kDa increased from 14.65% to 38.51%, and the proportion of the HAs with MWs higher than 100 kDa increased from 65.31% to 85.49%. Although HS in digested sludge on average contained more oxygen functional groups and had more aromatic structures and larger molecular size, the humification degree was relatively low compared with sludge compost. Mineralization was still the main process observed during sludge anaerobic digestion.

Key words: anaerobic digestion, fulvic acid, humic acid, sludge

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