METHANE PRODUCTION FROM LIQUID EFFLUENTS PRODUCED DURING BIODEGRADABLE WASTES COMPOSTING

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Introduction. In Mexico City 20% of urban solid wastes are biodegradable (1), stabilized by composting and reused as fertilizer (2). During composting, liquid effluents (LE) are produced characterized for a very high organic matter content (108.5±14.9 gCOD/L), ammonium (1.3±0.57 g/L) and acetic acid (1634.1±3417.5 g/L), posing an important and still unknown atmospheric pollution risk (3), as well as to aquifers and soil.

The aim of this research was to evaluate the performance of acidogenic-methanogenic reactors to diminish the pollutant load and to produce methane, from LE batches sampled in the Composting Plant at Bordo Poniente dump.

Methods. LE batches were collected through 2012 and 2013 during the first 24 hours of composting and composition was determined through suspended solids, organic matter as total and soluble COD, ammonium (NH_4+), volatile fatty acids (VFA) content and produced alkalinity. An acidogenic 3L UASB reactor (RA) was operated at 0.5 d of hydraulic retention time (HRT) for LE pretreatment. A methanogenic 13 L packed filter (RM) operated at 1.5 d HRT was used for methane production. Both reactors were inoculated with anaerobic municipal sludge (20.4 gVSS/L) and were operated in series for 198 days. Feeding consisted of LE diluted with municipal wastewater (MWW) in increasing COD concentration ranging from 5.0 to 17.5 g/L. Reactors performance was followed up through the consumed COD and produced NH_4+, sulfide, alkalinity, biogas and CO_2/CH_4 content.

Results. RA was fed at acid pH (4.0) and showed an organic matter conversion efficiency (EC) to VFA of 61.8 al 94%, for the COD concentrations used, with a mean value of 77.9% (see Table 1). No acetogenesis was found because of the RA acidic pH and the initial content of acetic acid in the feeding, which prevented a further formation of acetic and propionic acid, and none of the VFA produced were transformed to acetic acid. Also a sulfide production of 0.58 g/L was detected.

Table 1. Acidogenic-methanogenic system performance.

COD (g/L)	EC_{RA} (%)	ER_{RM} (%)	PM (m^3CH_4/m^3d)
5.0	70.0	94.9	0.79
7.5	61.8	94.6	0.65
10.0	80.6	94.9	1.27
12.0	75.4	95.4	1.21
15.0	94.0	94.7	3.71
17.5	85.9	93.8	4.49
Average	**77.9**	**94.7**	
SD	**11.5**	**0.52**	

RM attained removal efficiencies (ER) higher than 90% for all feeding concentrations used, with a mean value of 94.7%. Alkalinity ratio was higher than 0.77, indicating reactor stability to the organic loading rate fed. The higher methane productivity (PM) was of 4.49 m^3CH_4/m^3d. Ammonium concentration duplicated from 0.17 to 0.34 g/L and sulfide diminished to 0.31 g/L, indicating that autotrophic denitrification was taking place. Nevertheless, ammonium or sulfide had no adverse effect in methanogenesis.

Conclusions. LE from biodegradable waste composting diluted with MWW make up a suitable mixture for anaerobic treatment and methane production. The amount of energy to be obtained is directly related to the amount of LE produced every day.

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