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Florian Paillet, Renaud R. Escudie, C. Barrau, Eric Trably

IMPACT OF LEACHATE AMMONIA CONTENT ON OFMSW CONVERSION TO BIOHYDROGEN

F. PAILLET[1,2], R. ESCUDIE[2], C. BARRAU[1] and E.TRABLY[2,*]
[1] TRIFYL, 81300 LABESSIERE-CANDEIL, France
[2] INRA, UR0050, Laboratoire de Biotechnologie de l'Environnement, 11100 Narbonne, France
*Corresponding author: eric.trably@supagro.inra.fr, tel. +33 (0) 468 425 172; fax +33(0) 468 425 160.

Abstract

The organic fraction of municipal solid waste (OFMSW) contains highly biodegradable elements making OFMSW particularly suitable for biological conversion to high value end-products. By coupling dark fermentation with anaerobic digestion processes, a mixture of H_2/CH_4 (5-20% of H_2 v:v) so called biohythane, can be produced and further used as efficient biofuel. Such two-step reactors represent an interesting process increasing the total energy recovery when compared to a more usual one step AD system [1]. As first step of OFMSW treatment, a fermentative anaerobic reactor, so called fermenter, can be operated using OFMSW as feeding substrate and landfill leachate as water and bacterial inoculum sources. The outlet of the H_2-producing fermenters, rich in volatile fatty acids, can be sent to long term storage in landfill cells producing methane. The methanogenic leachate, coming out of the solid AD cells, can be recirculated into the first reactor for a new cycle of hythane production. Such leachate recycling can save water consumption during the overall process, but requires heat-shock pretreatment to avoid methane contamination of the fermenters. Moreover, by cycling the leachate, an accumulation of ammonia which comes by time from protein degradation in AD can cause a severe inhibition of the H_2-producing fermenter [2]. Thus, the objective of this study was to investigate the impact of ammonia content in AD leachate on the conversion of the OFMSW to biohydrogen by dark fermentation.

The effect of the ammonia concentration ranging from 0.07 to 8.16 gNH_4 /l on dark fermentative hydrogen production was investigated at 37°C and pH 6 using a freshly prepared organic fraction of household solid waste (paper, carton and food waste). Each experiment contained 9.25gVS of substrate for an S/X (substrate/biomass in VS basis) of 20. The AD leachate was first stripped to remove the initial quantity of ammonia, and NH_4 was then added in a range of 0-8.16 g/L (Table 1). Experiments were carried out in a 500 ml bottle with 400 ml total medium volume. The gas and metabolite compositions were periodically measured.

Table 1: Hydrogen yields in batch reactor (37°C, pH6) containing different initial concentration of ammonia in AD leachate

$[NH_4^+]$ (g/l)	0.07	0.63	0.920	1.56	2.19	2.99	3.63	6.30	8.16
$Yield_{H2}$ (mlH_2/gVS)	22.52	23.39	23.97	22.45	23.35	22.53	14.24	14.05	16.15

Results show that hydrogen production reached an average yield of 23.04±0.5 mlH_2/gVS from 0.07 to 2.99 g NH_4 /l, with no impact on kinetics. At higher concentration (from 3.6 to 8.2 gNH_4 /l), hydrogen production decreased by 35.7 % (14.81±0.9 mlH_2/gVS) but was not

totally inhibited. For the first time, such high concentration in ammonia did not impact severely the dark fermentation process, suggesting a successful adaptation of the microbial community (molecular analysis in progress). As output of this study, a target of a maximal ammonium concentration of 3.0 gNH4+/l in AD leachate should be maintained at industrial scale to guaranty an optimal operation of the hydrogen-producing fermenter.

References

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