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INHIBITION OF THE ANAEROBIC ACETATE DEGRADATION BY FORMATE.

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case our reactor would also have selected a microbial population able to use formate efficiently.

The effect of different formate concentrations on the acetoclastic reaction was determined and the maximal rate of acetate consumption for each curve (Table 1) was calculated by double reciprocal plot from each point of the curves. $1/V = f(1/S)$:

formate	Vm	standard deviation
mM	mmol acetate/l.h	
0	3.02	0.25
5	2.50	0.10
50	2.31	0.07
100	2.05	0.13

Table 1. Effect of different formate concentrations on the rate of acetate degradation, for the same initial acetate concentration (8.5 mM) (triplicate experiments).

Clearly table 1 demonstrates the inhibitory effect of various formate concentrations on acetate degradation; at 100 mM the maximal rate (Vm) is decreased by one third. This confirms with anaerobic sludge the experiment performed with pure cultures of Methanosarcina (Guyot, 1986) and adds new perspectives in the field of the inhibition of anaerobic digestion. Since formate, like hydrogen, is a major product of the first step of anaerobic degradation of organic matter, and nevertheless the sludge capacity to use formate is low, as we described, we suspect that formate accumulation in such a digester may cause either a decrease of reactor performances or a digester failure. Another interesting observation made by Belay et al (1986), is the inhibition between pH 5.8 to 6.2 of both growth and methanogenesis of Methanococcus thermolithotrophicus grown on H_2-CO_2 in presence of formate; it would be valuable to define the extent of such an inhibition with other hydrogenophilic methanogens. We note that formate might not be inhibitor of the Methanothrix type of bacteria, since they have a formate dehydrogenase and the hydrogen evolved by formate breakdown does not inhibit them (Zehnder et al, 1980). Thus the effect of formate or hydrogen on the acetoclastic reaction in anaerobic reactors might greatly depend on the relative proportion of Methanosarcina and Methanothrix. Therefore, there is a double interest to look for the enrichment of a digester sludge with Methanothrix, because of its high affinity for low acetate concentrations and its potential resistance to inhibition by either hydrogen or formate. In the future the definition of an index which would characterize the ratio Methanosarcina/Methanothrix for a sludge, might help to forecast the ability of an anaerobic reactor inoculum to be inhibited by either formate or hydrogen at the level of the acetoclastic reaction.

MATERIALS AND METHOD:

UASB reactor: a 4.5 litre UASB reactor was continuously fed during one year with a mixture of acetic (3.5 g/l) and propionic (1 g/l) acids as carbon and energy sources, in the following salt medium (mg/l):
NH_4HCO_3 (1000), $NaHCO_3$ (600), $(NH_4)_2SO_4$ (250), K_2HPO_4 (130), $CaCl_2.2H_2O$ (200), $MgCl_2.6H_2O$ (10), $FeSO_4.7H_2O$ (14), $(NH_4)_6Mo_7O_{24}.4H_2O$ (10), $MnCl_4.H_2O$ (1), $CuCl.2H_2O$ (0.1), $NiCl.6H_2O$ (0.2), $CoCl_2.6H_2O$ (0.05).

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REFERENCES

APHA (1980). Standard Methods for the Examination of Water and Wastewater, 15th edition.

Balch, W.E., Fox G.E., Magrum L.J., Woese C.R., and Wolfe R.S. (1979). Microbiol. Rev. 43, 260-296.

Balch, W.E., and Wolfe, R.S. (1976). Appl. Environ. Microbiol. 32, 781-791.

Belay, N., Sparling, R., and Daniels, L. (1986). Appl. Environ. Microbiol. 52, 1080-1085.

Fergusson, T.J. and Mah, R.A. (1983). Appl. Environ. Microbiol. 46, 348-355.

Guyot, J.P. (1986) FEMS Microbiol. Lett. 34, 149-153.

Guyot, J.P., and Brauman, A. (1986). Appl. Environ. Microbiol. 52, 1436-1437.

Hungate, R.E. (1969). A roll-tube method for the cultivation of strict anaerobes. In: Methods in Microbiology, J.R. Norris and D.W. Ribbons, eds. vol.3B, pp. 117-132, Academic Press Inc. New-York.

Schauer, N.L., Brown, D.P., and Ferry, J.G. (1982). Appl. Environ. Microbiol. 44, 549-554.

Thiele, J.H., Chartrain, M., and Zeikus, J.G. (1988) Appl. Environ. Microbiol. 54, 20-29.

Zehnder, A.J.B., Huser, B. A., Brock, T.D., and Wuhrmann, K. (1980). Arch. Microbiol. 124, 1-11.