CULTIVATION OF WELL ADAPTED PELLETIZED METHANOGENIC SLUDGE

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SUMMARY

Treating soluble wastewaters anaerobically in UASB-reactors, the development of sludge-granules can be expected, provided that there are optimal growing conditions. Two types of granules were obtained, both with high specific activities and excellent settling properties. Type 1 mainly consists of short fragments of multicellular filaments of a bacterium showing much resemblance with a recently isolated acetate-degrading methanogenic bacterium (Zehnder et al, 1980). Type 2 is mainly made up by long filaments of presumably the same bacterium. The development of anaerobic bulking sludge must be prevented.

INTRODUCTION

An optimal employment of the UASB-process (Lettinga et al, 1980) for waste water treatment requires the development of well adapted sludge. Well adapted methanogenic sludge meets the following requirements:

i. the volatile fatty acids are simultaneously and completely broken down

ii. the specific activity of the sludge is high

iii. the settling properties of the sludge are good (de Zeeuw, 1980).

One of the features of the UASB-process is its quality to enhance the development of such a sludge starting with digested sewage sludge (without additional support material) (Lettinga et al, 1980). Pelletization of sludge has been found so far with medium strength waste waters containing little or no suspended solids (approximately 2-10 kg COD.m⁻³). In laboratory experiments with volatile acid mixtures, and with waste water from a yeast factory, as well as in pilot plant and full scale experiments with sugar beet- and potato processing wastes a granular sludge developed with excellent settling properties and a high specific activity. These properties make high space loading rates possible (table 1).
Table 1. Properties of pelletized methanogenic sludge in UASB-reactors

<table>
<thead>
<tr>
<th>Waste water source</th>
<th>Operating conditions</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>methanogenic activity</td>
</tr>
<tr>
<td>VFA(^{1)})</td>
<td>2.2</td>
</tr>
<tr>
<td>Yeast factory(^{2)})</td>
<td>0.7 - 0.9</td>
</tr>
<tr>
<td>Sugar beet factory(^{3)})</td>
<td>1.3</td>
</tr>
<tr>
<td>Potato processing factory(^{4)})</td>
<td>1.0 - 1.4</td>
</tr>
</tbody>
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1) 1.25 g/l acetate + 1.0 g/l propionate (Hulshoff Pol, unpublished)
2) data from Mulder, 1981
3) data from Pette et al, 1980
4) data from Versprille, 1978

As at present well adapted methanogenic sludge is not readily available for the start-up of new UASB-reactors the appropriate seed material to be used is digested sewage sludge. This sludge usually has a rather low specific activity of 0.05 - 0.1 kg COD.kg VSS\(^{-1}\).day\(^{-1}\) (de Zeeuw et al, 1980).

The objective of this paper is to present some preliminary results concerning the cultivation of well adapted pelletized methanogenic sludge in UASB-reactors using digested sewage sludge as seed material.

EXPERIMENTAL

In our experiments a mixture of acetate and propionate was chosen as a feed for reasons given before (de Zeeuw, et al, 1980). The experiments have been conducted in 30-120 liter UASB-reactors, 1-4 m in height, at a temperature of 30°C. The UASB-reactors were started up at a low sludge loading rate of 0.05 to 0.1 kg COD.kg VSS\(^{-1}\).day\(^{-1}\) (space loading rates of 0.6 - 1.2 COD.m\(^{-3}\).day\(^{-1}\) and liquid detention times of 60 - 120 hours. The loading rates were increased stepwise when about 80 to 90% of the feed components were converted into CO\(_2\) and CH\(_4\). Finely dispersed matter was allowed to be washed out. Figure 1 shows the development of the methanogenic activity of the sludge.