Microbiological aspects of denitrifying, desulphurizing, waste water treatment

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In the microbiological production of methane from industrial effluent, sulphide produced by sulphate-reducing bacteria in the reactors is often an undesirable by-product. This can lead to various problems including corrosion, sulphur pollution (e.g. acid rain) and unpleasant smells. Any ammonium in the same waste water also, for environmental reasons, cannot be discharged and can present difficulties. However, after the aerobic, microbiological conversion of the ammonium to nitrate, both problems can be dealt with in the same reactor by means of denitrifying colourless sulphur bacteria which oxidize the sulphide using the nitrate as terminal electron acceptor and thereby producing sulphate and gaseous nitrogen. Such a system has been patented by Gist Brocades, Delft, and is under study in this laboratory.

Analysis of the influent to the desulphurizing, denitrifying reactor has shown that it contains roughly equivalent amounts of reduced sulphur compounds and small organic molecules such as acetate, but that the position is complicated by a certain amount of biomass and cell lysis products from the preceding reactors. Extrapolation of results obtained with chemostat cultures (Gottschal and Kuenen, 1980) leads to the prediction that conditions in the reactor would not favour obligate autotrophs, and that the sulphide-oxidizing bacteria in the system would be of the mixotrophic type. This has proved to be the case. No obligate autotrophs have been found, and at least 30% of the population is mixotrophic. Most of the heterotrophs present have complex nutritional requirements and probably play an active part in the breakdown of the biomass from the methane reactor. The dominant heterotroph is a strain of *Klebsiella*. Among the dominant mixotrophs is a new species, *Thiosphaera pantotropha* (Robertson and Kuenen, 1983) which can grow autotrophically, heterotrophically and mixotrophically under both aerobic and anaerobic conditions. This organism has

been selected for model studies of the system. The occurrence of this and the other versatile species, together with the lack of specialist autotrophs support the contention that experiments with pure cultures and simple mixtures of organisms can provide clues to the behaviour of considerably more complex systems.

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