Investigation into a biosupplement for possible reduction of activated sludge production in a system with excess biological phosphorus removal

DW de Haas*
Umgeni Water, PO Box 9, Pietermaritzburg, 3200, South Africa

Abstract

The availability and use of so-called "biosupplements" (or biological "catalysts") in wastewater treatment systems has increased significantly in recent years. The effectiveness of adding either live cultures of micro-organisms produced commercially (or enzyme products from such cultures) to systems which naturally develop mixed and complex populations of many different micro-organisms (e.g. activated sludge) may be questioned. Comparatively few studies have been published in which the commercially-produced cultures have been tested under controlled conditions. This study was aimed at conducting a controlled study of one "liquid live micro-organism" (LLMO) product in a nitrification-denitrification biological enhanced phosphorus removal (NDBEPR) activated sludge system. The product was marketed by the supplier for its ability to reduce sludge production in activated sludge systems. Using two parallel pilot-scale NDNEPR activated sludge systems operated in parallel under identical conditions, one with and one without the addition of the LLMO product, this study found no evidence to support the supplier's claim for the product. Two experiments were conducted: one in which the LLMO product was dosed in relatively large amounts without prior aerobic activation, and one in which activation was carried out aerobically for 24 to 36 h, as specified by the supplier. For both experiments, satisfactory mass balances for the systems could be shown, but no statistical difference in sludge production was observed, despite dosing at least ten times more product than that specified by the supplier for typical full-scale applications. Performance of the test and control systems was also virtually identical in all other respects.

Introduction

Biocatalysts (or so-called biosupplements) have been marketed and used in wastewater treatment processes for a number of years with varying degrees of success. According to Koe and Ang (1992), results from the commercial application of such biocatalysts, particularly in wastewater treatment systems facing operational problems, have tended to be positive. However, laboratory research investigations have often contradicted these results and many researchers have concluded that no significant improvement in process performance can be achieved with biosupplementation (Kunst, 1989; Koe and Ang, 1992).

On the simplest level of wastewater treatment processes, some manufacturers claim that bio-enhancement technology can improve the performance of oxidation ponds (Ascough, 1997). Other products use either enzymes or live bacterial cultures to accelerate degradation of fats, greases, proteins and carbohydrates (including cellulose) in structures such as septic tanks, pipes, greases traps, and sumps (Jager et al., 1989; Mylie, 1990; Beams and Burns, 1991). Koe and Ang (1992) investigated a biocatalyst which had reportedly improved performance of full-scale anaerobic digesters. They identified the bacterial flora present in the biocatalyst and found that, with the exception of certain strict aerobes, all were facultative anaerobes (typically acid-forming fermenters) which were shown to exist as part of the natural bacterial flora in a normal anaerobic digester without biocatalyst addition. Since no significant shift in bacterial population was detected in either the control or augmented laboratory reactors, it was concluded that the commercial biocatalyst is unlikely to improve the performance of the digestion process (Koe and Ang, 1992).

In activated sludge systems, there have been commercially-oriented reports of bacterial cultures or mixtures of cultures which could be useful in improving biodegradation of specific target effluents. For example, particular attention may be directed to situations where consistent nitrification is the objective, but has proved difficult to achieve in cold climates. The addition of pure cultures of nitrifying organisms was reported to significantly improve nitrification within 10 d (Anonymous, 1991). Similarly, Glancer et al. (1994) cited the use of denitrifying organisms *Moraxella* and *Corynebacterium* for improving denitrification on a full-scale biological nutrient removal activated sludge plant in Salzburg (Austria). Glancer et al. (1994) also cited the use of a mixed culture containing the yeast *Trichosporon*, which produces increased amounts of the enzyme peroxidase, for accelerated degradation of complex refractive molecules such as lignins, and mixed cultures of *Pseudomonas*, *Flavobacterium* and *Bacillus* spp. for improved biodegradation of arylsulphonic acids (used as auxiliaries in tanning, paper and textile industries). However, a criticism of the work of Glancer et al. (1994) may be that the use of suitable controls was not reported. Potentially, this may be a common error in research where a number of variables could influence the observed result. Vansever et al. (1997) drew attention to the need for controlled experiments when investigating the potential effects of supplements to activated sludge systems. Since it is rare to have identical but separate systems in parallel for test and control purposes at full scale, such experiments are usually conducted on small-scale systems. The latter allow statistical analysis of the data obtained. From their experiments with a nutritive supplement containing grain supplements, ferrous sulphate and alumino

* Current address: Gutterridge Haskins and Davey, GPO Box 668, Brisbane, 4001, Australia.
☎ +61 7 3258 3545; fax +61 7 3832 4592;
e-mail david_de_haas@ghd.com.au
Received 25 May 1998; accepted in revised form 16 September 1998.