P22

EVALUATION OF MASS TRANSFER COEFFICIENTS WITHIN BIOFILMS

M.J. Vieira, A. G. Brito, F. Teixeira*, L.F.Melo
Centre of Biological Engineering, IBQF, University of Minho, 4710 Braga, Portugal
* ISEP, Instituto Superior de Engenharia, 4000 Porto, Portugal

The knowledge of mass transfer rates in microbial biofilms is often the limiting step on biofilm modelling, and therefore on the prediction of the behaviour of the biofilm system (bioreactor, a biofilm in a water dustribution system or in a heat exchanger).

A biofilm is a complex gelatinous matrix containing microorganims. The characteristics of this pellicle, in terms of thickness, porosity, density, and therefore the physical structure, depend upon the hydrodynamic and substrate conditions under which it is formed, as well as on its age, and type of microorganisms present. Thus, the internal diffusion in biofilms is strongly dependent on biofilm structure and must be determined for every case under study. In spite of that, some authors assume that the diffusion coefficient of the substances within the microbial film are the same as in water or is a fixed percentage of the latter (Characklis & Marshall, 1990). Others calculated the diffusion through the application of diffusion reaction models or developed methods for measuring the mass tranfer within biofilms, based on artificial biofilms (formed by centrifugation, sedimentation or filtartion) or inactivated biofilms (by UV light or chemical inactivation). In recent years NMR (Lens *et al.*, 1996) and an electrochemical method (L'Hostis *et al.*, 1995), had been used to measure the mass transfer in biofilms.

In this work the determination of mass transfer coefficients within biofilms by mass transfer measurements will be presented. The technique is non-invasive and can be used along the biofilm formation. It is based on the formation of a biofilm on a permeable membrane, and on the diffusion of an inert substance through the system biofilm-membrane. It is a reproducible technique and it has already been tested in different conditions, namely in: i) biofilms formed by *Pseudomonas fluorescens* both in laminar and turbulent flow, with high and low substrate concentrations as well as in the absence and in the presence of abiotic particles; ii) in biofilms formed under anerobic conditions in laminar flow similar to those present in bioreactors. The values obtained for the mass transfer coefficients is steady-state biofilms range between 0.8×10^{-6} m/s and 1.8×10^{-6} m/s. This indicates similar mass transfer conditions in all cases although the biofilm thickness and structure varied from case to case: some biofilms were very loose and fluffy (with thicknesses of the order of several millimeters), others were more dense and thinner (thicknesses between 100 -800 micrometers).

Lens, P., et al., Third International IAWQ Special Conference on Biofilm Systems, Copenhagen 1996
L'Hostis, Eva *et al., International Conference on Microbially Corrosion, New Orleans, 1995*
Characklis, W.G., and Marshall K.C., "Biofilms", John Wiley and Sons, Inc, 1990