Formation of Biofilms on Suspended Particles in an Airlift Bioreactor

F.A. Lopes, L.F. Melo and M.J.Vieira
Centro de Engenharia Biológica - IBQF, Universidade do Minho, 4700 Braga, Portugal

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The Biofilm Airlift Reactor is one of the new technologies applied to waste water treatment.This is a promising system for aerobic treatment since it is possible to achieve a high biomass concentration in the reactor that leads to a high substrate consumption.
In this research, a biofilm of *Pseudomonas fluorescens* was studied using suspended basalt particles in an airlift bioreactor. In order to investigate the effect of substrate loading, biofilm formation was followed under different glucose influent concentrations (25, 53, 78, 150, 191 mg/L). During these experiments, the observed reaction rate (r_{fa}), the specific removal rate (q_{obs}), the respiratory activity, biofilm thickness and its composition in proteins and polysaccharides (total and extracellular) were measured. Biofilm detachment was followed by measuring the Total Suspended Solids (SST).
Results - Higher substrate loadings resulted in thicker hairy biofilms much more susceptible to detachment, leading to lower Biofilm/SST ratios (Figure 1).
Substrate uptake rates and the specific removal rates clearly showed that, despite increasing organic load and consequently increasing biofilm thickness, there is no decrease in the biological activity (Figure 2). This fact seemed to be confirmed by the respiration rates.
An increase of exopolymer content occurred at the beginning of each test, followed by a decrease and finally attaining a stable value. These experimental data confirm the key role of exopolymers during the early phase of microbial adhesion. Results also showed that polysaccharides were the mainly component of the exopolymer matrix, although it was possible to detect some proteins.
The **total** proteins and polysaccharides amounts were also determined in all those biofilms. In such samples, a preponderance of proteins was observed.
Assuming that cell mass can be indirectly quantified by measuring the total proteins content, as some authors propose, it seems credible that a substantial part of these biofilms were bacterial cells. This is in agreement with the activity results indicated above.

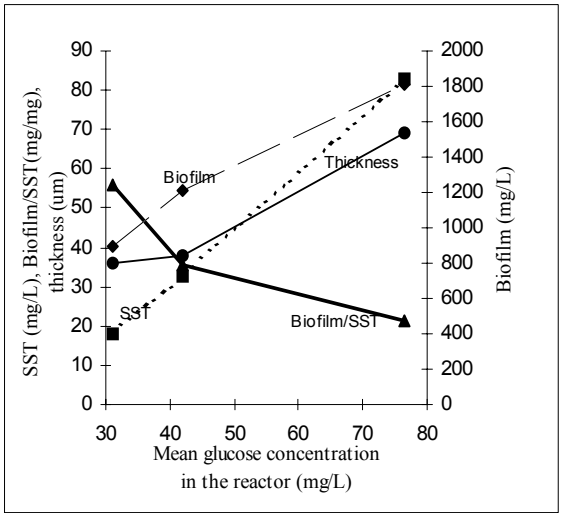

Figure 1 - Steady-state values of biofilm concentration, SST, Biofilm/SST ratio and Biofilm thickness

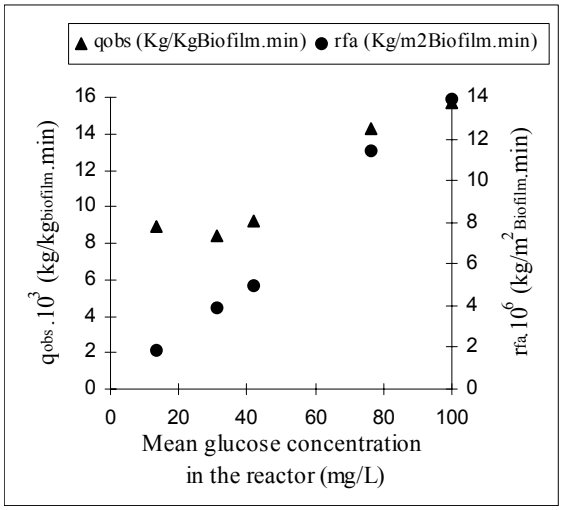

Figure 2 - Steady-state values of r_{fa} and q_{obs} obtained under different substrate conditions