# Characteristics of a Denitrifying Biofilms in a Fluidized bed Reactor

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The aim of this work was to study and optimise the operating performance (stability) of the fluidized bed reactor (FBR) by monitoring the variation of the bioparticle density (support+biofilm) and the thickness of the biofilm that coated the support over the time, under various operating conditions. Basalt was used as the support medium for biological growth and the denitrifying microorganism seeded was a heterotrophic culture of *Alcaligenes denitrificans* (ATCC 15173). Different C/N/P conditions were used in the FBR (hydraulic retention time, superficial velocity, recycle ratio, temperature and pH were kept constants) and denitrifying biofilm thickness, density and composition (in terms of total proteins and totals polysaccharides) were monitored along the time. The results obtained showed that the growth of the biofilm is not strongly affected by the C/N/P variable conditions, even in low nitrate removal efficiency. The biofilm that has achieved the highest denitrification activity has also presented a total amount of proteins far above the amount of polysaccharides (see Table 1). Nevertheless, for the conditions studied, the proteins/polysaccharides ratios are not significantly higher in the more active biofilm, in contrast with the results founded by Lazarova *et al.*[1]. Therefore the proteins/polysaccharides ratio does not indicate a good performance of denitrifying activity.

**Table 1** - Relationship between the operating conditions, the denitrifying activity and the content of proteins and polysaccharides

| C/N ratio (mgC/mgN-$NO_X^-$) | [P] (mgP/L) | Denitrifying Activity (%) | Thickness (μm) | mgTotal Prot/mgSV | mgTotal Polysac./mgSV | Ratio Prot/Poly |
|---|---|---|---|---|---|---|
| 1.78 | 1.14 | 45 | 0.395 | 0.390 | 0.163 | 2.5 |
| 3.6 | 1.14 | 93 | 0.402 | 0.307 | 0.107 | 2.9 |
| 3.6 | 0.49 | 49 | 0.344 | 0.227 | 0.107 | 2.1 |
| 1.81 | 0.16 | 15 | 0.384 | 0.167 | 0.181 | 0.9 |
| 1.43 | 0.16 | 25 | 0.385 | 0.268 | 0.244 | 1.1 |

During all the experiments was observed that when the attached support biofilm was grown, the biofilm and bioparticles density decreased resulting in the expansion of the fluidized bed at a given liquid recycle flow rate (similar results were founded by Livingston *et al.*[2]). After approximately a period of 20 to 25 days' operation, the mean bioparticle density decreased reaching values of decrements between 50 to 55%. At this point, manual operations of removal of biomass were required to keep the reactor within good operating conditions. Therefore, the current reactor does not produce the required shear stress that would allow the control of biomass growth on the support particles. This has caused a considerable reduction of the bioparticle density, previously reported, and hence various operating difficulties, namely excessive biomass growth, bioparticle washout and bioparticle clogging. The maximum thickness achieved by the biofilm, before clogging occurring, ranged between 350 and 400 μm.

[1] Lazarova V. Z., Capdeville B., Nikolov L. (1994), Influence of seeding conditions on nitrite accumulation in a denitrifying fluidized bed reactor. Wat. Res. Vol. 28, Nº5, pp. 1189-1197.
[2] Livingston A. G., Chase H. A. (1991), Development of a phenol degrading fluidized bed bioreactor for constant biomass hold-up. The Chemical Engineering Journal, 45, pp. B35-B47.