Session: Biofilm application

Bubbling for light: fighting microalgae biofilms development in photobioreactors

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Biofouling in photobioreactors (PBRs) negatively impact the cultivation process by decreasing light penetration and therefore biomass productivity. Biofouling results from the adhesion of single microalgal cells, and a later development of mature biofilms, on the surfaces of a reactor. The three-dimensional structure (i.e. spatial organization of cells) of such complex microbial communities strongly affects their cohesion and response to mechanical stresses and therefore may impact their resistance to cleaning procedures. Despite the importance of understanding biofouling in PBRs, the 3D structure of microalgae biofilms has been seldom characterized. In this study, we aimed at understanding how microalgae (a diatom and a cyanobacterium) colonize the surfaces of PBRs by studying in the short-term (few hours) their adhesion dynamics and in the long-term (weeks) their development as a function of different hydrodynamic conditions aimed at reducing biofouling. The experiments were conducted in a flat-panel reactor and several hydrodynamic conditions were generated by air bubbling. Cell adhesion was monitored by time-lapse microscopy and video analysis and biofilm evolution by confocal laser scanning microscopy (CLSM) and optical coherence tomography (OCT). The results show that the adhesion dynamics are species-specific and that shear-stress generated by bubbles helps creating low-biofilm areas that improve light penetration. In these areas the biofilms appear to exhibit different 3D structures and a strong resilience to shear-stress is also identified. Overall, studying biofilm properties in PBRs allows a better comprehension of such complex microalgae lifestyle and helps improving bioprocesses stability and productivity.