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Epiphytic Growth on Filamentous Bacteria Found in Activated Sludge: A Morphological Approach

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Abstract : Filamentous bacteria are well documented as causative agents of bulking and foaming in the biological wastewater treatment process. These filamentous bacteria are however closely associated with other non-filamentous organism forming a micro-niche. Among these specific epiphytic bacteria attach to filaments in the consortium of organisms that make up the floc. Neither the eco-physiological role of the epiphytes nor the nature of the interaction between the epiphytic bacteria and the filament hosts they colonize is well understood and in need of in-depth investigations. The focus of this presentation is on the interaction between the epiphytic bacteria and the filament host. Samples from the activated sludge treatment have been repeatedly collected from several wastewater treatment plants in KwaZulu Natal. Extensive investigations have been performed with SEM and TEM electron microscopy, Polarized Light Microscopy with Congo red staining, and Thioflavin T staining to document the interaction. SEM was used to document the morphology of both the filament host and their epiphytes counterparts with the focus on the interface/point of contact between the two, while the main focus of the TEM investigations with the higher magnification aimed to document the ultra-structure features of two organisms relating to the interaction. The interaction of the perpendicular attachment partly seems to be governed by the physiological status of the filaments. The attachment further seems to trigger a response in the filaments with distinct internal visible structures at the attachment sites. It is postulated that these structures most likely are amyloid fibrils. Amyloid fibrils may play an overarching role in different types of attachments and has earlier been noted to play a significant role in biofilm formation in activated sludge. They also play a medical role in degenerative diseases such as Alzheimer's and Diabetes. Further studies aims to define the eco-physiological role of amyloid fibrils in filamentous bacteria, based on their observed presence at interaction sites in this study. This will also relate to additional findings where selectivity within the species of epiphytes attaching to the selected filaments has been noted. The practical implications of the research findings is still to be determined, but the ecophysiological interaction between two closely associated species or groups may have significant impact in the future understanding of wastewater treatment processes and broaden existing knowledge on population dynamics.

Keywords : activated sludge, amyloid proteins, epiphytic bacteria, filamentous bacteria
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