

Roughness and Wettability of Biofilm Carriers: A Systematic Review

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Abstract

Since the 1980s, many studies have reported the importance of biofilm carrier roughness on microbial attachment. Roughness can enhance the wettability (hydrophobicity or hydrophilicity) of biofilm carriers. Roughness and wettability can lead to firmly attached biofilms with proper thickness communities and can protect them from being detached. However, roughness and wettability have not been adequately defined and discussed with regard to biofilm activity. Also, there is a contradiction among literature reports on how wettability affects bacterial adhesion. This systematic review presents a discussion of these properties as they affect biofilm formation and stability. In addition, it critically reviews past developments that occurred to advance carrier properties. It was found that an effective biomass immobilization requires rough surfaces having edges, and peaks and valleys. These carrier surfaces need to be substantially less or more hydrophobic/hydrophilic than the suspended biomass. The difference in wettability is the driving force to determine the degree of interaction with bacteria. Rough and wetted surfaces ensure the initial adhesion of bacterial communities and provide robust protection from detachment. If roughness was inadequate and the carrier wettability range was close to that of the biomass, it would significantly destabilize the overall biofilm system performance and deteriorate biofilm attachment.

Keywords: Biofilm carrier; Hydrophobic and hydrophilic surfaces; Roughness; Wastewater treatment; Wettability.

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