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Impact of carrier media on oxygen transfer and wastewater hydrodynamics on a moving attached growth system

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ABSTRACT

This study investigated the impact of five different carrier media on oxygen transfer efficiency and flow mixing in a 2 m^3 moving attached growth system pilot-plant. The five media studied varied in shape (cylindrical and spherical), size, voidage and protected surface area (112-610 m^2/m^3). In clean water tests, the media enhanced the overall oxygen transfer efficiency by 23-45% and hydraulic efficiency (HE) by 41-53%, compared with operation with no media. When using spherical media (Media 1, 2 and 3), the presence of biofilm increased the HE to 89, 93 and 100%, respectively. Conversely, Media 4 and 5 with biofilm contributed to a reduction in HE to 74 and 63%, respectively. The media protected surface area, the parameter traditionally selected to design biofilm processes, did not correlate with HE or with oxygen transfer efficiency in clean water tests. This study provides clear evidence that other media physical properties play a role in the mixing and oxygen transfer in moving attached growth systems. A correlation (R^2) of 0.89 and 0.90 was obtained between the media dimensionality times voidage (Di x Voi) and HE, with and without biofilm development, respectively. The combination of parameters (Di x Voi / HE) also correlated well with oxygen transfer efficiency in clean water (R^2 of 0.92 without biofilm and R^2 of 0.88 with biofilm). Dimensionality and voidage should be utilised to design and optimise media size and shape, to enhance mixing and oxygen transfer, ultimately contributing to energy savings and higher removal efficiencies.

Keywords: Aeration efficiency, carrier media, dimensionality, hydraulic efficiency, voidage.

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