Oxygen Transfer Model for a Flow-Through Hollow-Fiber Membrane Biofilm Reactor - DTU Orbit (01/01/2019)

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A mechanistic oxygen transfer model was developed and applied to a flow-through hollow-fiber membrane-aerated biofilm reactor. Model results are compared to conventional clean water test results as well as performance data obtained when an actively nitifying biofilm was present on the fibers. With the biofilm present, oxygen transfer efficiencies between 30 and 55% were calculated from the measured data including the outlet gas oxygen concentration, ammonia consumption stoichiometry, and oxidized nitrogen production stoichiometry, all of which were in reasonable agreement. The mechanistic model overpredicted the oxygen transfer by a factor of 1.3 relative to the result calculated from the outlet gas oxygen concentration, which was considered the most accurate of the measured benchmarks. A mass transfer coefficient derived from the clean water testing with oxygen sensors at the membrane-liquid interface was the most accurate of the predictive models (overpredicted by a factor of 1.1) while a coefficient determined by measuring bulk liquid dissolved oxygen underpredicted the oxygen transfer by a factor of 3. The mechanistic model was found to be an adequate tool for design because it used the published diffusion and partition coefficients rather than requiring small-scale testing to determine the system-specific mass transfer coefficients.

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