Understanding the influence of operating parameters through *in silico* optimization of energy consumption of submerged membrane bioreactor for urban wastewater treatment

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**ABSTRACT**

Membrane bioreactor technology has become relatively widespread as an advanced treatment for both industrial and municipal wastewaters. The main problem of these installations is that they do not operate at the maximum of their potential, mainly because of membrane fouling. Experimental research with this kind of installation requires resources and is time consuming. The use of a computer simulator, as in the present work, allows the fouling behaviour in a bench-scale submerged membrane bioreactor to be investigated over a wide range of operating parameters: average specific aeration intensity (0.041–0.277 L m\(^{-2}\) s\(^{-1}\)), filtration flux (0.032–0.160 m\(^3\) m\(^{-2}\) d\(^{-1}\)) and filtration and coarse bubble aeration cycles (filtration and aeration times: 60–1080 s, with/without ratio: 0.33/10). A quadratic optimization method applied to the energy consumption (EC) was first carried out: minimum values of 0.27 and 0.32 kW h m\(^{-3}\) were obtained for EC in the sequential and non-sequential operating modes, respectively. Using the optimal operating conditions and the most influent parameters found in the first part, the second part details their influence on both membrane fouling and EC for each operating mode. The mean filtration flux and the mean aeration intensity have opposite effects on fouling and EC, which implies that a more global, economic optimization, including chemical cleaning, is needed. The detailed study of filtration and coarse bubble aeration cycles showed that they had little influence for a with/without ratio superior to 1. Using the quadratic optimization method with *in silico* experiments gave reliable first approximation results.

**Keywords:** Quadratic optimization; Submerged membrane bioreactor; Urban wastewaters simulator

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