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Optimization of the operational parameters in a submerged membrane bioreactor using Box Behnken response surface methodology: membrane fouling control and effluent quality

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ABSTRACT

Various strategies have been assessed over the years to minimize membrane fouling in MBR. Backwashing and relaxation, the integral part of MBR operation, have been considered to be effective for the control of membrane fouling. In this study, Box–Behnken design (BBD) method was employed to investigate the combined influence of permeate flux, backwashing and relaxation duration on the performance of MBR. Based on the experimental results, quadratic models for effluent quality parameters, namely COD, NH_4–N, TN and TP removals were developed and the significance of these models was analyzed using the analysis of variance (ANOVA). Trans-membrane pressure (TMP) was monitored as the indicator of membrane fouling, and the increase in TMP was used to generate the regression model. Quadratic models based on the experimental results depicted that high permeate flux, backwashing and relaxation durations can negatively affect the performance of MBR. On the other hand, backwashing and relaxation durations were effective to minimize membrane fouling and the contribution of each tested variable was as follows: backwashing duration > permeate flux > relaxation duration. Since backwashing and relaxation durations negatively affected the removal of bulk organic and nutrients, optimization of these variable is vital for efficient performance of MBR. Based on the optimization of the variables, optimal backwashing and relaxation durations were 25 and 100 s, respectively, at a constant filtration duration of 8 min, while optimum permeate flux was 18 LMH.

Keywords: Box–Behnken design (BBD); Membrane fouling control; Optimization; Membrane bioreactor; Response surface methodology

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