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Photocatalytic degradation of palm oil mill effluent over ultraviolet-responsive titania: Successive assessments of significance factors and process optimization

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ABSTRACT

In this study, for the first time, the application of central composite design, a response surface methodology in the design of experiment, was carried out for the optimization of process variables in the photocatalytic degradation of palm oil mill effluent over a UV/titania system. Prior to the optimization study, the factors (oxygen flowrate, titania loading and initial concentration of palm oil mill effluent waste) were screened using a 2^3 full-factorial design to determine the signficance of their influences on the degradation of palm oil mill effluent. The screening results showed that all the three main factors were significantly influencing the final degradation of palm oil mill effluent. The analysis of variance (ANOVA) results revealed that the oxygen flowrate (A) contributed the highest effects to the degradation (63.5%), follows by the initial concentration of palm oil mill effluent (C, 22.32%), titania loading (B, 5.69%), and finally the interaction effect between the oxygen flowrate and the initial concentration of palm oil mill effluent (2.29%). In the ensuing optimization process, a quadratic model with R^2-value of 0.92 was found to offer the best correlation judging from the fitting test as well as residual analysis. All the terms, including main factors and interaction effects, were significant to the degradation, except the interactions between oxygen flowrate and initial concentration of palm oil mill effluent (AC), as well as titania loading and initial concentration of palm oil mill effluent (BC). Validation experiments were conducted and the degradations obtained were 54.33% and 55.62%, with only 4.41% deviation from the predicted value.

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