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Abstract

An integrated design methodology which incorporates theories, experiments and knowledge base has been formulated for the design of an anaerobic fluidized bed bioreactor. The design methodology starts with identifying the design objectives of the reactor and measuring the characteristics of the wastewater to be treated. Experiments are conducted in different steps of the methodology to determine parameters that are specific to the wastewater under study. With the experimental data available, theories and heuristics are used to determine the major design and operating parameters of the reactor. These parameters include hydraulic retention time (HRT), organic loading rate (OLR), sludge loading rate (SLR), reactor and inclined settler dimensions, sludge discharge frequency, and liquid and biogas recycle ratio. With these design and operating parameters, pilot-scale reactor can be constructed and anaerobic degradation experiments are conducted to evaluate whether all the design objectives are met. Possible modifications are identified in the methodology to guide the designer how to modify the design and operating parameters when the design objectives are not fulfilled or when the influent wastewater characteristics vary. Finally, the major design and operating parameters of a full-scale bioreactor can be specified. An example on designing an anaerobic fluidized bed reactor for treating a synthetic dyeing effluent is illustrated in this paper. Experiments were conducted to illustrate how the theories and knowledge base can be utilized to design the reactor. A pilot-scale reactor was built and a COD removal of >80% and a color removal of >90% could be achieved which satisfied the desired pollutants removal.

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