Title of Article: Influence of reactor design on the treatment performance of waste stabilization pond.
Authors: Olukanni, D. O and J. J. Ducoste
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Abstract: Waste stabilization ponds (WSP) have been used extensively to provide wastewater treatment throughout the world. A study was conducted that utilized Computational Fluid Dynamics (CFD) coupled with an optimization program to optimize the selection of the best WSP configuration based on minimum cost and maximum treatment efficiency. In this study, the pond length to width (L/W) ratio was allowed to increase from 1:1 to 1:4. This L/W ratio was based on the limitation of land availability. The optimization model simulations were also performed for different baffle to reactor side length ratio between 5% and 95% as well as for different number of baffles from 0 to 8. As expected, the multi-objective genetic algorithm optimization produced the lowest cost WSP design. The results of monitoring the fecal coliform concentration at the reactor outlet showed that the conventional 70% pond-width baffle pond design is not consistently the best pond configuration as previously reported in the literature. Several other designs generated by the optimization tool showed that both shorter and longer baffles may improve the process efficiency of the ponds with different pond foot prints. Experiments were performed on a pilot scale three-stage WSP that included (anaerobic, facultative and maturation) removal performance based on a number of parameters (Faecal coliform, Chloride, Sulphate, Nitrate, pH, TDS and Conductivity). The experimental results showed that the design based on the optimized CFD WSPs performed well compared to the standard baffle WSP configuration developed from literature data. An improvement was observed for the optimized WSP design compared to the standard WSP design. Overall, the CFD/optimization results has demonstrated that minimizing the WSP cost to meet or exceed a target effluent log reduction may be achieved by reducing the amount of construction material and tolerating some degree of fluid mixing within the pond.