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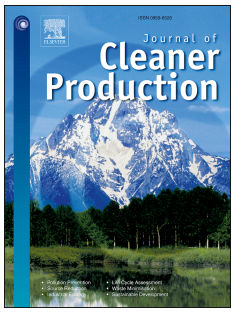

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On the Hydrodynamics and Treatment Efficiency of Waste Stabilisation Ponds: From a Literature Review to a Strategic Evaluation Framework

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Abstract:

Waste stabilisation ponds (WSP) are designed to treat wastewater through natural microbiological, photosynthetic, biochemical, physico-chemical and hydrodynamic processes. They are used throughout the world for wastewater treatment due to their minimal technical requirements, low cost and minimal energy consumption. It is well recognised that WSP hydrodynamics plays a crucial role influencing WSP treatment efficiency. In this study, published WSP literature is reviewed with a focus on the importance of environmental forces, pond configurations and pond loadings on WSP hydrodynamics and pond treatment efficiency. The findings are used to propose future WSP design and modelling requirements. It has been found that the interrelated effects of multiple factors such as pond length-to-width ratio, inlet/outlet configuration, temperature, solar radiation and wind on WSP treatment performance are not investigated sufficiently at present. It is suggested that a system based on numerical pond modelling and field measuring analyses be formulated to address the interacting influences of these factors on WSPs. Consequently, field studies on full-scale WSPs are required to obtain a complete dataset for validation purposes. In this regard, a combination of three-dimensional pond water temperature survey and tracer concentration mapping is suggested. Details of specific modelling components, such as sludge accumulation, turbulence mechanisms and the assumption of constant influent conditions, require further attention. As a result of this review process, a strategic evaluation framework together with the required dataset for the modelling and field work activities are proposed. This paves the way for subsequent studies on WSP hydrodynamics and treatment efficiency, thus benefitting pond design and operation processes.