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# STUDIES INTO THE HYDRAULICS OF WASTE STABILISATION PONDS

A thesis presented in partial fulfilment of the requirements for the degree of

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## ABSTRACT

Wastewater stabilisation ponds are used extensively to provide wastewater treatment throughout the world. A review of the literature indicated that, while understanding the hydraulics of waste stabilisation ponds is critical to their optimisation, the research in this area has been relatively limited and that there is a poor mechanistic understanding of the flow behaviour that exists within these systems.

Traditional tracer studies were used in this study but, in addition, new methodologies were developed involving drogue-tracking techniques to directly quantify the internal flow pattern. The investigation included study of physical scale models in the laboratory, operational ponds in the field and the simulation of both using computational fluid dynamics (CFD) mathematical modelling.

Twenty experimental configurations were tested in the laboratory with the variables being: retention time; outlet position; inlet type and position; and the influence of a baffle. Ten of these experimental cases were then mathematically modelled and, in general, the simulations had close similarity to the experimental data.

In the next phase of the work, the tracer and drogue tracking techniques were applied on two full-scale waste stabilisation ponds in the field. For one of the ponds a large scale model was also constructed. Mathematical modelling was again performed and a high degree of similarity was achieved. The study then finished with a broad review of wind effects and an investigation of integrating a biodegradation equation within the CFD model.

While it was concluded that a CFD model cannot always be expected to precisely predict the performance of a field pond, this work has validated its use to the extent that it can be pragmatically applied for the systematic evaluation of alternative baffle, inlet and outlet configurations, thereby, addressing a major knowledge gap in waste stabilisation pond design.

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