STUDIES INTO THE HYDRAULICS OF WASTE STABILISATION PONDS

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

Doctor of Philosophy

in

Environmental Engineering

at

Massey University,

Turitea Campus, Palmerston North, New Zealand.

Andy Shilton

2001

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.

ACKNOWLEDGEMENTS

Over the six years that I have worked on this thesis I have received help, assistance and guidance from a large number of people. Of these, I will only be able to mention a few.

My supervisors Professor Rao Bhamidimarri (Massey University, New Zealand), Professor Bruce Melville (University of Auckland, New Zealand) and Professor Duncan Mara (University of Leeds, England) must be first in these acknowledgments. My research work crosses a number of areas. Bruce has been invaluable with regard to the hydraulics – particularly the work with scale models. Duncan is a recognised authority on waste stabilisation pond technology and has hosted me on several visits to England. Rao, being my primary supervisor, has spent many hours giving advice to me on this project. In particular, it is through his experience and mentoring that I have come to understand the philosophy of research.

At the commencement of this work I was awarded a Hume Fellowship to assist me to travel abroad in support of my studies. The benefits of being able to travel to meet and work with leading researchers around the world have been tremendous.

In addition to the knowledge imparted by my supervisors, I was fortunate enough to receive specialist advice from many other academics and practitioners. In particular, I would like to acknowledge Professor Torban Larsen (University of Aalborg, Denmark) with regard to the theoretical evaluation of wind and inlet power; Dr David Glynn (Flowsove Consultants, London) and Dr Mike Malin (CHAM, London) with regards to the computational fluid dynamics modelling; and finally Dr Roger Nokes (University of Canterbury, New Zealand) with regard to Reynolds number effects on scaling.

It is also important to give credit to the students who have worked with me on various projects that have tied in with my broader research into waste stabilisation ponds. In particular, I would like to acknowledge the hydraulic research work undertaken by Murray Kerr, Mike Pratt and Stefan Kreegher. With particular regard to the fieldwork, the cooperation and assistance of the Palmerston North City Council, the Manawatu District Council and Horizons MW was greatly appreciated.

Two colleagues at Massey University who had significant input were Dr Don Bailey and Mr Paul Bickers. Without Don the technique for image tracking of drogues in the laboratory would simply not have been possible, whilst Paul provided a willing sounding board for planning and review of the experimental work.

Undertaking a doctorate part-time requires the sacrifice of considerable quantities of time outside working hours. The indirect role that my family, Bettina, Lilla and Jordan have played in supporting my work has been fundamental to its success.

This thesis is dedicated to my mother Heather Shilton, one of New Zealand's early woman scientists and my late father Dr Ted Shilton, a man who gave so much to the community he served.

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