EXECUTIVE SUMMARY

INTRODUCTION

Recently research attention has been devoted to linking simulation models for activated sludge (AS) and anaerobic digestion (AD) such as Activated Sludge Model No 1 (ASM1, Henze et al., 1987) and Anaerobic Digestion Model No 1 (ADM1, Batstone et al., 2002) to develop plant wide wastewater treatment plant (WWTP) models (Jeppsson et al., 2006). In such models, the outputs of one unit operation become input to the next downstream one. However, plant wide models assembled by linking simulation models are large, complex and require significant modelling skills, experience and understanding to master and use effectively. Furthermore, such models are not compatible with design because they require all the reactor sizes and interconnecting flows and all the starting concentrations in all the reactors to be quantitatively defined.

Steady state models are more practical for design because they are simpler, require less experience and expertise and demand less input data than the complex simulation models, and so are used more often by designers and operators. With steady state models, one can (i) estimate reasonably simply and quickly the principal system design and operating parameters, such as sludge age, unaerated (anoxic and anaerobic) mass fractions, reactor volume, recycle ratios from system performance criteria specified for the design, such as effluent and sludge quality, (ii) investigate the sensitivity of the system performance to the design and operation parameters, (iii) estimate product stream concentrations for design of down- (or up-) stream unit operations of the WWTP and (iv) very importantly, provide a basis for cross-checking simulation model output results, all with very little input data requirements compared with the simulation models. Once the overall WWTP scheme is established and the main system defining parameters of the individual unit operations estimated, complex simulation models can be applied to the individual unit operations to refine their design and evaluate their performance under cyclic flow and load conditions. Steady state models of WWTP unit operations are therefore a very useful complement to the complex simulation models and so both steady state and dynamic simulation WWTP models need to be developed.

RESEARCH OBJECTIVES

In this research project the primary focus was on developing steady state models to a point where they can be connected into a plant wide WWTP model (Fig 1). Because of the (1) common use of the total suspended solids (TSS) parameter at WWTPs, the inorganic suspended solids (ISS) needs to be incorporated into the steady state models, and (2) current interest in green house gas generation, carbon also needs to be included in the steady state models via stoichiometry of the biological processes in the various unit operations of WWTPs. To provide the required information to develop a plant wide steady state WWTP model, the main objectives of this project were:

(i) Determine experimentally the characteristics and biodegradability of primary (PS) and waste activated sludge (WAS) under anaerobic and aerobic digestion conditions.

(ii) Track the inorganic suspended solids (ISS) through the WWTP to check whether or not it is conserved.