Obviously, the design of activated sludge systems has already received a large amount of research attention. Several design software packages have been developed, most of which were based on the Activated Sludge Models from the IWA (Henze et al; 1986, 1994 and 1998). The theoretical concepts used in the IWA models are for a large part based on the research done at the University of Cape Town (UCT) in South Africa (Water Research Commission, 1984). The same research also forms the basis of the general and ideal steady state models presented in in this book.

However, the format of the IWA models is not particularly suitable for application as a design tool. One should consider that the main objective of these dynamic models is to increase our knowledge of activated sludge system behaviour, for instance by allowing this behaviour to be simulated. For this purpose, a large number of variables and parameters are included. These are indispensable when studying system reactions to disturbances or to process control measures, but can be considered as unnecessary ballast from a design viewpoint. In fact, the IWA models are of such a complexity that an analytical optimised design solution is not possible.

An example is the dissolved oxygen (DO) concentration, which is included in the IWA models as one of many state variables, all having their own separate mass balance. Furthermore, the concentration of dissolved oxygen is included in nearly all reaction rate equations, in the form of a control function. This Monod type control function is either in the form DO/(K + DO) or (K + DO)/DO and thus "switches" a particular process on or -off, depending on the dissolved oxygen concentration. This is a crucial feature when simulating the behaviour of activated sludge systems. However, it is not required for system design, where sufficient availability of oxygen in the aerobic reactors and the absence of oxygen in anoxic- and anaerobic reactors is presupposed. Proper aeration control, including installation of sufficient aeration capacity and a suitable process control system, is there to ensure that oxygen will be present at the right time, location and quantity. From a design perspective, it will not make a significant difference whether the oxygen concentration will be 1.9 or 2.3 mg $O_2.l^{-1}$. A second example is alkalinity. In the design of an activated sludge system, it is only important to know whether sufficient alkalinity will be available in the influent, given the design requirements. If not, then provisions will be made for pH control.