CONTROL SYSTEM DESIGN FOR ACTIVATED SLUDGE WASTEWATER TREATMENT PLANTS : SOME PRACTICAL EXPERIENCES

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ABSTRACT

In this paper we present some of our experiences on the design and implementation of control systems for the activated sludge wastewater treatment plants. The following two issues will be particularly addressed :

Choosing an appropriate control strategy. Before designing a control system, one usually has on hand an objective function which has to be minimised or maximised by appropriately controlling the process. This, together with the mathematical model of the process, if available, constitutes an optimal control problem which is often difficult to solve due to for instance the complexity of the model, the incomplete on-line information, and so on. Very often one is determined to find a sub-optimal control strategy with which the objective can be approximately achieved. This consists mainly of choosing the controlled and sometimes even the manipulated variables and determining how the controlled variables should be controlled. By presenting a few practical examples[1][2], we show how an appropriate control strategy can be found by means of model-based analysis of the concerned process.

Deriving information for feedforward control. A wastewater treatment plant typically suffers large external disturbances. For instance, the peak to minimum ratio of the flow to a small treatment plant with a concentrated sewer network can be as much as ten[3]. To reject such large disturbances with feedback loops, one usually has to apply high feedback gains which are not always acceptable due to for instance the limited measurement accuracy or frequency. Feedforward control helps to reduce the burden on the feedback loops but requires extra measurement of the disturbances. In this paper we present an idea of designing feedforward control without requiring additional measurement. The essence is to derive the information needed by feedforward from other on-line measured signals. This is possible because the external disturbances to a wastewater treatment plant varies usually much slower than the dynamic processes occurring in the plant. For instance, the oxygen respiration rate, which is considered as an external disturbance to the control of the oxygen concentration varies very slowly in comparison to the time constant of oxygen transfer. Another advantage of deriving the feedforward information on-line is that the 'disturbance' obtained often represents the effect of the real disturbance, which leads to a more straightforward design of the feedforward law.

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