

Simulation and control tools for biological treatment processes optimization

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DESCRIPTION AND SPECIAL FEATURES

The increasing urban sewage load and the more restrictive effluent requirements imposed by water authorities due to the public concern about the environment quality have triggered the design of complex biological processes for carbon and nutrients removal.

Thus conventional rules for plant design and operation are frequently limited and the selection of their most appropriate values is frequently a very difficult task, even for experienced people.

The necessity and the possibility of designing and operating treatment plants with different objectives (effluent requirements, safety, investments costs, exploitation cost, etc.) and different external conditions (influent load, temperature, etc.) significantly increases the complexity of the problem.

The use of simulation, instrumentation, control and automation (ICA) tools in the wastewater treatment plants (WWTP) (figure 1) could significantly improve both the stability of the process and the quality of the effluent and at the same time achieve a simultaneous reduction in running costs. These instruments also facilitate the analysis of complex designs, operation conditions, plant failures, etc.

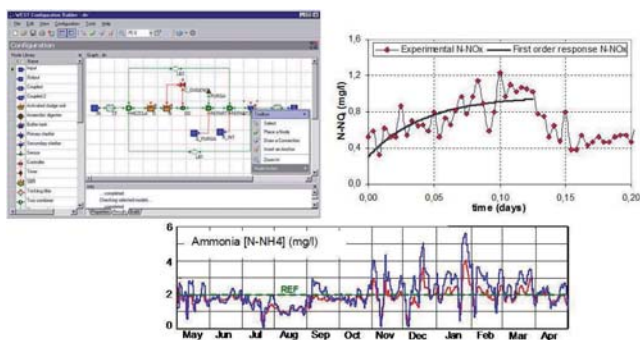


Figure 1.- Combination of simulation tools, calibration using experimental values and validation

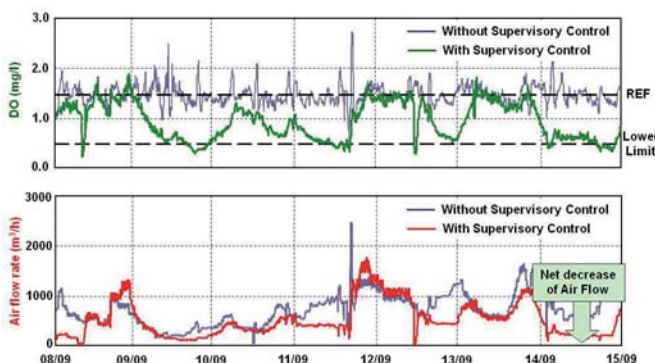


Figure 2.- Comparative air consumption and Dissolved Oxygen concentration in a case study (AS process)

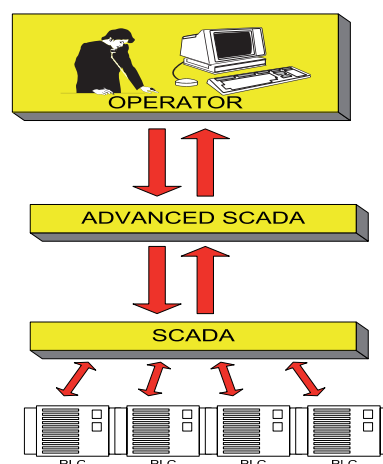


Figure 3.- Supervisory control structure

INNOVATIVE ASPECTS AND COMPETITIVE ADVANTAGES

The development of new mathematical models describing physical, chemical and biological processes in treatment technologies combined with optimization algorithms demonstrate their usefulness in the selection of the 'best value' for the operating variables within the process, depending on the selected objective criteria.

In different case studies it has been demonstrated that the synergetic combination of supervisory control loops facilitates a stable operation of biological processes, improves the effluent quality and lowers simultaneously the air flow needed (Figure 2).

The application of supervisory control strategies (Figure 3) based in simple simulation models previously calibrated and validated for the automatic selection of the main operational parameters in Wastewater Treatment processes, both in industrial and municipal wastewater facilities can be a very useful tool for optimizing the exploitation of the process.