Knowledge Embedded Software for Simulation, Design/Upgrading and Testing of WWTPs: SWater®

Introduction

This application note introduces SWater, a software to support design/up-grading, testing and simulation of urban/industrial and mixed wastewater treatment and/or equivalent.

Born to meet the needs of "field", SWater allows to verify, in all operative conditions, operational performance and the residual capacity of each of the different sections of the cleaning treatment (physical-chemical-biological).

The used approach allows to consider "dimensioning and verification" like two "points of view" of a same object. That is to say the corrected functionality of the plant (or an existing project), in achieving the quality of continuity of the effluent, in accordance with local regulations.

Why?

In spite of a large availability of mathematical models from academic WWTPs, some responsible technical and operators have consistently complained about a general low functional applicability and flexibility of these models to real way of working of treatment plants.

Moreover, mathematical modelling has largely been seen as an academic analysis, and so it is far from 'real' input of water treatment plants.

SWater has been realized to satisfy specific needs of filed. It uses a new approach in design and testing of WWTPs, to meet our far-seeing Customers' specific requirements in wastewater market. It has been designed using approaches developed with years of experience.

Most of existing systems on the market for design/upgrading, testing and simulation of urban/industrial wastewater treatment (BioWin, GPS-X, SASSPro, STOAT, WEST…) have the following features:

- They are bound by strict and rigid mathematical patterns, with fix generic parameters as "constants" "k" as from technical-scientific literature;
- They have been made by theorist and not by workers, experts of processes;

- They require some input parameters not covered in the analysis of routine checked in laboratories (for. Ex. Soluble COD, etc.);
- They observe processes from one point of view, considering design and testing as two different approaches;
- They are based on the graphically linking of model blocks, which represent unit processes (e.g. sewer section, primary treatment, activated sludge tanks).

Features

SWater uses a holistic approach, by analysing and testing wastewater processes. It is based on the integration of traditional deterministic mathematical models (IAWPRC) and heuristic knowledge based softcomputing models related to wastewater processes.

SWater has been made because between theory and practice there is a difference that makes really understand the goals of treatment, which represents the added value that all the operators require to a simulation software.

The difference is not in the theoretical principles of operation of treatment processes; even SWater's code is derived by theoretical models ASM1/ASM2 (Activated Sludge Models developed by the International Water Association - IWA), as all the more influential existing computer codes on the market. The difference is in how the theoretical models are used, and not in their calculations.

These algorithms are compared to the reality of wastewater treatment plants and the parameters that you have actually in the field and in the case of the project, both in case of testing and/or upgrading.

So, SWater:

- gives possibility to interact at the same time or with the data of dimensioning, than of verification, because not bound to rigid mathematical models;
- doesn't need to calibrate of the theoretical models "k" because it uses a heuristic approach (non deterministic), very close to actual operating conditions of real plants;

- has been realized to satisfy the needs of operators;
- uses operative data and input normally available (hydraulic load, pollution load, …);
- provides rapid analysis with minimum sustainable number of data input;
- considers design and testing as two point of view of the same target: a designed WWTP should satisfy its testing, and a tested WWTP should satisfy its design;
- identifies "working area" of each treatment section: a visual indicator detects the process efficiency parameters in their range-ability, in order to notify by "earlywarning" (near end-scale), a critical process-event in progress;
- provides global view information about the process;
- provides "just in time" information that guide the operator in selecting the most appropriate system solutions based on the real needs of field;
- provides to control the quality of the final effluent, continually;
- provides a trend behaviour of the treatment plants;
- provides statistic integration of hourly load data;
- doesn't use a graphical layout for the design of the plant, and so it is easy to use even for non-designers;
- calculates both construction and operative costs, with reference to the algorithms used in action plans;
- provides a supply report automatically in Word format, which allows the operator to have clear and documented design and testing operations at the end of each operation.

Advantages and Innovation

SWATER is a flexible instrument that allows the matching between theory and practical experience. It is expected interdisciplinary integration (kinetics, biology, chemistry, etc.) between theoretical and practical methods, using artificial intelligence.

The main peculiarity of the software are:

1. size of wastewater plants is from 5.000 to 5.000.000 equivalent habitants;
2. fusion of heterogeneous data (chemical, physical, biological, …);
3. cost reduction of wastewater quality control process management at least by 15%;
4. low-cost installation;
5. development of new sensibility in water management control for professional operators;
6. it can be used not only for urban wastewater, but also for industrial wastewater and mixed (urban-industrial compliant mixed) wastewater.

Conclusion

SWater is the software able to realize design/upgrading, testing and simulation of urban/industrial wastewater treatment.

SWater is the first/only (at the moment) WWTPs simulation software made by operators of the field, although it is ASM1/ASM2 compliant as all academic models in literature. In fact, SWater gets over the gap, that exists between theory and practice, since it has been realized to satisfy specific needs of field.

Its principal characteristic are:

- flexibility, by using heuristic algorithms, in addition to the traditional ones;
- the use of data and input normally available (hydraulic load, pollution load, …);
- graphical and numerical simulation of the optimum operating conditions;
- the use of process indicator for verifying the correct functioning of the plant;
- the possibility to operate in design and in testing mode at the same time just clicking on it;
- its layout is "user-friendly", and so it can be used easily even by an operator with the basics of computer.

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