

OptimEDAR

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OptimEDAR is a new control and management solution for wastewater treatment plants (WWTP) based on an **innovative on-line monitoring of the aeration process in the biological reactor**.

The classic automatic operation of a WWTP biological treatment is based on controlling the blowers by measuring the dissolved oxygen parameter (DO) and its following comparison with a specific value, whereas in a manual state, blowers are controlled for timed cycles on / off. This mode of operation works properly when influent is constant (inflow, concentration, and nature of organic matter levels) and under external stable conditions (temperature, rainfall, etc.), but cannot be optimal for those plants where the influent suffers significant load and flow cyclic variations over a 24 hour period, weekend or seasonal peaks.

DESCRIPTION:

OptimEDAR principle of operation is an application of 'virtual sensing' techniques. OptimEDAR uses DO and Redox measures to determine the status of the biological reactor. Using the instantaneous values and their temporal evolution and trend, the mathematical algorithms - based on probability calculations and fuzzy logic techniques - calculate the Equivalent Organic Charge (EOC), that estimates the organic matter load in the bioreactor.

By adjusting the timing and operating conditions of the blowers according to the stringent reactor's oxygen requirements, energy consumption is optimised and biological results can be modulated according to the need of elimination of the organic matter.

APPLICABILITY AND PRE-REQUISITES:

The OptimEDAR solution is applicable for Active Sludge WWTPs with biological reactor (concentric or carrousel), aerated with up to 3 blowers (1 or 2 speeds). The control of variable speed blowers will be developed in future versions.

Better results are achieved in plants where influent suffers a significant variation in organic matter load. Also, an inefficient operation has been detected in plants designed for covering a seasonal peak demand that are normally oversized.

The main OptimEDAR market are medium WWTPs (from 2.000 up to 50.000 P.E.), representing 76% of the overall EU market. Large WWTPs are often highly automated and probably they have alternative solutions for efficiency aeration process.

BENEFITS:

- Reduce energy consumption, by average 20%, by adapting blower operation to the actual reactor load.
- Optimise the denitrification process and increase the biological phosphorous removal.
- Increase the sludge microbiological stability. Improve the quality of water discharged to the natural environment.
- Reduce sludge production.
- Reduce the "ecological footprint" of the complete wastewater treatment process.

OPERATION AND MAINTENANCE:

OptimEDAR is an 'add-in' solution, easy to install, and based on robust probes with low maintenance requirements. In addition, it does not interfere with existing automation tools, allowing the operator to easily change to the old control system, by means of a selector switch located in the control panel.



The OptimEDAR solution is composed of a control cabinet and a sensors cabinet installed in the bioreactor. Data transfer between cabinets is done by wireless connections, simplifying installation and reducing their costs. In addition, it includes a GPRS/3G connection and a data collection software is delivered in order to manage and monitor the system.

Average commissioning time is estimated at one day, in case electric schemes are available in advance. Fine tuning will take 2 or 3 more days, and can be performed remotely.

COSTS:

The basic OptimEDAR unit cost is 19.500 €.

OptimEDAR operation costs are limited to the maintenance of DO and Redox probes, further more cheaper, in terms of investment and maintenance, than more sophisticated controls based on ammonia analysers.

In the activated sludge treatment, nearly 50% of the energy used is consumed by the aeration process in the biological reactors. Therefore, a 20% decrease of energy consumption in this process means a significant reduction in the energy bill for the whole plant.

The Return of Investment (ROI) depends on the initial performance of the plant, which determines the expected % of energy consumption reduction, and the number and power of the blowers. Consequently, for small plants the ROI will be longer because of the low power consumption.

REFERENCES:

The OptimEDAR solution has been installed in different WWTP in order to verify and validate its performance. The first prototype was tested in the **Albuera WWTP (Badajoz, Spain)**: a plant designed for 4,000 P.E., with a total volume of 1,000 m³/day. Before installing the prototype, blowers were working 14-16 hours per day. At the end of the test, once the system operation was optimised, blowers were working 5-6 hours per day, which represents more than 60% of energy saving. In terms of treatment efficiency, the results achieved were 92% - 99 % in nitrate reduction, and 40% - 65%, in phosphate reduction.

A second prototype was tested in **Carme (Barcelona, Spain)** (4,023 P.E., 518 m³/day). Figure 1 shows the different evolution of measured parameters before and after control with OptimEDAR system in Carme WWTP. The first chart shows standard Oxygen Control: the start and stop of blowers is controlled to maintain oxygen level between 0.2 ppm and 2.5 ppm. The second chart shows OptimEDAR control: EOC is calculated (red points) and used to evaluate the load of the biological reactor. In this plant, an average reduction from 6.3 hours of blowing to 4.9 has been achieved, which represents more than 20% energy save.

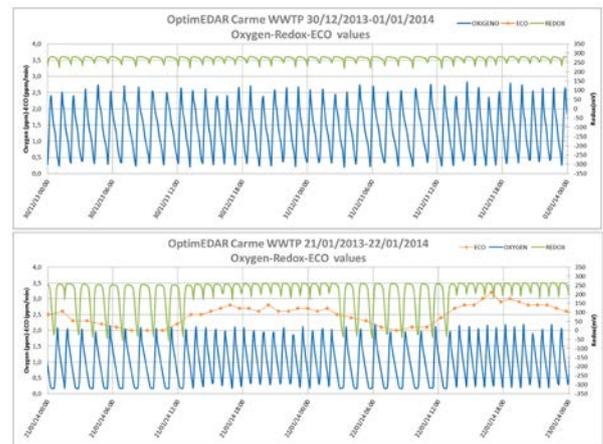


Figure 1. Evolution of Oxygen and Redox in Carme's reactor before (top) and after (bottom) OptimEDAR controlling.

Within the R3Water project, the OptimEDAR demonstration will be held in **Wijer (Belgium)** (1,440 P.E., design flow max. 2470 m³/day) and in **Empuriabrava (Spain)** (70.000 P.E., 16.000 m³/day), as cases of study for a small plant in different climatic conditions and a big plant with highly seasonality.

For more details about the demonstration sites, please, visit: <http://r3water.eu/demonstration-belgium/> and <http://r3water.eu/demonstration-spain/>

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