The ENVICON TAT-IntelliClean® Aeration Control is a self-parameterizing, intelligent fuzzy control for wastewater treatment plants with intermittent aeration. Experience has shown that use of the TAT-IntelliClean® fuzzy control leads to optimization of the treatment process in the treatment plant concerned and, as a result of a high degree of evening-out of the effluent values to a lower level, to energy savings of up to 30%.

The economic advantages of the TAT-IntelliClean® Aeration Control result from the ability to automatically adjust the aeration intensity to the actual load conditions in the treatment plant ensuing from the inflow conditions and status of biocoenosis in the aeration tank, with a minimum of measurement and control equipment.

Conventional controls - clocked controls, redox controls, and also controls based on the parameters NH₄, NO₃, P, etc. - function according to threshold values, which are merely empirically determined on the basis of operational experience. In terms of the process, they do not function optimally, since the process conditions in the aeration tank change constantly, i.e., they are dynamic. However, the control criteria for aeration are rigid and static.

The TAT-IntelliClean® fuzzy control uses the actual time curve of process-defining variables to control. According to a patented process, based on the analysis of the signal time sequences according to fuzzy pattern classification, characteristic patterns are generated as switching criteria. The switching criteria are no longer absolute values, but signal curves. In order to adjust our control to the respective

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**Graph:**

- **$N_{tot}$ [mg/l]**
- **Start of TAT-IntelliClean®**

**Table:**

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treatment plant, the specific characteristics of the signal time curves (e.g., increase in the oxygen concentration, operating frequencies,…) must be taken into account. For this reason, a trial operation for 2-3 months is necessary, which is not a formal replacement of the existing control, but corresponds to the cost, in terms of engineering, of a process analysis and optimization.

The fuzzy control comprises a fuzzy control computer as a compact module, complete with screen and keyboard, which is pre-installed in a wall cupboard in accordance with DIN VDE 0110, 0113, 0660. A digital and analog interface system is integrated in the computer, as well as a telecontrol option via a telephone connection. Thus, permanent process analysis by means of visualization and recording and filing the process data during the trial operation and also for later maintenance, is possible.

The prerequisite for the use of the fuzzy control is the existence of an oxygen, a redox and a pH measuring sensor at each aeration tank and a telephone connection. The TAT control computer provides the switching signals for the blowers of the SPC. Optionally, direct control of the blowers via the $O_2$ control is also possible.
Based on our experience in treatment plants of comparable size and mode of operation, the following economic advantages can be expected as a result of the use of our TAT-IntelliClean® Aeration Control:

- improved preconditions for explaining the lowering of the wastewater levy as a result of a high degree of evening-out of the effluent values to a lower level
- savings in aeration energy > 10 – 30 %
- increasing N elimination by up to 60 %
- lowering of the precipitant requirement for P elimination as a result of improving biological P removal
- increasing the capacity of the treatment plant by up to 15 %
- increasing technical and process safety as a result of improving the degree of monitoring of the process parameters and the entire technical complex of the aeration stage
- increasing the stability of plant operation

Comparison: total annual costs according to LAWA for TAT-IntelliClean® Aeration Control / conventional controls, taking as an example treatment plants for 40.000 PE / 75.000 PE

![Comparison Graph]

The TAT-IntelliClean® fuzzy aeration control allows the treatment plant to be operated according to the specific requirements of the operator of the plant in the form of a compromise between the level of the effluent values and savings in aeration energy.

The greater the load fluctuations at a plant, and the more the treatment plant finds itself at the limit of its capacity, the greater the efficiency and saving potential of the control.
Other advantages of the fuzzy control are the simple, rugged and cost-effective system for measuring the oxygen concentration, redox potential and pH value. Even with changing load statuses, manual adjustment of the operating parameters is no longer necessary. The control is relatively insensitive to zero drifts, sensor soiling and ageing of the measuring sensors, since no absolute values, but merely curves from signals, are used as the basis for switching operations.

The fuzzy control can be used irrespective of the size of the treatment plant. Existing plants can be retrofitted with simple means. The measured data is visualized and filed. The control system can also be checked after start-up per remote control (maintenance control possible). The TAT-IntelliClean® Aeration Control does not interfere with existing control algorithms of the control system (SPC) and provides the switching signals for the blowers completely independently: