Practice Report

Application
RTC-N

# Real time control for increased process stability and aeration energy optimisation

## Problem

Originally the plant was operated under fixed aeration regimes, often resulting in frequent over-aeration, especially during periods of low load, and very low effluent ammonia concentrations. However, in the peak tourist season, the plant experienced compliance issues, as the system couldn't cope with peak loads.

## Solution

A standardised nitrification controller based on activated sludge model No. 1 (ASM 1), combined with sensors for ammonia, dissolved oxygen and total suspended solids was used, and applied to control aeration on the medium sized (24.000 PE) WWTP in Italy.

## Benefits

The results indicate increased process stability as proven by the stable effluent values and fast reaction to peak loads, and a significant reduction in the plants total energy consumption (26 %) equalling savings of £10,600 per year.

## Initial Situation / Background

Before implementation of the real time controller, the plant was operated under fixed aeration conditions, resulting in frequent over aeration, especially during periods of low load, and very low effluent ammonia concentrations. However, during the peak tourist season, the plant experienced compliance issues, as the fixed DO control did not respond or adapt to incoming peak loads.

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# Improvements

A standardised control module continuously adapts the oxygen set point to reach the required ammonia effluent concentration, using a combination of feed-forward and feed-back control.

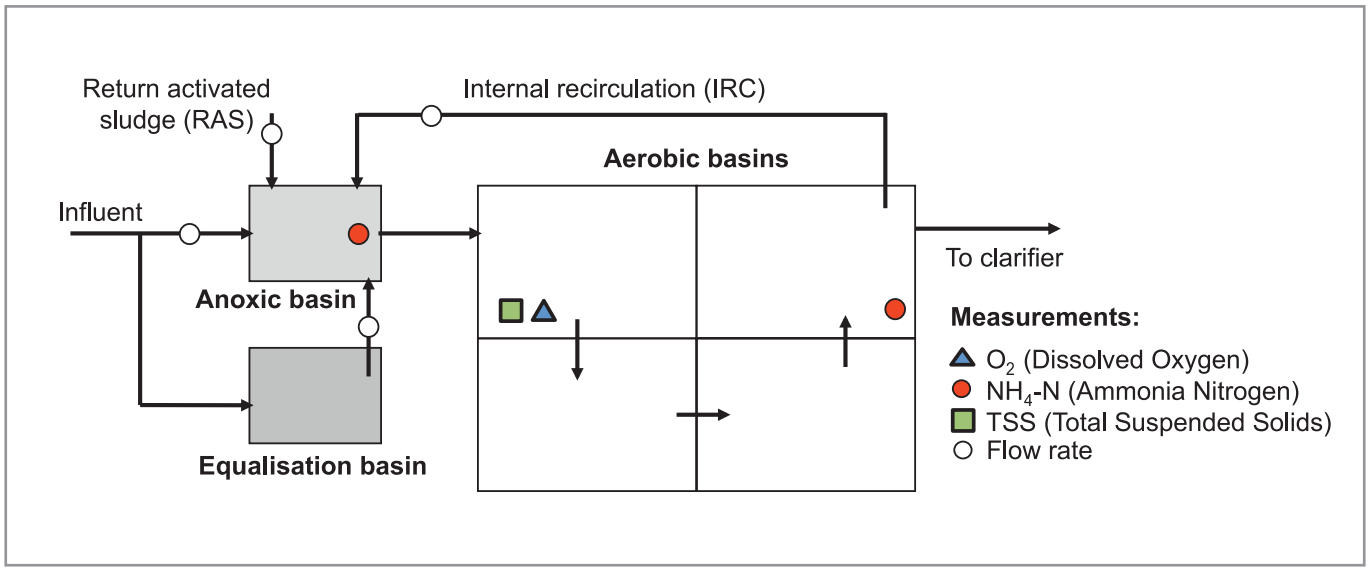


Figure 1: Site layout and control strategy of a 24,000 PE municipal plant in Italy

**Figure 1** shows the application of the controller to the wastewater treatment plant. In the feed-forward control loop, the influent ammonia load is determined using an online measurement of the ammonia concentration in the anoxic zone, and the different flows (re-circulation, influent flow and return activated sludge flow) entering this anoxic zone. Other parameters taken into account are the temperature and mixed liquor suspended solids.

The theoretical oxygen set point calculated by the feed-forward loop, is adjusted using the feedback control loop, based on a comparison between the effluent ammonia set point and the effective effluent ammonia concentration.

Before implementation of the real time controller, the plant was then operated under fixed aeration regimes, resulting in frequent over-aeration, especially during low loads periods and very low effluent ammonia concentrations. However, during the peak tourist season, the plant experienced compliance issues, as the fixed DO control did not respond or adapt to incoming peak loads.

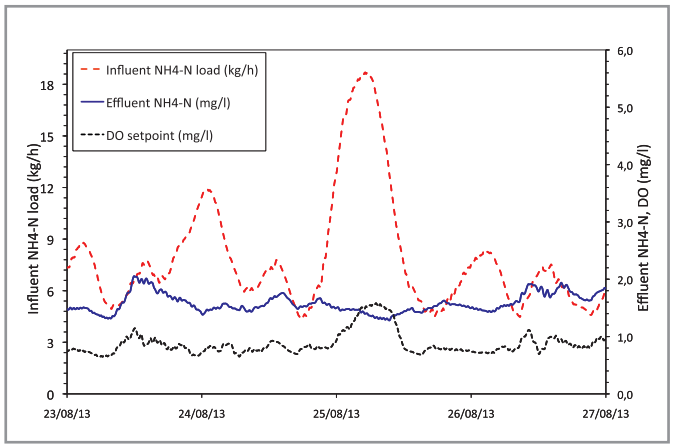


**Figure 2:** Influent ammonia load, DO setpoints and resulting effluent ammonia concentrations: reaction on peak ammonia influent load

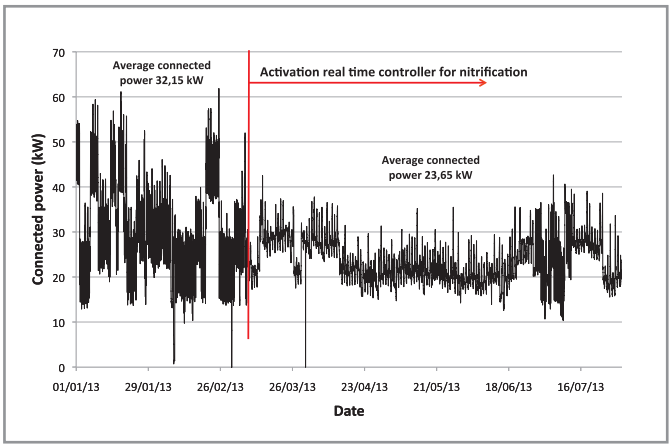


**Figure 3:** Comparison in connected power before and after activation of the real time nitrification controller

**Figure 2** shows a typical profile for the influent NH4-N load, the effluent ammonia concentration, and the DO set point after implementation of the nitrification controller. The peak influent ammonia load is received on 25/08/2013, which is detected promptly by the feed forward control loop, and the DO set point is raised to 1.8 mg/L.

This quick adaptation of the DO concentration to the incoming peak load ensures that the effluent ammonia concentration can be maintained stable around its set point of 2 mg/L.

As well as the fast reaction to peak loads, the real time control strategy also rationalises the energy consumption, as illustrated in **Figure 3:** After activation of the real time control module, the average total connected power of the plant was reduced by 26 % from 32.2 to 23.6 kW, corresponding to an estimated 50 % reduction of the aeration energy. This dual concept of feed forward and feedback control thus allows fast reaction to peak loads, thereby ensuring compliance with the effluent requirements, at the lowest possible aeration energy demand.

## Benefits

- Improved compliance
- Save money on chemical dosage
- Standardised off-the-shelf system

Adjusting aeration based on real-time data makes your process more consistent. The RTC-N system continually monitors the ammonia levels in your water and responds automatically to load changes, ensuring plant compliancy.

The off-the-Shelf System is ready to use after a very simple set up. Minimal downtime is needed to install the system.
The RTC-N module is pre-programmed with algorithms that will adjust blowers to maintain the calculated DO set point without over treating.

## Conclusion

The results of this case study corroborate other case studies on real time control optimisation for large scale plants which also report increased process stability and a reduction in aeration energy consumption between 15% and 28% for large scale plants due to real time control optimisation of nitrification, based on simultaneous comparisons between lanes under fixed DO control and lanes under real time control.

However, due to the standardised approach, optimisation strategies that were previously reserved for large scale plants due to the prohibitive costs associated with tailor-made systems, are now also within reach of smaller wastewater treatment plants.

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DOC043.52.30209.Mar14