

## Right-sizing aeration

Winnenden • Baden-Württemberg • Germany



EmiCo lite at the aeration tank

## KEY FACTS

- The **0.14% emission factor** indicates already quite low direct greenhouse-gas emissions. Continuous off-gas monitoring additionally identified potential to reduce **indirect emissions** through more efficient aeration.
- The high-emission states were **not load-driven**. Instead, the analysis pointed to **over-aeration** and a low COD/TN ratio as possible causes of the elevated N<sub>2</sub>O emissions.
- Continuous off-gas monitoring makes aeration surpluses visible and enables their targeted reduction, yielding potential to save **up to 16%** of aeration energy without compromising process stability.

## PROJECT AT A GLANCE

**0.14 %**

N<sub>2</sub>O-N EMISSION FACTOR

**258 days**

CONTINUOUS N<sub>2</sub>O MONITORING

**94.3 %**

SHARE OF N<sub>2</sub>O IN DIRECT EMISSIONS

**up to 16%**

AERATION-ENERGY SAVING

activated sludge, nitrification + denitrification

## 1 The starting point

The Winnenden wastewater treatment plant operates an activated-sludge process with nitrification and denitrification. To capture the greenhouse-gas emissions and identify further optimisation potential, an EmiCo lite system was installed. Over 258 days it continuously measured N<sub>2</sub>O, CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub> in the off-gas.

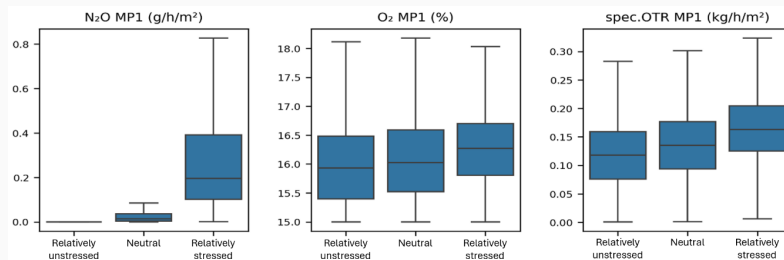
## 2 What continuous monitoring revealed

Continuous monitoring returned a **low emission factor of 0.14%**, yet nitrous oxide still accounted for **94.3%** of the greenhouse-gas footprint. Comparing low- and high-emission operating states showed that the elevated N<sub>2</sub>O emissions **did not coincide with a higher nitrogen load**. On the contrary: nitrogen and sludge load were higher in low-emission states, while residence time was longer in high-emission states. The analysis thus pointed to causes other than a mere increase in load.

## 3 What drives it, and how to fix it

The analysis pointed to **aeration surpluses** as the likely driver of N<sub>2</sub>O formation in nitrification, while a low COD/TN ratio in high-emission states pointed to an additional contribution from denitrification. Continuous off-gas monitoring makes the aeration surplus visible and shows when air can safely be reduced. Based on this plant's data, there is potential to save **up to 16%** of aeration energy. A further lever is improving the COD/TN ratio through more targeted use of the available carbon.

### WEEKLY NITROGEN LOAD AND N<sub>2</sub>O EMISSION FACTOR



Alongside higher nitrous oxide emissions, high-emission operating states also showed higher oxygen concentrations in the off-gas. This indicates oxygen surpluses in the aeration system and highlights the potential of targeted aeration optimisation.

## THE TAKEAWAY

Even at a low **0.14%** emission factor, continuous off-gas monitoring made further optimisation potential visible. The identified measures offer potential to save **up to 16% of aeration energy** while also improving process stability and effluent quality.