HORIBA

Case study

Ammonia Nitrogen Sensor in AquaNereda® Application

*Nereda® is a registered trademark of Royal HaskoningDHV.

1 Overview of AquaNereda

The AquaNereda Aerobic Granular Sludge Process is an innovative wastewater treatment technology that provides advanced biological treatment using unique features of aerobic granular biomass. As shown in Fig. 1, the aerobic granular biomass supports aerobic, anoxic and anaerobic biological process environments simultaneously, leading to optimal biological treatment in one efficient aeration step. This results in less space requirement, and energy & chemical savings comparing with conventional activated sludge systems.

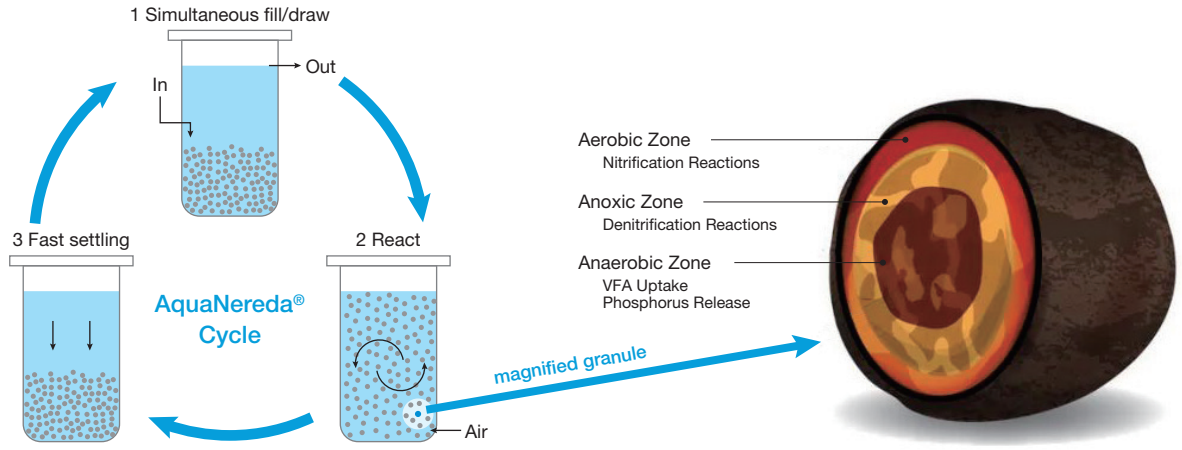

Fig. 1 Overview of AquaNereda

AQUA-AEROBIC SYSTEMS, INC. Homepage, 2025, https://aqua-aerobic.com/biological/aerobic-granular-sludge

2 Ammonia-based aeration control and ammonia monitoring

In the nitrification process, the aeration is controlled by monitoring water qualities such as dissolved oxygen (DO), ammonia nitrogen (NH_4-N). Compared with DO-based aeration control, ammonia-based aeration control has shown to be more efficient because NH_4-N is the direct indicator of nitrification.

Based on research conducted by Aqua-Aerobic Systems, Inc. (AASI), a water treatment engineering company in the U.S., NH_4-N concentration monitoring is challenging due to the limitations of NH_4-N sensors and analyzers. NH_4-N concentrations in a batch reactor vary depending upon the feed conditions and treatment cycle's reaction time.

When wastewater is introduced, the NH_4-N concentration could range from near zero to around 10 mg/L or higher within an hour. After aeration is complete and the feed flow is stopped, the nitrification process will drive the NH_4-N concentration back down to well below 1 mg/L prior to discharge.

Efficient aeration control requires an equipment with both fast reaction and wide range detection capabilities. The accuracy of the timing to stop the aeration is paramount in reducing energy consumption of the system.

There are several methods for online NH_4-N measurement. Some common approaches are Ion Selective Electrode (ISE) sensors, and analyzer types that measure alkalized samples using gas sensitive electrodes. Response time of ISE sensor is relatively fast because it can be immersed directly into the reactor. However, according to AASI, some manufactures do not recommend ISE sensors for NH_4-N concentration below 1 mg/L in reactors which can experience higher variations in NH_4-N concentrations.

Conversely, the analyzer type offers higher accuracy at lower concentrations but at the expense of slower response time. Depending on the analyzer, response time ranges from 5 to 20 minutes due to the processes of drawing sample from the reactor, followed by mixing it with alkaline reagent, and finally measuring the concentration.

As a result, both ISE sensor and analyzer type had limited the use of ammonia-based aeration control in AquaNereda.

3 Measurement by HORIBA ammonia nitrogen sensor

To solve this conundrum, HORIBA developed an ISE ammonia nitrogen sensor that measures NH_4-N concentrations over a wide range of 0 mg/L to 1,000 mg/L while offering near immediate results. One of the beauties is the sensor's reliability in maintaining accurate results in concentrations near zero, but also at high reactor concentrations.

AASI conducted a year-long evaluation at the AquaNereda aerobic granular sludge demonstration facility at the Four Rivers Sanitation Authority in Rockford, Illinois. The sensor was installed with HORIBA's unique ultrasonic cleaning system which minimizes microbial fouling (see Fig. 3)

without cleaner after 60 days　　with cleaner after 60 days

Fig. 3 Example of ultrasonic cleaning effect

An extended abstract mentions the performance of HORIBA ISE sensor. It shows that there is a difference in the sensor's response time to changes in concentration (Fig. 4).*1 Additionally, it can be seen that there are differences in energy consumption between DO-based aeration control and ammonia-based aeration control (Fig. 5).

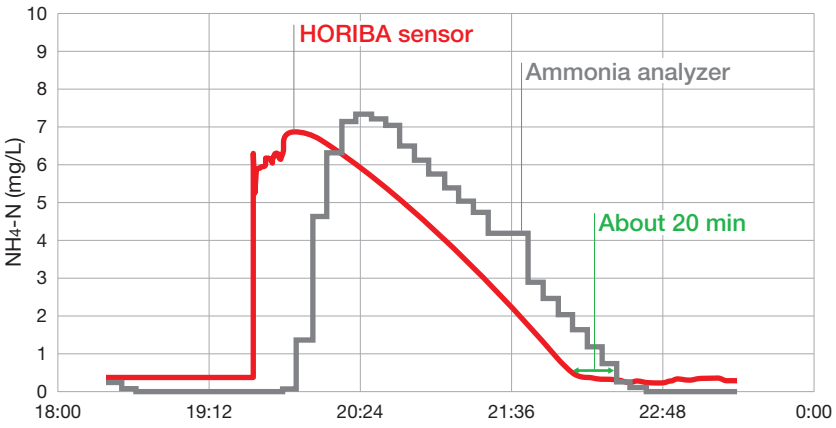

Fig. 4 NH_4-N measurement in AquaNereda

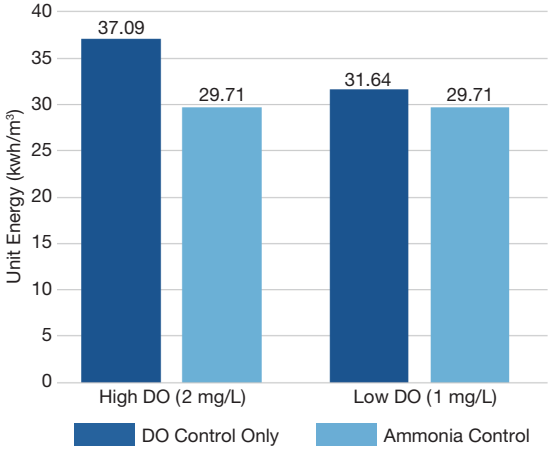

Fig. 5 Energy consumption comparison

*1. REFERENCE
Manuel de los Santos, Terry Reid, P.E., Brett Quimby, Paula Dorn, Darryl Gravagno, Joseph Tardio(2020), Full scale energy savings validation of an aerobic granular sludge system, WEFTEC 2020 Session 206

Learn more about the HORIBA ammonia nitrogen sensor

HORIBA Advanced Techno, Co., Ltd. **Japan**

Head Office
2 Miyanohigashi-cho, Kisshoin, Minami-ku, Kyoto, 601-8551, Japan
Phone: 81 (75) 321-7184　Fax: 81 (75) 321-7291
www.horiba.com/water-liquid/

Worldwide locations of HORIBA

Bulletin:HAE-4028Aa

Printed in Japan　2503SK00