Aerated Biological Nitrogen Removal

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Excess ammonia in receiving waters causes algal blooms that decrease oxygen levels. For this reason, many wastewater treatment plants (WWTPs) must limit ammonia in discharge.

Aerated nitrification, or the conversion of ammonia to nitrate, requires a specific population of beneficial bacteria and the proper environment to maintain that population:

1. **Microorganisms**

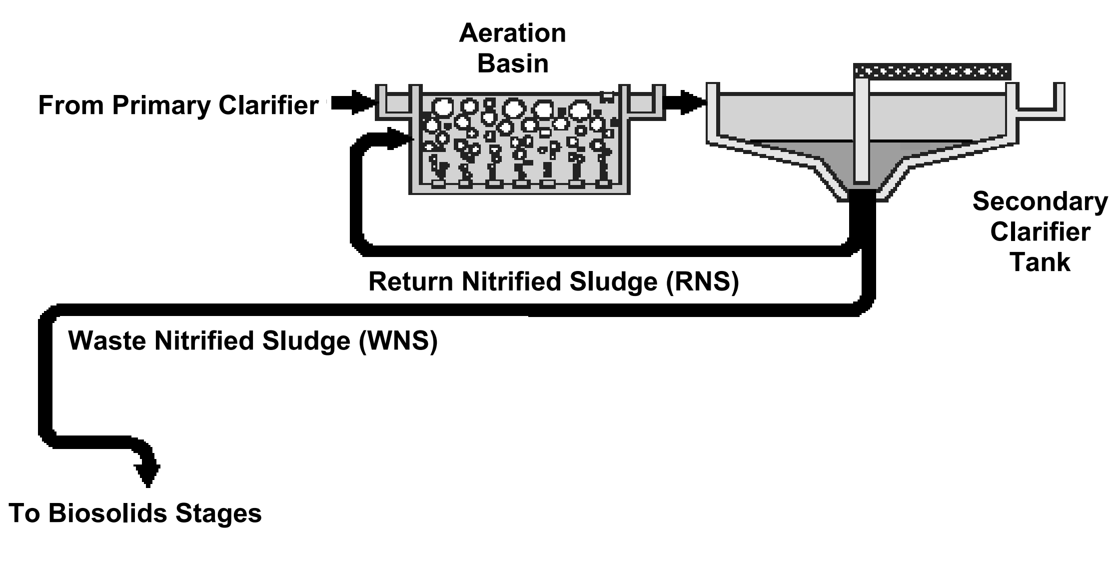
   Bacteria from the *Nitrosomas* group – nitrogenous bacteria that convert ammonia to nitrite, the first stage of biological decomposition.

   Bacteria from the *Nitrobacter* group – carbonaceous bacteria that convert nitrite to nitrate, the second stage of the nitrification process.

   These microorganisms exist together in the aeration basin, after a first-stage activated sludge process or a trickling filter (primary clarifier) that removes the carbonaceous biological oxygen demand (BOD) and 90-95% of the suspended solids.

2. Proper aeration. The effluent leaving the first stage process flows into the secondary stage nitrogenous activated sludge process, shown below. This process requires an

Aerated biological (secondary) nutrient removal



aeration rate that results in dissolved oxygen (DO) levels between 1.5 and 4.0 mg/l. Aeration rates yielding more than 4 mg/l DO can cause poor-settling sludge. DO levels less than 1.5 mg/l can cause the nitrifying bacteria to die.

3. Solids (bacterial food). Primary effluent slowly fed into the aeration basis provides bacteria their carbon food source. Detention time in the process must be at least 4 to 8 hours and Mean Cell Residency Time (MCRT) must be at least 4 days to allow for the growth of the bacteria. The process needs to maintain these solids levels as food for the nitrifying bacteria in the system.

4. Proper pH. Alkalinity and pH are critical to the life of the nitrifying bacteria. If the alkalinity level drops to less than 50 mg/l with a pH of less than 7, nitrification may be inhibited. (The bacteria may be able to adapt to limited periods of time at pH less than 7.) If a decrease in alkalinity causes pH to drop below levels needed to sustain nitrification, operators must add chemicals to increase pH.

Operators should continuously monitor nitrogen levels in the basin and ammonia levels in secondary clarifier effluent. Knowing these levels will help them determine the proper aeration rates and detention times.

The following Hach on-line instruments are vital in controlling the aerated nitrification process:

• **The OptiQuant™ Suspended Solids Analyzer** monitors and helps maintain the proper solids level in both the return nitrification sludge and the waste nitrification sludge as well as the aeration basin itself.

• **The HACH LDO™ Dissolved Oxygen Sensor** is the state-of-the-art DO system providing the most accurate measurements and requiring the least amount of maintenance of any DO system on the market today.

• **The OptiQuant UV Nitrate Analyzer** with in-situ probe measures nitrate readings in the aeration basin without chemicals or special pumping.

• **The Amtax™ Ammonia Analyzer** equipped with a Filtrax™ in-situ Filtration System monitors ammonia levels in the final plant effluent.

Hach Company is the single source that WWTPs can rely on for experience, application knowledge, and simple, low maintenance systems that will help optimize treatment through reduced nitrogen levels and controlled power and chemical costs. The systems described here provide the ultimate control of the aerated nitrification process.

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