AnammoPAQ® PROCESS
SUSTAINABLE NITROGEN REMOVAL

HOW WE CREATE VALUE
Cost-effective nitrogen removal from digester sidestreams (with or without THP) using Anammox

Compared to conventional nitrification and denitrification:
• 60% energy savings compared
• 100% reduction in supplemental organic carbon
• 90% reduction in sludge production
• 90% reduction in footprint
• 85% reduction in CO₂ emissions

Quick startup time with potential for full process optimization within 3 weeks

THE CHALLENGE
• Despite representing 1% to 3% of the flow to the mainstream, typical anaerobic digester sidestream contains 10% to 30% of the nitrogen load, with concentrations often in excess of 1,000 mg/L ammonia-N
• Sludge pre-treatment with THP can double the ammonia-N concentrations in the sidestream
• Stringent BNR limits on main stream
• Conventional nitrification and denitrification requires significant aeration energy and supplemental carbon

THE OVIVO SOLUTION
The AnammoPAQ® process is an elegant shortcut in the natural nitrogen cycle. The process utilizes Anammox bacteria which directly convert ammonium (NH₄⁺) and nitrite (NO₂⁻) into nitrogen gas. Paques B.V. developed the original process for commercial purposes in cooperation with Delft University of Technology and the University of Nijmegen. Since the first full-scale plant started up in 2002 (treatment of sidestream from sludge digestion), many other plants have been installed and are running successfully.

The AnammoPAQ® ADVANTAGE
• Proven technology with 15+ years operational experience
• 65+ AnammoPAQ® references worldwide including North America
• Largest single unit can handle 10 metric tons of nitrogen/day (equivalent to sidestream from a 250 MGD municipal plant)!
• Robust system, handling high loading variations
• Up to 60% saving on operational costs
• Savings on excess sludge production
• No addition of organic carbon source (methanol) required
• Production of valuable Anammox biomass
• High loading rates leading to compact footprint
• Lowest O&M amongst competing systems

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OPERATING PRINCIPLE

AnammoPAQ® technology is a continuous flow reactor system in which nitritation and anammox conversion occur simultaneously in a single process unit. Anammox (anaerobic ammonium oxidation) conversion is an elegant short-cut in the natural nitrogen cycle where ammonium and nitrite are converted to nitrogen gas. As the Anammox process involves removal of ammonium over nitrite ($\text{NO}_2^-$) rather than nitrate ($\text{NO}_3^-$), 63% less oxygen ($\text{O}_2$) is required while eliminating the need for an external carbon source altogether. Optimal process control ensures retention of AOBs and Anammox bacteria while eliminating NOBs, leading to stable & robust operation.

$$\text{NH}_4^+ + 1\frac{1}{2} \text{O}_2 \rightarrow \text{NO}_2^- + \text{H}_2\text{O} + 2\text{H}^+$$

$$\text{NH}_4^+ + \text{NO}_2^- \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$$

HOW IT WORKS

1. Ammonia-rich influent
2. Aerators for mixing and ammonia removal process
3. AnammoPAQ® separator for biomass retention
4. Effluent exits the reactor

The Olburgen WWTP in Netherlands, with the Ovivo AnammoPAQ® process has reached stable & continuous 92% ammonium and 85% total nitrogen removal average for over 10 years.