



Activated Sludge Technologies

WATER TECHNOLOGIES

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With over 100 installations in the United States, Kruger offers wastewater treatment facilities extensive biological experience and proven operating strategies. Kruger offers a multitude of processes, including our signature Phased Isolation Technologies and A/O®, A²/O, and An/O systems, providing flexibility in meeting the diverse requirements of plants. Kruger's activated sludge technologies efficiently achieve today's stringent effluent requirements.

Double Ditch

Perfect Fit for Smaller Communities

- All processes, including settling, occur within two reactors; secondary settling tanks are not required
- Reduced plant maintenance
- Continuous flow; no batching, no decanters, no post equalization required
- Achieves exceptional effluent quality of BOD and TSS <10 mg/L, complete nitrification, and total nitrogen removal to less than 8 mg/L
- Ease of future expansion and upgrade for increased nitrogen removal or flow by adding secondary clarifiers to convert to BIO-DENITRO



Phased Isolation Technologies

Dynamic System for Meeting Plant Challenges

Kruger's phased isolation technologies provide operational flexibility by alternating phase lengths, accurately matching the level of treatment needed for changing wastewater treatment strengths. Systems are optimized for biological nutrient removal (BNR) and flow increases or future tighter effluent requirements. Kruger's phased processes are equipped with PLC based control and preprogrammed operational modes, simplifying daily operation.

BIO-DENITRO™

Adaptable Process for Varying Conditions

- Energy efficient; separation of mixing and aeration with dissolved oxygen (DO) control
- Reduced operation and maintenance costs by achieving high level total nitrogen removal without internal recycle pumping or chemical dosing
- Advanced storm flow control made to ensure maximum treatment with no solids washout during wet weather events
- Advanced control modes with all phasing and aeration based on real-time ammonia and nitrate monitoring

BIO-DENITRO with Oxidation Ditches



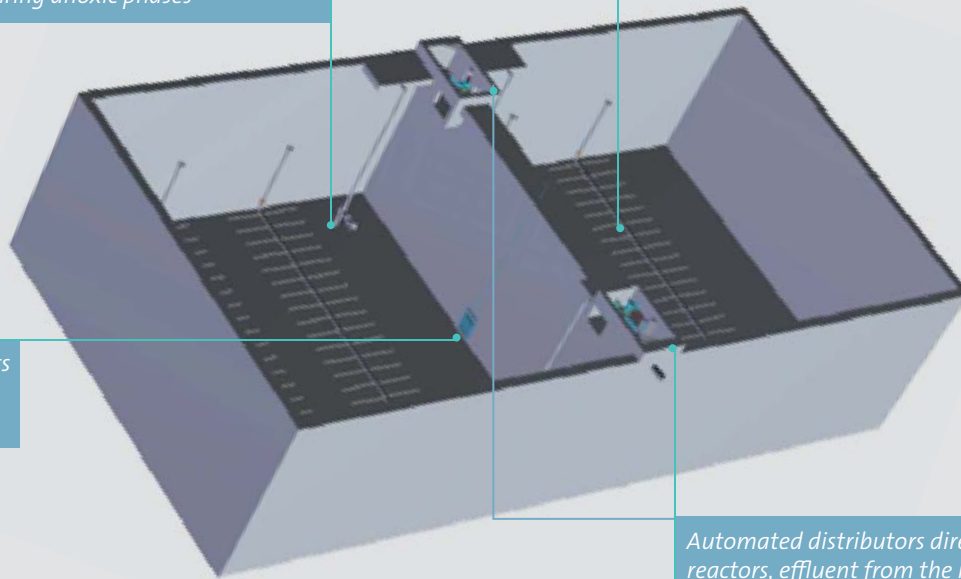
Phased Isolation imparts tremendous process flexibility. The operational strategy provides the ability to effectively vary the process volumes (e.g. aerobic or anoxic), unlike conventional processes where these volumes are fixed. By adjusting the specific phase lengths of the process, the volume allocated for specific treatment can be adjusted, thereby enabling the treatment process to accommodate a wide range in influent flow and characteristics.

Proven Phased Operation in a Simpler Package

Submersible mixers maintain complete mixing during anoxic phases

High Efficiency Fine Bubble Aeration turns on or off depending on phase of operation, DO concentration, and online nutrient monitoring

Interconnecting port permits flow between reactors for operation in series



Automated distributors direct influent to the reactors, effluent from the reactors, and control the flow path through the reactors

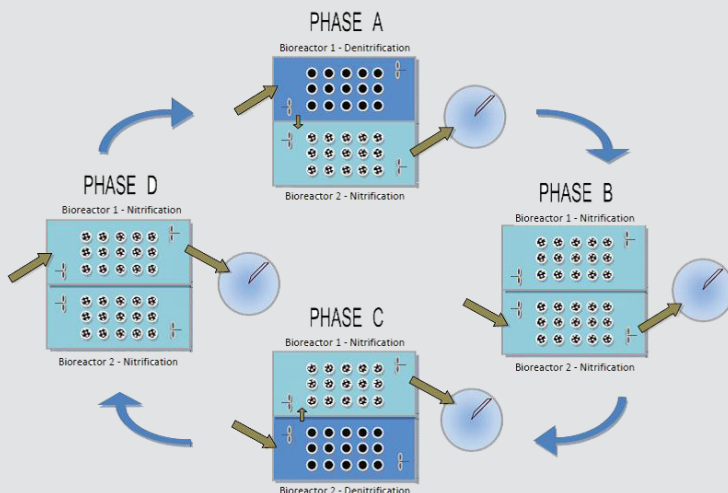
Benefits vs Oxidation Ditch

- Simplified Concrete Construction
- 25-50% Reduced Footprint and Installed Cost
- Replaces Rotors with Diffusers and Blowers
- Eliminates Automated Effluent Weirs
- 25-50% More Energy Efficient

3.0 MGD BIO-DENITRO - Sanford, FL



BIO-DENITRO Phases Diagram



BIO-DENIPHO™

Enhanced Biological Phosphorus Removal

- Biological phosphorus removal achieving TP<1 mg/L, resulting in highly efficient BNR system
- Expansion of BIO-DENITRO with addition of Block and Hong 3-Stage Anaerobic Selector
- Optimized anaerobic zones to maximize PAO growth and activity

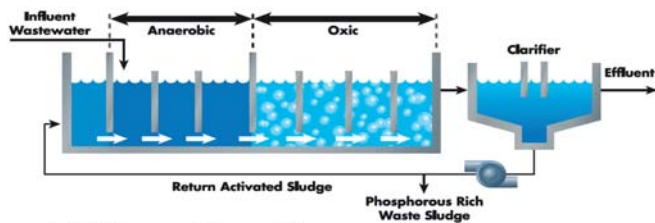
Additional Activated Sludge Solutions

Veolia's additional biological treatment solutions are superior alternatives to other multi-stage BNR systems. We apply the A/O® and A²/O processes in both oxidation ditch and rectangular tank layouts. These processes can be applied to existing activated sludge and oxidation ditch plants resulting in significantly improved performance.



A/O® (Anaerobic/Oxic)

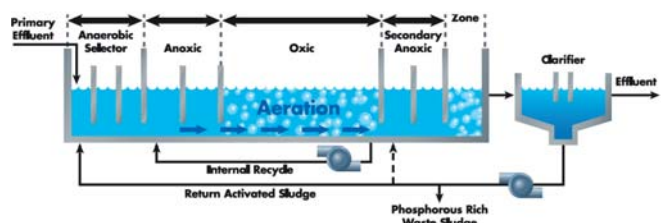
Kruger's A/O process utilizes the Block and Hong Anaerobic Selector followed by a single or multiple reactors for nitrification. The anaerobic selector performs two important functions for effective treatment – biological phosphorus removal and filament control.



A/O® Process Schematic

A²/O (Anaerobic/Anoxic/Oxic)

Another attractive feature of the A/O process is that upon expansion, nitrogen removal can be added by including anoxic tanks and operating as an A²/O process. Kruger's A²/O process incorporates an anoxic zone between the anaerobic selector and oxic zones for nitrate reduction. For more stringent TN limits, a secondary anoxic zone can be added for additional denitrification.



A²/O Process Schematic



Typical Effluent Quality (mg/L)

Kruger Process	NH ₃ -N	TN	TP
D-Ditch	≤1	≤8	≤2
BIO-DENITRO	≤1	≤3	≤2
BIO-DENIPHO	≤1	≤3	≤1
A/O®	≤1	N/A	≤1
A²/O	≤1	≤3	≤1

Advanced BNR Technologies For New or Existing Plants

Kruger's advanced BNR technologies are incorporated in many of our activated sludge processes. In addition, each process is easily implemented into existing plants for treatment upgrades. Kruger solutions are therefore ideal for helping plants address new nitrogen and phosphorus limits.

Block and Hong Anaerobic Selector

Kruger's Block and Hong Anaerobic Selector ensures optimum biological phosphorus removal with little to no chemical addition. In many cases, use of the Block and Hong Anaerobic Selector eliminates the expense and quantity of excess sludge generated by chemical precipitation. In addition, filamentous growth is inhibited, providing consistent performance during difficult treatment conditions.



Secondary Anoxic Zone

Kruger's advanced Secondary Anoxic Zone design enhances denitrification with our RAS Bleed Off addition. Kruger's RAS Bleed Off process increases nitrate removal rates by more than 30% and reduces effluent TN up to 2 mg/L. This results in plants benefiting from cost savings of a reduced secondary anoxic zone and chemical usage.

Process Control Features Enhancing Daily Operations

- Customizable PLC-based control
- Plant-wide SCADA system
- Open architecture software
- Point-and-click navigation and control
- 24-hour alarm monitoring and notification

STAC (Superior Tuning and Control)

- Dynamically control aerobic and anoxic phase lengths in response to incoming nitrogen loading
- Improve total nitrogen (TN) removal by 2-4 mg/L
- Energy savings by an estimated 10% from optimization of ditch aeration equipment operation
- Automated chemical dosing for phosphorus removal via online phosphate monitoring
- Ideal for new or existing phased isolation plants

