



Oxidation Ditch Technologies

WATER TECHNOLOGIES

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With over 80 installations in the United States, wastewater treatment facilities can rely on Kruger's extensive biological experience and proven oxidation ditch technologies. Kruger offers a multitude of processes, including our signature Phased Isolation Ditch (PID) and A/O®, A2/O, and An/O systems, providing flexibility in meeting the diverse requirements of plants. Kruger's biological treatment technologies efficiently achieve today's stringent effluent requirements.

Phased Isolation Ditch (PID) Technology

Offers a Dynamic System for Meeting Plant's Challenges

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

1.2 MGD D-Ditch - Lawrenceville, VA



Brush Aerators (Rotors)



Double Ditch

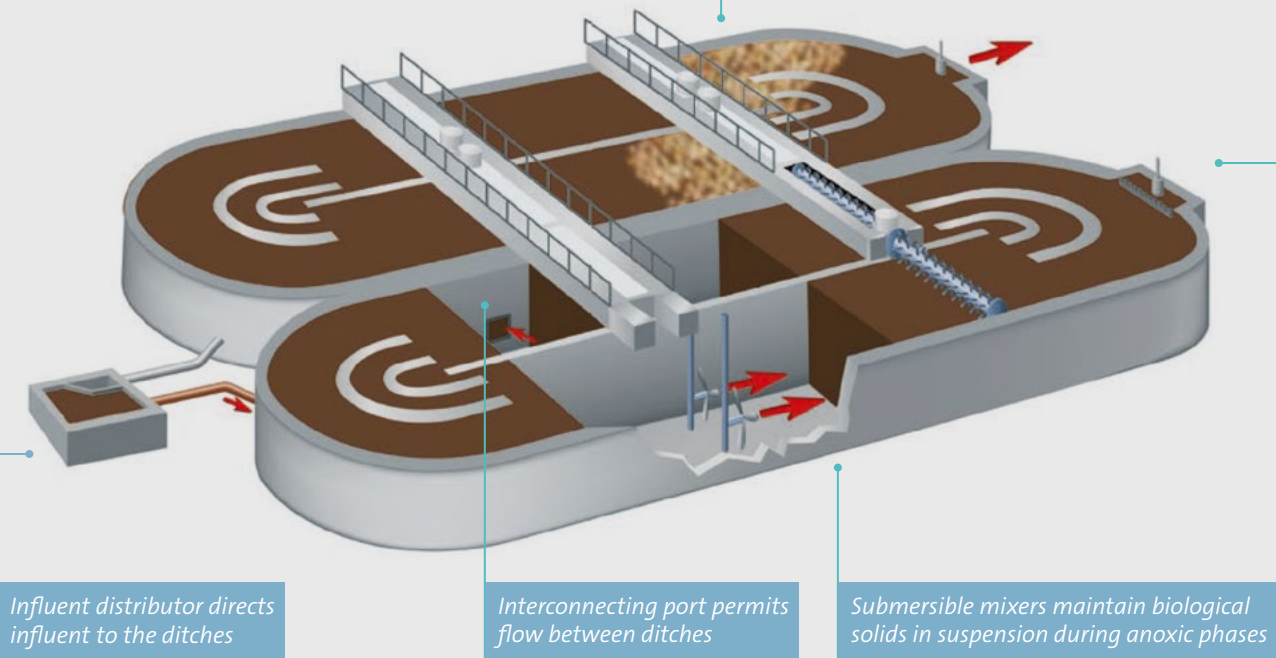
Perfect Fit for Smaller Communities

- Ideal solution for plants with future growth plans or stricter nutrient limits
- Ease of future expansion and upgrade for increased nitrogen removal or flow by adding secondary clarifiers and/or another ditch
- Reduced plant maintenance, secondary settling tanks are not required
- Constant water level and continuous effluent discharge, eliminating periodic surges of effluent and the need to oversize equipment downstream
- Achieves exceptional effluent quality of BOD and TSS <10 mg/L by alternating between aerobic (nitrification) and settling phases

Phased Isolation Ditch

Brush aerators (rotors) turn on or off depending on DO concentration

Effluent weirs raise and lower depending upon desired flow direction and for optimum brush aerator submergence



BIO-DENITRO™

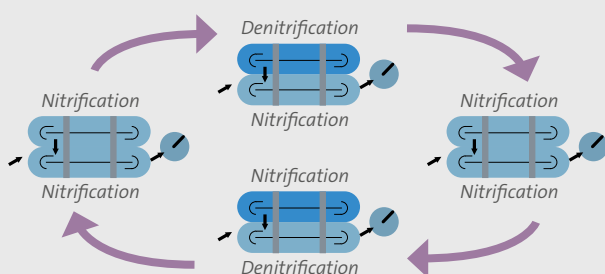
Adaptable Process for Plant's Varying Conditions

- Energy efficient, separation of mixing and aeration with dissolved oxygen (DO) control
- Reduced operation and maintenance by achieving high level nitrogen removal (TN <5 mg/L) without internal recycle pumping or chemical dosing
- Process flexibility afforded by varying effective process volumes allocated for treatment, adaptable to either load or seasonal variations
- Alternates between aerobic (nitrification) and anoxic (denitrification) phases

3.0 MGD BIO-DENITRO - Sanford, FL



BIO-DENITRO Phases Diagram



BIO-DENIPHO™

Meeting Total Phosphorus of 1 mg/L

- Biological phosphorus removal achieving TP <1 mg/L, resulting in highly efficient BNR system
- Expansion of BIO-DENITRO with addition of Block and Hong Anaerobic Selector

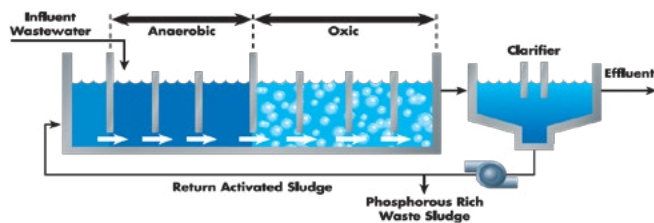
Additional Activated Sludge Solutions

Kruger's additional activated sludge solutions are superior alternatives to other multi-stage BNR systems. Kruger adapted the A/O[®] and A²/O processes for oxidation ditch layouts. With minor modifications, these processes can be applied to existing oxidation ditch plants, resulting in significantly improved performance.



A/O[®] (Anaerobic/Oxic)

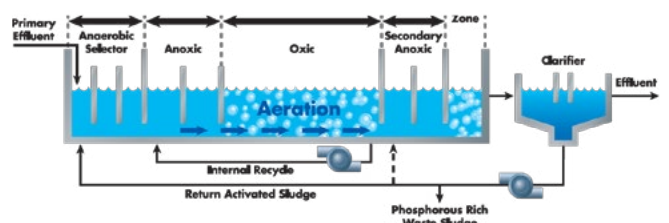
Kruger's A/O Ditch process utilizes the Block and Hong Anaerobic Selector followed by a single or multiple oxidation ditches for nitrification. The anaerobic selector performs two important functions for effective treatment – biological phosphorus removal and filament control.



A/O[®] Process Schematic

A²/O (Anaerobic/Anoxic/Oxic)

Another attractive feature of the A/O Ditch process is that upon expansion, nitrogen removal can be added by including anoxic tanks and operating as an A²/O Ditch. 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	10-15	<1-2
BIO-DENITRO	<1	<5	N/A
BIO-DENIPHO	<1	<5	<1-2
A/O [®]	<1	N/A	<1-2
A ² /O	<1	<8	<1-2
Secondary Anoxic	N/A	3-5	N/A
Block and Hong Anaerobic Selector	N/A	N/A	<1-2

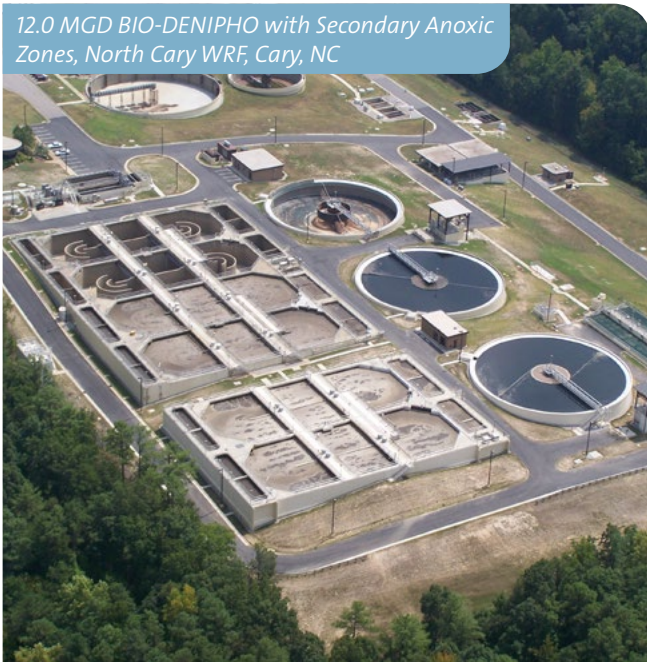
Advanced BNR Technologies For New or Existing Plants

Kruger's advanced BNR technologies are incorporated in many of our oxidation ditch processes. In addition, each process is easily implemented into existing plants for treatment upgrades.

Block and Hong Anaerobic Selector

Kruger's Block and Hong Anaerobic Selector ensures biological phosphorus removal without elaborate or additional reactors or dosing of costly chemicals or alternative carbon sources. Biological phosphorus removal 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.

12.0 MGD BIO-DENIPHO with Secondary Anoxic Zones, North Cary WRF, Cary, NC



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 Plant's 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
- Systems certified integrators

STAC (Superior Tuning and Control) Optimizing TN Removal

- Dynamically control ditch phase lengths in response to incoming loading, providing real time operation
- Improving total nitrogen (TN) removal by 2-4 mg/L
- Energy savings by an estimated 10% from optimization of operation of ditch aeration equipment
- Ideal for new or existing PID plants

Customized Kruger SCADA Screen

