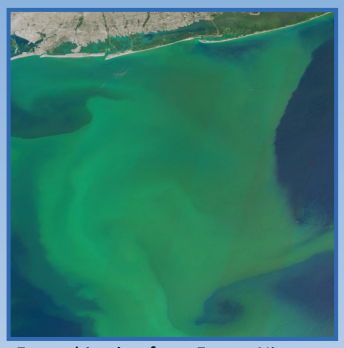
ORTHOS LIQUID SYSTEMS

Poseidon Filtration System® — Denitrifying Deep Bed Filter

Fixed Film Denitrification with Suspended Solids, Total Phosphorus, and BOD Removal

Key Benefits:

- **Biological removal of nitrate-nitrogen (NO_3-N) from clarified wastewater to as low as 3 mg/L**
- **Effluent suspended solids, total phosphorus, and BOD reduction**
- **Structurally-superior Orthos Centurion™ underdrain with no gravel layer required**
- **Compound-loop feedback control of carbon addition**
- **Run-time and backwash optimization**



Eutrophication from Excess Nitrogen

Poseidon Filtration Systems® deliver to municipal clientele comprehensive process technology that includes Ortho-Wash™ PLC-based controls, Centurion™ nozzle-based monolithic floor underdrains, backwash troughs, air header piping, filtration media, blowers, pumps, valves and instrumentation.

Poseidon is used for conventional water treatment, wastewater tertiary filtration, membrane pretreatment, biologically active filtration, and denitrification.

POSEIDON FILTRATION SYSTEM® ORTHOS

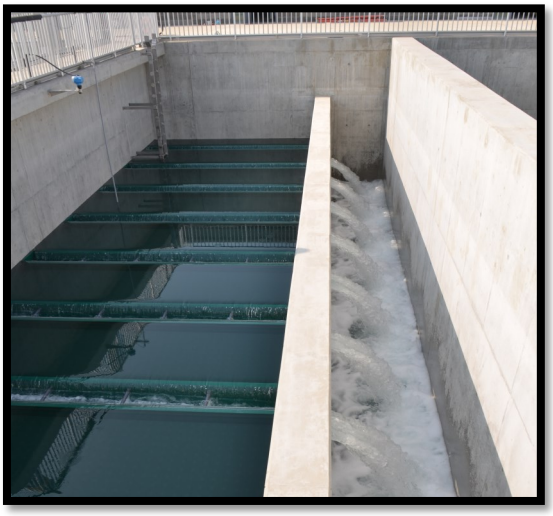
The Orthos Denitrifying Deep Bed Filter (*DDBF™*), a wastewater treatment process of the *Poseidon Filtration System®*, provides fixed-film biological denitrification in a downflow filter configuration. With proper chemical treatment, the *DDBF™* is capable of meeting stringent effluent limits of total nitrogen as low as 3 mg/l, total suspended solids to 2 mg/L, and total phosphorus to 0.3 mg/L or less.

Process Description

Biological denitrification converts nitrate (NO_3-N) to nitrogen gas in anoxic conditions from already-nitrified wastewater. In the *DDBF™*, denitrifying organisms attach to the filter media, which consists of mono-media granular sand of ±2 mm effective size at 4-8 feet of depth. Supplemental carbon (e.g., methanol, glycerin) is augmented to the filter influent to drive the denitrification process. Wastewater flows around nitrogen gas bubbles that accumulate in the media and reduce the space between sand grains, which improves biomass contact and filtration efficiency.

Design considerations of the *DDBF™* include denitrification kinetics (±0.75 lbs. NO_x-N removed/ft^2), empty bed contact time (30+ minutes), hydraulic loading rate (±3 gpm/ft^2), nitrogen release cycle frequency, solids holding capacity, temperature, and influent macronutrient concentrations.

Orthos' Centurion™ structurally-superior filter underdrains feature nozzles with solid-expelling slots, specifically-sized to retain the *DDBF™* media and prevent biological fouling. No gravel layer is necessary, which reduces hydraulic profile and eliminates related horizontal short-circuiting.



Poseidon Filtration System®

Nitrogen, Solids, Phosphorus, and BOD Removal

Over time, nitrogen gas accumulates in the media and increases filter headloss. Filtered effluent is periodically (every 3-6 hours) pumped up through the *DDBF™* (±6 gpm/ft^2, ±4 minutes) to shift the media and release the nitrogen gas bubbles into the atmosphere.

Phosphorus is removed via consumption by the biomass, and as particulate, is stored in the filter media. Suspended solids (containing some nitrogen and BOD) are also filtered and accumulate in the media. When the filter backwash process cleans the media and releases these trapped solids to waste, a net reduction results.

Process and Backwash Optimization

A backwash cycle is initiated when the nitrogen release cycle no longer reestablishes sufficient headloss, filter effluent rate is minimized, or the filter run maximum time is reached. Backwash frequency for the *DDBF™* is comparable to that of a conventional filter. A typical *DDBF™* Ortho-Wash™ sequence consists of: Filter isolation; air scour of 2 minutes at 5 scfm/ft^2; simultaneous air/water wash of 12 minutes at 5 scfm/ft^2 and 6 gpm/ft^2, respectively; and final rinse of 5 minutes at 6 gpm/ft^2. Fluidizing the mono-media is unnecessary, which enables the relatively-low water rates. Sequence and air/water rates are operator-adjustable.

After backwash, reduced denitrification performance may initially occur for several minutes due to biomass loss. Thus, more *DDBF™* cells are typically designed than for a conventional filter arrangement in order to produce the required blended effluent nitrogen concentration.

Carbon Dosage and Level Controls

Using flow meters and reliable NO_3-N and dissolved oxygen (DO) analyzers, carbon dosage may be fed on mass basis near 100% of theoretical values. Orthos' compound loop algorithm of feed-forward and feedback with effluent concentration control delivers required effluent quality with no carbon increase through the *DDBF™*. Effluent NO_3-N concentration is held at a desired setpoint under varying hydraulic and NO_3-N loading.

Ortho-Wash™ filter controls may be either split-flow/constant-level or variable-level. Constant-level operation prevents influent cascade, minimizing DO and its related carbon addition expense, whereas variable-level typically provides longer run times.

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