ENVIROGEN TECHNOLOGIES
A Lifecycle Performance Company

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Denitrification

Envirogen Technologies, Inc.'s FBR Model EFB-7.5 system

Envirogen Technologies, Inc.'s Fluidized Bed Reactor (FBR) denitrification process lowers discharge levels of nitrogen in wastewater to less than 0.1 mg/l NO_3-N. There is no more efficient denitrification process on the market today. In fact, our FBR process has been approved by the California Department of Public Health for the treatment of nitrate-laden groundwater to drinking water standards.

ENVIROGEN TECHNOLOGIES ADVANTAGE

- Very low effluent NO_3-N levels achievable (<0.1 mg/l)
- Small footprint – typically smaller than continuous backwash or static denite sand filters
- Low capital
- Minimal biosolids production
- Can use different carbon sources
- No backwashing required
- No filter burping or upsets caused by accumulating nitrogen bubbles
- Simple end-of-pipe solution

FBR Model EFB-5

FBR Model EFB-3

FBR Model No.	Flow Rate at 50°F (MGD)	Flow Rate at 65°F (MGD)	Reactor Diameter (feet)	System Footprint
EFB-3	0.05-0.075	0.075-0.1	3	12' x 12'
EFB-5	0.15-0.25	0.25-0.3	5	14' x 12'
EFB-7.5	0.3-0.55	0.6-0.8	7.5	21' x 13'
EFB-9	0.45-0.8	0.85-1	9	23' x 13'
EFB-11.5	0.7-1.25	1.3-1.6	11.5	25' x 21'
EFB-14	1.0-2.0	2.1-2.5	14	30' x 21'

Treatment of water containing 15 mg/l of NO_3-N

FBR Model EFB-11.5

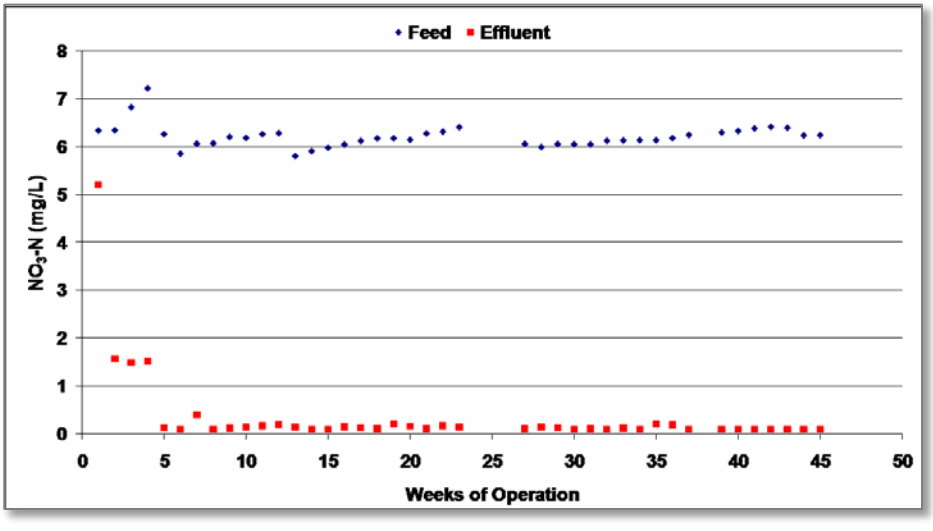
FLUIDIZED BED REACTORS

The FBR is a fixed-film bioreactor that fosters the growth of microorganisms on a hydraulically fluidized fine media, typically sand. The small fluidized media provides an extremely large surface area upon which microorganisms can grow, producing a large biomass inventory while maintaining thin films, which reduces any mass transfer limitations. This large biomass inventory, spread out in thin films, provides the system's high volumetric efficiency. For removal of nitrate, the biomass is composed of heterotropic, denitrifying bacteria that convert nitrate to nitrogen gas (N_2).

FBR Model EFB-14

The influent is fed into the lower portion of the FBR where it is mixed with a carbon (soluble food) source. Denitrification is supported within FBRs using a broad range of carbon sources, including methanol, ethanol, acetic acid, MicroCg® and MicroCglycerin™(1). The nitrate-laden water flows upward through the reactor at a velocity sufficient to fluidize (expand) the bed, allowing the denitrifying bacteria to come into intimate contact with the carbon source and nitrate. The long solids retention time characteristics of the system allows for the efficient removal of nitrate at even low temperatures. The nitrogen gas formed is simply carried to the top of the reactor with the following water where it disengages and escapes to the atmosphere. No backwashing is required, and there is no 'burping' that can occur, such as with static denitrification filters.

FBRs are capable of accommodating high and/or fluctuating nitrate levels, making them the system of choice for groundwater remediation applications. This is primarily because the recycle flow dilutes nitrate in the feedwater, effectively homogenizing the nitrate load to the reactor. The required amount of carbon source is metered into the system using a feed-forward control loop that takes into account both feed flow and nitrate concentration (patent pending). Alternatively, for applications where the nitrate concentration in the feed water is relatively steady, the addition of carbon source can simply be paced into the system proportional to the feed flow.



(1) MicroCg® is a registered mark of Environmental Operating Solutions, Inc. MicroCglycerin™ is a trademark of Environmental Operating Solutions, Inc.