

CASE STUDY: Warren, Michigan Water Recovery Facility



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Application:	BNR Mixing
Design Flow:	50 MGD
Mixing Efficiency:	0.1 HP/1000 FT ³
Compressors:	Two (2) 15 HP Rotary Screw
Mixing Nozzles:	160
Design Engineer:	Johnson Controls / AECOM

Sustained Efforts to Optimize Bio-P Result in Award-Winning Process Solution

In the past, the City of Warren WRF utilized a conventional activated sludge process, requiring phosphorus to be removed entirely with ferric chloride, costing hundreds of thousands of dollars every year. In 2014, the plant upgraded to an anaerobic/oxic (A/O) secondary treatment process.

Two EnviroMix projects have enabled the plant to remove phosphorus biologically:

- As part of the 2014 upgrade, BioMix Compressed Gas Mixing was installed to mix the anaerobic selectors, reducing capital and installation costs, and lowering the operating power to less than 15 BHP. **The project resulted in more than \$150,000 per year in chemical savings.** During the plant’s conversion from chemical removal to biological phosphorous removal (bio-P), parallel trains of each process were operated side-by-side. **The bio-P trains using BioMix removed 50% more total phosphorus than those using chemical precipitation.**
- While greatly improved, the bio-P performance was not consistent enough, due to variable influent conditions, to eliminate the need for periodic chemical addition. In 2021, **the Warren staff worked with EnviroMix to implement a full-scale demonstration of BioMix-DC Enhanced Anaerobic Mixing**, a technology that allows the plant to maximize bio-P performance and minimize chemical addition.



BioMix Compressed Gas Mixing optimizes the anaerobic fermentation process.



ENERGY EFFICIENCY

90% or greater net energy savings vs. continuous mechanical mixing



STRAIGHTFORWARD OPERATION

No mechanical or electrical components in the wastewater
Non-clog maintenance free equipment in the tank



PROCESS OPTIMIZATION

Maximized VFA formation and utilization
Proven negligible oxygen transfer drives down ORP



UNPARALLELED FLEXIBILITY

Compatible with any tank geometry
Adjustable parameters compensate for variable influent



Testing samples reveal the creation of a concentrated VFA-producing fermentation layer.

Taking Biological Phosphorus Removal to the Next Level with BioMix-DC

After the 2014 upgrade, which enabled biological phosphorus removal, variable influent conditions proved to be challenging, resulting in inconsistent effluent total phosphorus levels, and requiring periodic chemical addition to achieve permit limits.

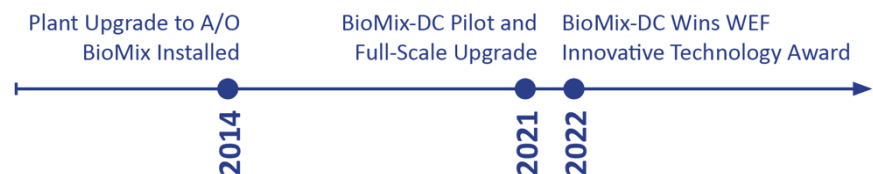
The lack of consistency was attributed to the low influent BOD:P ratio which was further reduced by the high levels of phosphorus in the filtrate recycle stream from the solids dewatering process. Warren often operates well below the industry recognized optimum BOD:P ratio of 25:1, which prompted the staff to consider alternatives for increasing volatile fatty acids (VFAs).

Working with the Warren facility, EnviroMix developed BioMix-DC Enhanced Anaerobic Mixing — a new solution that maximizes VFA production and utilization to enhance biological phosphorus removal. Building on the proven BioMix technology, BioMix-DC optimizes the anaerobic fermentation process by alternating a short mixing cycle with a long, unmixed, deep cycle.

BioMix-DC was first implemented in the west side anaerobic selectors to boost VFA production. Generating a surplus of VFA ensures the phosphorus accumulating organisms (PAOs) are never VFA limited. This increased biological phosphorus removal efficiency and consistency while nearly eliminating the dependency on chemicals for phosphorus removal. **The unique solution produced consistent effluent orthophosphate concentrations of ≤ 0.1 mg/L.**

Comparative Operating Performance	Bio-P with BioMix Jan 1 – April 7, 2021	Bio-P with BioMix-DC April 8 – June 15, 2021
Raw Total Phosphorus (avg.):	3.3 mg/l	3.3 mg/l
Effluent Sol. P:	0.4 mg/l	0.1 mg/l

After full-scale implementation, the improved bio-P removal and consistency has minimized the need for chemical addition. The work completed as part of the demonstration led to EnviroMix being recognized with the 2022 WEF Innovative Technology Award for BioMix-DC. More importantly, the Warren operational staff, through their sustained efforts, have realized their nutrient removal goals and reduced their environmental impact.



“Working with a team like EnviroMix, whose goals align with ours to protect the environment, has been one of my greatest pleasures.”

Bryan Clor, Warren WRF Division Head



Contact sales@enviro-mix.com today to discuss the ways EnviroMix can optimize your mixing and process solutions.