

CASE STUDY: Warren, Michigan Wastewater Treatment Plant



Application:	BNR Mixing
Design Flow (ADF):	36 MGD
Mixing Efficiency:	0.1 HP/1000 FT ³
Compressors:	Two (2) 15 HP Rotary Screw
Mixing Nozzles:	160
Design Engineer:	Johnson Controls / AECOM



BioMix Compressed Gas Mixing optimizes the anaerobic fermentation process.

BioMix Upgrade Facilitates Bio-P Removal and Evolution of BioMix-DC

In 2014, Johnson Controls Inc. entered into an energy savings performance contract (ESPC) with the City of Warren, which included an anaerobic/oxic (A/O) process upgrade. Previously, the plant utilized a conventional activated sludge process which was not designed for biological phosphorous removal (BPR), requiring phosphorus to be removed through chemical precipitation using ferric chloride.

EnviroMix installed its BioMix Compressed Gas Mixing System to mix anaerobic biological selectors created within the existing footprint of the four operating process trains. **By implementing the BPR process with BioMix, the plant realized more than \$150,000 per year in operational savings through the elimination of hazardous and costly chemicals.**

BioMix reduced capital and installation costs and lowered the operating power to less than 15 BHP. In addition, the low maintenance requirements of the system coupled with the lower energy use significantly reduced the long-term O&M costs versus traditional mechanical mixing.

During the plant's conversion from chemical phosphorus removal to BPR, parallel trains of each process regime were operated side-by-side and the results compared. **The BPR process trains using BioMix removed 50% more total phosphorus than those using chemical precipitation** allowing the facility to meet effluent total phosphorus permit limit of less than 1 mg/l.



ENERGY EFFICIENCY

40-60% energy savings compared to mechanical mixing

90% or greater net energy savings vs. continuous mixing



STRAIGHTFORWARD OPERATION

No mechanical or electrical components in the wastewater

Non-clog maintenance free in tank equipment



PROCESS OPTIMIZATION

Maximized VFA formation and utilization

Proven negligible oxygen transfer designed to drive down ORP



UNPARALLELED FLEXIBILITY

Seamless integration with other BioMix applications in facility

Cycle parameters are adjustable to compensate for variable influent



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



Long periods without mixing create a fermentation layer, and intermittent pulses of mixing transport VFAs without disrupting the layer.

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

After implementing anaerobic selectors with BioMix, the Warren facility saw an improvement in biological phosphorus removal, but the performance was not consistent enough to eliminate the need for periodic chemical addition to achieve the effluent total phosphorus limit.

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 operated 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).

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

BioMix-DC was 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 eliminating the dependency on chemicals for phosphorus removal.

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

The unique and flexible mixing methods provided by BioMix-DC enabled the west side anaerobic selectors to operate as fermenters to create the excess VFA needed to produce consistent effluent ortho-P values of ≤ 0.1 mg/L, significantly less than the ortho-P values observed before BioMix-DC was initiated. The improved bio-P removal and consistency has eliminated the need for chemical addition, reducing sludge production which reduces operating costs and sludge disposal costs.

The BioMix-DC upgrade reduced energy and chemical consumption while minimizing phosphorus discharged to the environment.



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