

Case Study - Malatech Bioaugmentation

15 000 m³/d Municipal Wastewater Treatment Plant of a city

Goals of bioaugmentation:

1. Total Nitrogen removal enhancement due to recent strict effluent limits set by the authority (10 mg/l)
2. Total Phosphorus removal enhancement due to recent strict effluent limits set by the authority (0.7 mg/l)
3. OPEX reduction by lowering energy consumption, excess sludge dewatering, transportation and disposal costs



Author: Malatech Water Ltd.

Title: Municipal wastewater treatment plant optimization

The municipal WWTP operator client has had this **trouble-free plant located in an environmentally sensitive zone**. The plant has 2 parallel Dorr primary clarifiers, followed by 2 parallel anoxic zones. The mixed liquor from here is distributed into 3 lines heading to 3 parallel aerobic reactors followed by 4 Dorr secondary clarifiers. Internal recirculation is pumped from the recirculation duct after the 3 aerobic basins heading to the distribution duct upstream the anoxic zones. Sludge recirculation is done from the secondary clarifiers to the same endpoint.

Since the plant is located in a sensitive zone, and releasing the treated effluent into a freshwater stream which feeds freshwater lakes downstream, the authority limit for Total Nitrogen is 10 mg/l, for Total Phosphorus 0.7 mg/l all year long from 1st January 2015. Excess Phosphorus is removed by FeCl₃ since the plant is not equipped with Bio-P zones. For lowering the Total Nitrogen concentration of the secondary effluent, the plant is equipped with a fixed-bed, attached growth post-denitrification zone fed with the secondary clarified Nitrate-rich effluent, and Methanol dosed by the operator.

The operator chose to proceed with Malatech Bioaugmentation with the following goals:

- 1. Further lowering effluent Total Nitrogen concentration to be safely below the 10 mg/l limit in every seasons**
- 2. Provide a boost for Total Phosphorus removal since the new 0.7 mg/l limit could not be guaranteed safely even with increased chemical dosages**
- 3. Lowering the energy consumption of the plant**
- 4. Decreasing excess sludge production, saving costs on polyelectrolyte costs used for dewatering, dewatered sludge transportation, and disposal.**

Dosages:

Bioclean TM as our core technology has only been applied since the plant is running trouble-free, just we need to extract the most from its biology by Bioclean TM, which has a diverse portfolio of benefits making it a sole solution for the operator's challenges.

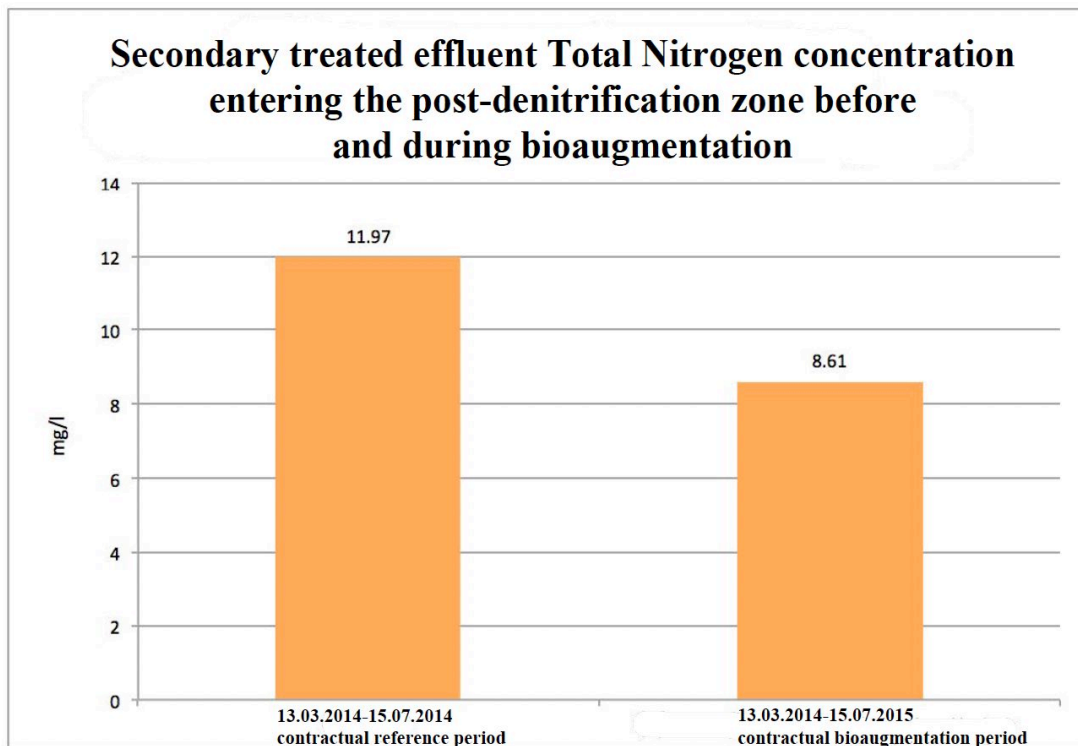
The shock dosage was 16 kg/d on week 1, followed by 14 kg/d on week 2, then 8 kg/d on week 3, and 6 kg/d on week 4. The maintenance dosage was 3 kg/d.

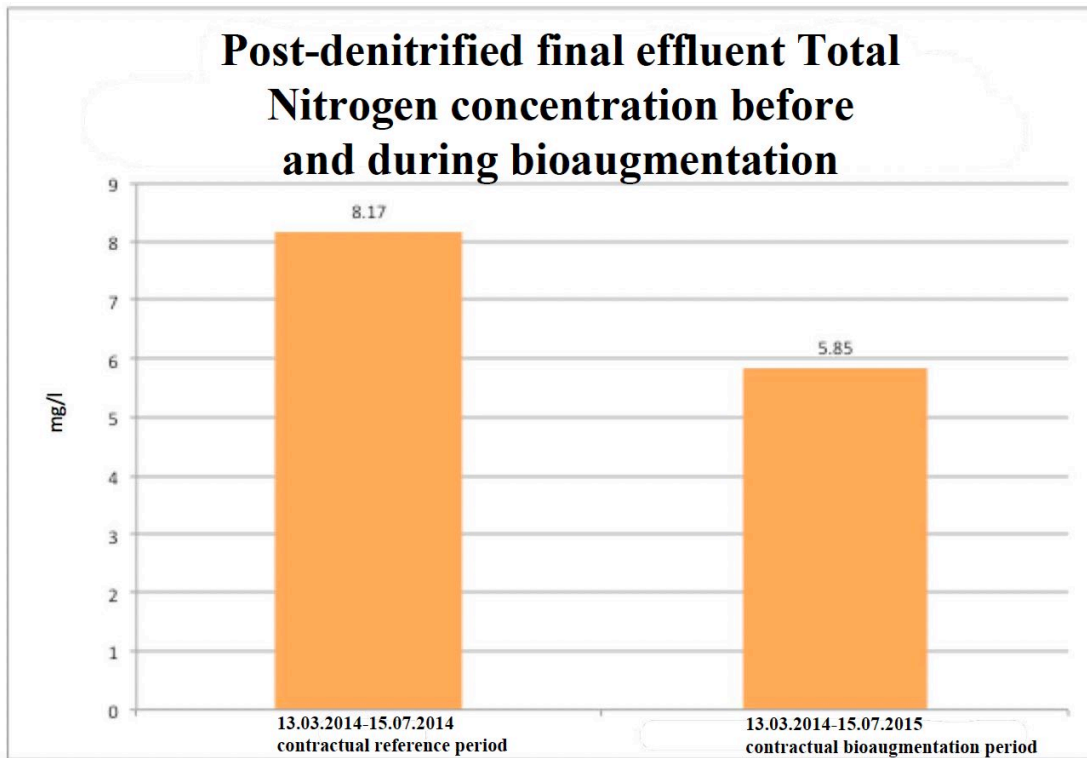
Results:

Total Nitrogen removal:

Bioclean TM has a massive impact on denitrification, it boosts Nitrogen removal both in anoxic, as well as in the aerobic reactors by its unique microbes with high simultaneous nitrification-denitrification (SND) capabilities. By enhancing the floc structure, the more compact, better settling, dense flocs are able to carry out intrafloc denitrification more efficiently in the aerobic reactors. The combination of the 2 processes results a significant drop in effluent Total Nitrogen concentration at every Bioclean TM bioaugmented plants. As the result shows, **we cut back effluent TN below 10 mg/l even for the secondary treated effluent before the post-denitrification zone. Post-denitrified final effluent has been lowered to 5-6 mg/l. Influent TN remained at the same level before, and during bioaugmentation, 70-170(!!!) mg/l in average.** The source of occasional TN peaks above 100 mg/l has never been revealed, but happened several times every year.

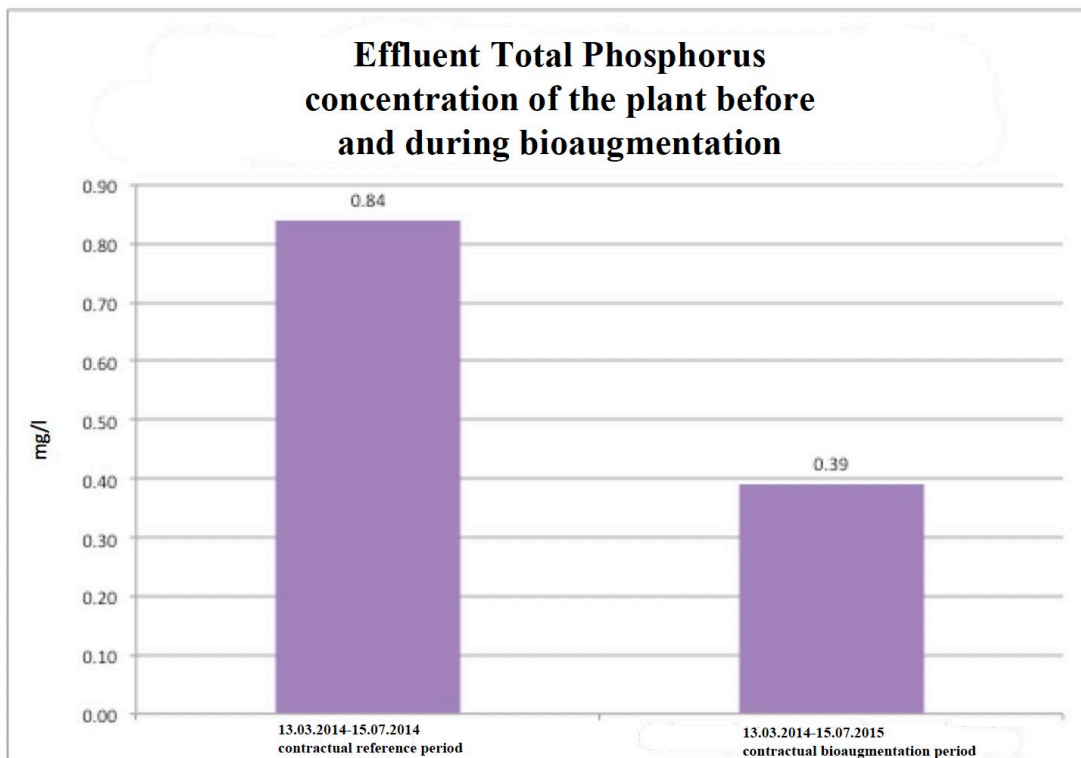
The plant meets more safely with the new legislation of 10 mg/l effluent Total nitrogen concentration thanks to Bioclean TM bioaugmentation.





Total Phosphorus removal:

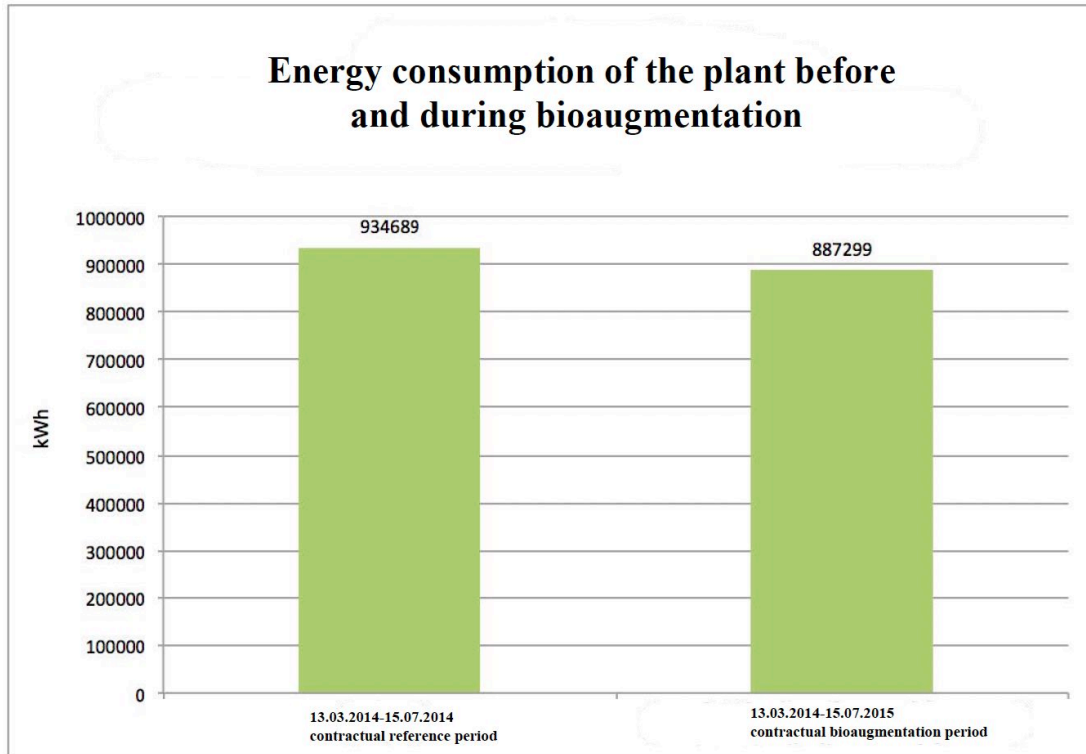
The complex Bioclean TM solution's other key strength could also be demonstrated: massive enhancement of Biological Phosphorus removal. **Bioclean TM has a decent positive impact on both poly-Phosphate formation, and excess Phosphate uptake.** Although the plant is not equipped with Bio-P reactor(s), the extremely low concentration of Nitrate in the recirculated sludge meant that the anoxic reactors were able to be used partly as a Bio-P reactor since Nitrate or DO as terminal electron acceptors were not present at most of the anoxic reactor volume during anoxic HRT. Bioclean TM also improves natural P-utilization in the biomass, which further reduces effluent TP values. **Effluent TP dropped, while operator dosed 4 tons less Fe(III)Cl3 altogether than the reference period.** Influent TP remained between 10-16 mg/l respectively.



Savings on operating costs:

Energy consumption:

Bioclean TM bioaugmentation has a natural effect on DO utilization ability of the activated sludge. As the plant is equipped with precise DO control, **the average operating frequency of the blowers dropped after the start of Bioclean TM dosage which resulted significant energy savings as shown below.**



Dewatered sludge production:

Bioclean TM also has a mentionable impact on excess sludge production. While reducing the yield of the activated sludge bacteria, operators of WWTP's naturally experience a drop in the monthly dewatered sludge production which is another major factor of cost-savings for bioaugmentation with Bioclean TM.

The source of reduction is the reduction in excess sludge formation, since the plant dewateres mixed sludge, and we do not have any impact on the raw primary sludge.

