Malatech Water Trading & Service, Ltd.
Address: 1/E Vanyi way, Alsonemedi, 2351 Hungary • Telephone: +36 30 377 8089
E-mail: info@malatechwater.com • Web: www.malatechwater.com

Case Study - Malatech Bioaugmentation

16 000 m3/d Municipal Wastewater Treatment Plant of a city with Dairy Industry load

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, Ferric(III)Chloride dosage, 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** in operation for many years. The plant has 2 parallel biological treatment lines, nearly equally sized. Both lines have 1 primary Dorr clarifier, followed by Bio-P, anoxic, and aerobic reactors, ending with 1 secondary Dorr clarifier. The excess sludge is thickened, mixed with the primary sludge, then fed into mesophilic digesters for producing biogas, then dewatered, and placed in a solar drier before transportation.

The influent wastewater has higher pollutant levels for the determining parameters, since a **dairy industry operates in the city**, and releases their physicochemically pre-treated, massive load into the canalization.

The plant ran trouble-free for years after renovation, but **authorities lowered the effluent limit for Total Nitrogen, and Total Phosphorus**, which was the main reason the operator chose Malatech Bioaugmentation. **In order to make the process profitable for the operator, we placed focus on the usual OPEX reduction capabilities of our technologies to make sure the operator saves more on operating costs than spending on the maintenance dosage of the bioaugmentation materials, while meeting with new Total Nitrogen (10 mg/l), and Total Phosphorus (0.7 mg/l) limits.**

We have targeted the 3 main factors for operating cost savings:

1. Lowering the energy consumption of the plant
2. Decreasing FeCl3 dosage significantly used for P-removal
3. Decreasing excess sludge production, saving on polyelectrolyte costs used for dewatering, dewatered sludge transportation, and disposal costs.

<u>Dosages:</u>

Bioclean TM as our core technology has only been applied since the plant is running trouble-free, just we needed 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.

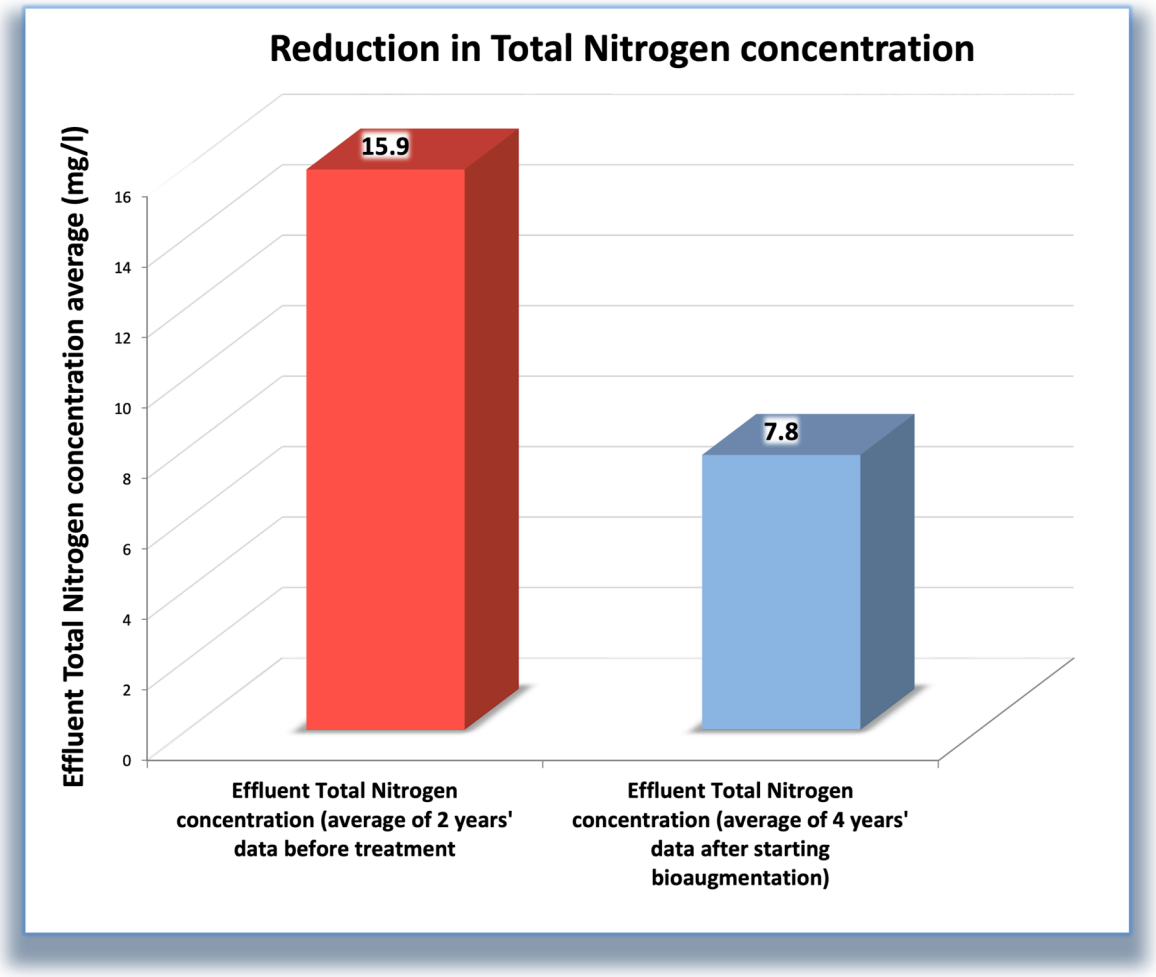
The shock dosage was 28 kg/d on week 1, followed by 20 kg/d on week 2, then 12 kg/d on week 3, and 8 kg/d on week 4. The maintenance dosage was 3 kg/d, 1.5-1.5 kg equally distributed between the 2 lines. On both lines Bioclean TM was added on a continuous basis into the primary treated effluent entering the biology.

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 managed to cut back effluent TN to less than the half of the reference period. Influent TN remained at the same level before, and during bioaugmentation, 70-80 mg/l in average.

The plant meets with the new legislation of 10 mg/l effluent Total nitrogen concentration thanks to Bioclean TM bioaugmentation. The representative TN values are 5.5-6.5 mg/l on a long term, just due to the industrial shock loads occasionally from the dairy industry, and a 1-2-week-long poor denitrification period during, and after Christmas, and New Year, there are some peaks when Nitrate grows higher.

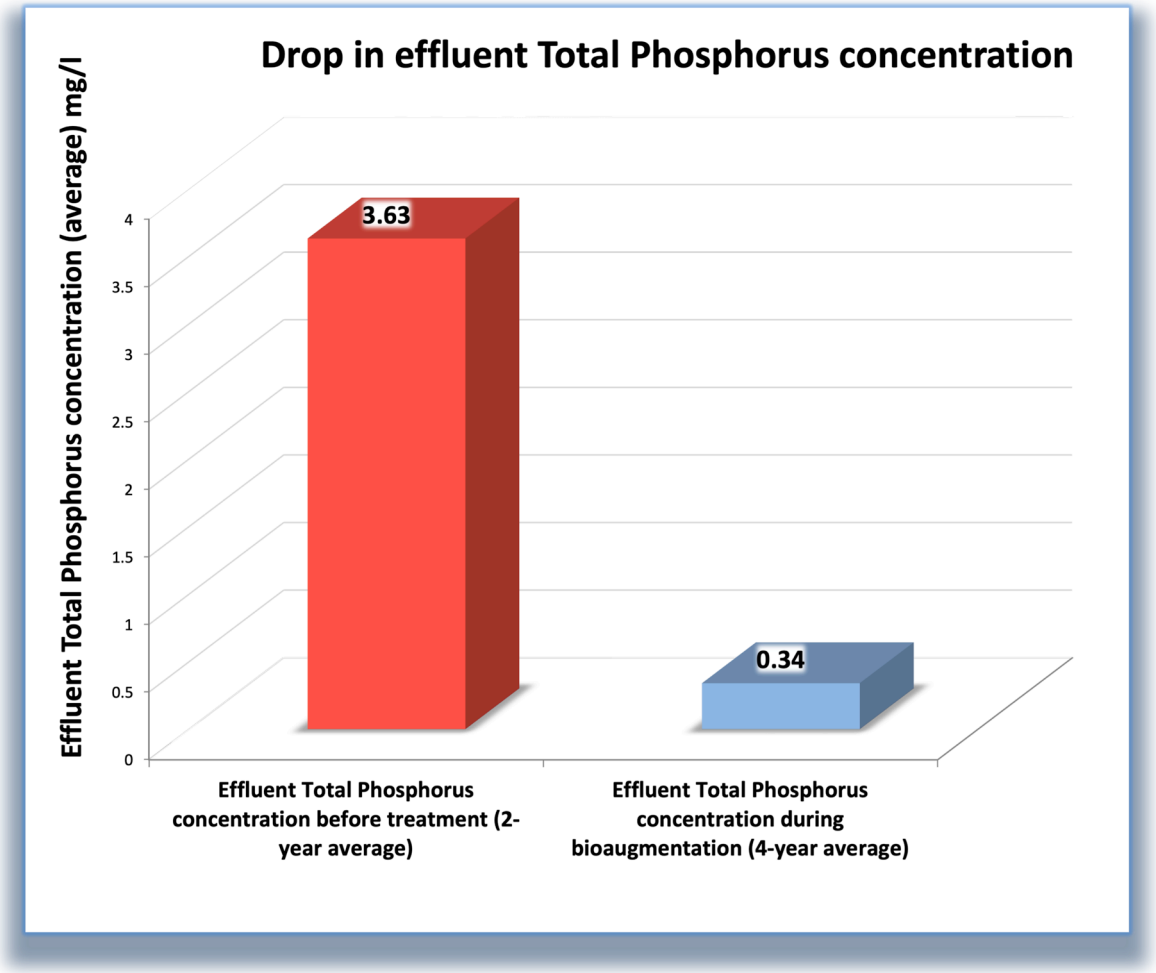


Total Phosphorus removal:

The complex Bioclean TM solution's other key strength also had to be extracted here: massive enhancement of Biological Phosphorus removal. Bioclean TM has a decent positive impact on both poly-Phosphate formation, and excess Phosphate uptake. Since both treatment lines are equipped with Bio-P reactors, we were hopeful of meeting with the pretty harsh 0.7 mg/l Total Phosphorus requirement from the authority for the final effluent. Influent Total Phosphorus concentrations vary between 12-25 mg/l, depending on the current load of the dairy industry.

As it is shown on the diagrams below, we managed to bring down effluent TP way below the required level in the effluent with generally no FeCl3 addition. As it is shown on the diagram (see on next page), enhanced Bio-P removal with Bioclean TM did not require Ferric anymore. Operator has kept 100 l/d dosage per day to prevent Struvite formation in the mesophilic digesters.

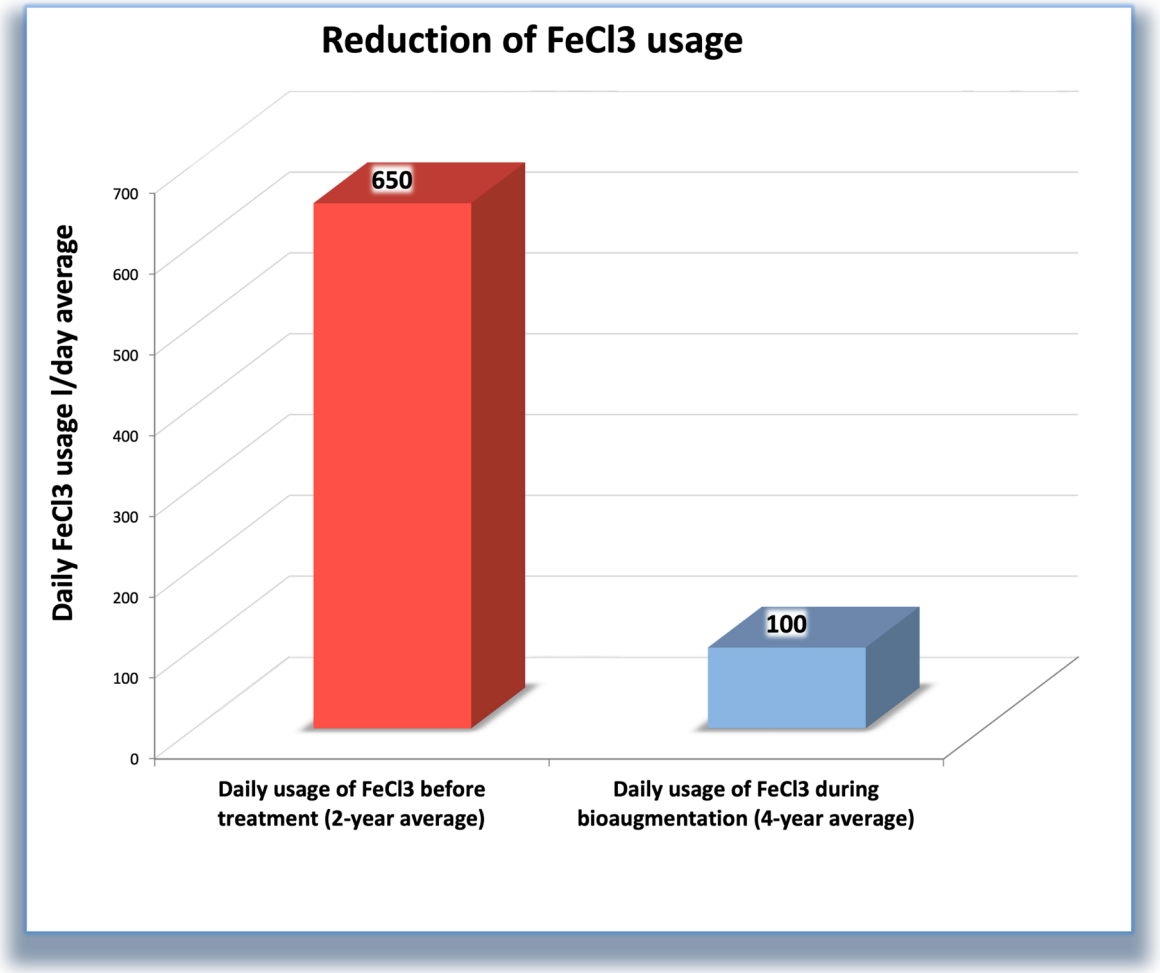
TP concentrations in the effluent varied between 2-5 mg/l, which started to fall gradually after bioaugmentation started, fell constantly below 2 mg/l in 2 months after start, parked below 1 mg/l after 4 months from start, then fell below 0.5 mg/l in 5 months from start. Since then, the representative effluent TP concentrations vary between 0.2-0.4 mg/l.



Savings on operating costs:

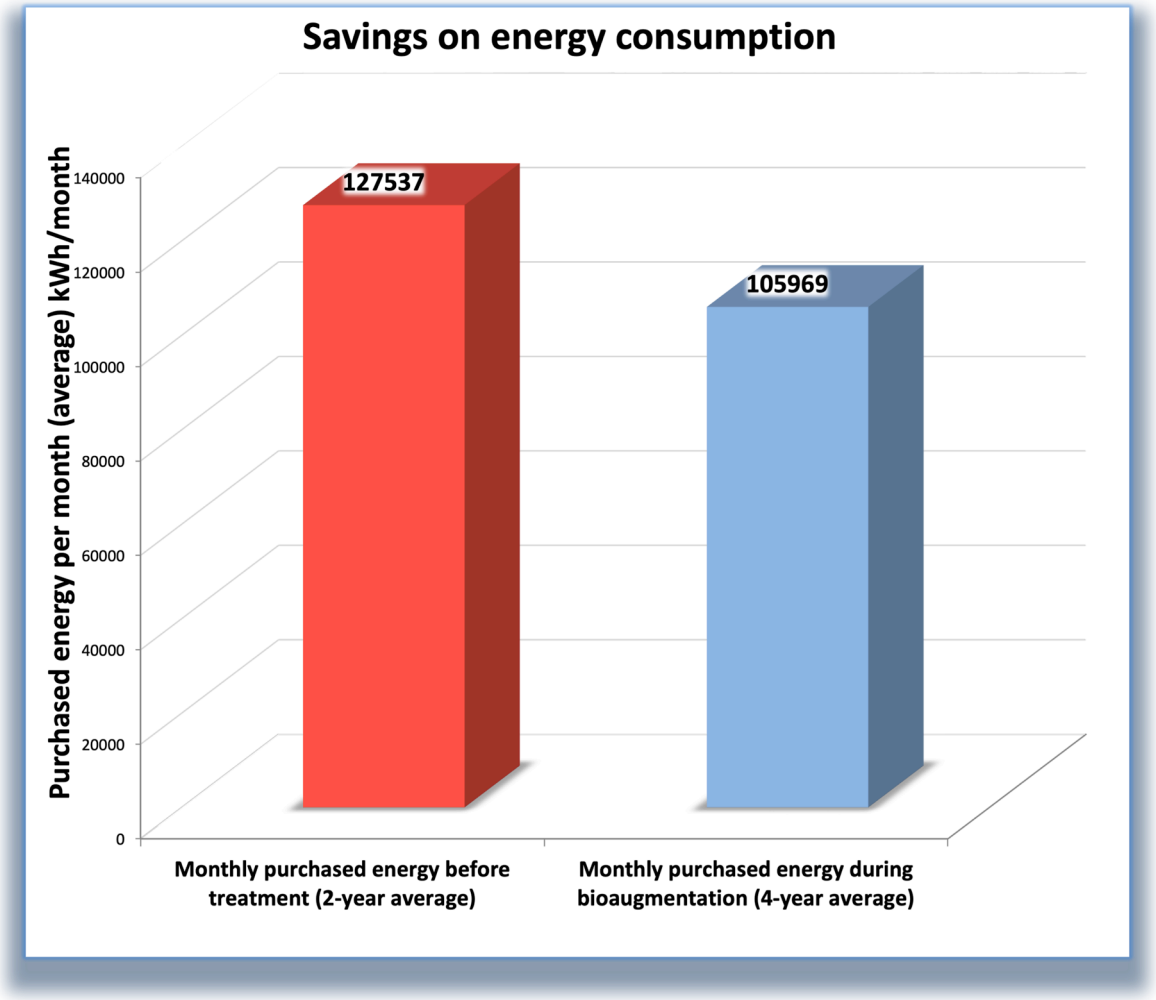
Ferric(III) Chloride dosage:

The operator doses FeCl3 (41 m/m%) for TP removal. Before bioaugmentation the daily average was 650 liters/day. After the start of bioaugmentation when operators started to see effluent TP concentrations dropping, they decided to subsequently reduce the dosage. When the effluent TP concentrations stabilized between 0.2-0.4 mg/l after half a year, they just dose 100 liters/day for safety reasons to prevent Struvite formation in the digesters.



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. The diagram shows purchased energy, because part of the energy consumption of the plant is provided by the energy generated from biogas.



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.