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Case Study - Malatech Bioaugmentation

9 500 m3/d Municipal Wastewater Treatment Plant of a city

Goals of bioaugmentation:

Continuous and rapid growth of the city's population resulted hard times for this recently upgraded municipal WWTP. The plant became overloaded again for the end of the new investment's warranty period. Effluent violations became more and more frequent, and the excess sludge dewatering line also could not handle the increased load of thickened sludge which had to be removed from the biology thanks to the increased C-, and N-load. The insufficient excess sludge removal led to an increase in MLSS, and sludge age in the reactors, that resulted a massive increase in filamentous count. Excessive foaming became uncontrollable, TSS also increased in the effluent. Operator aimed to address the situation by Malatech Bioaugmentation.



Author: Malatech Water Ltd.

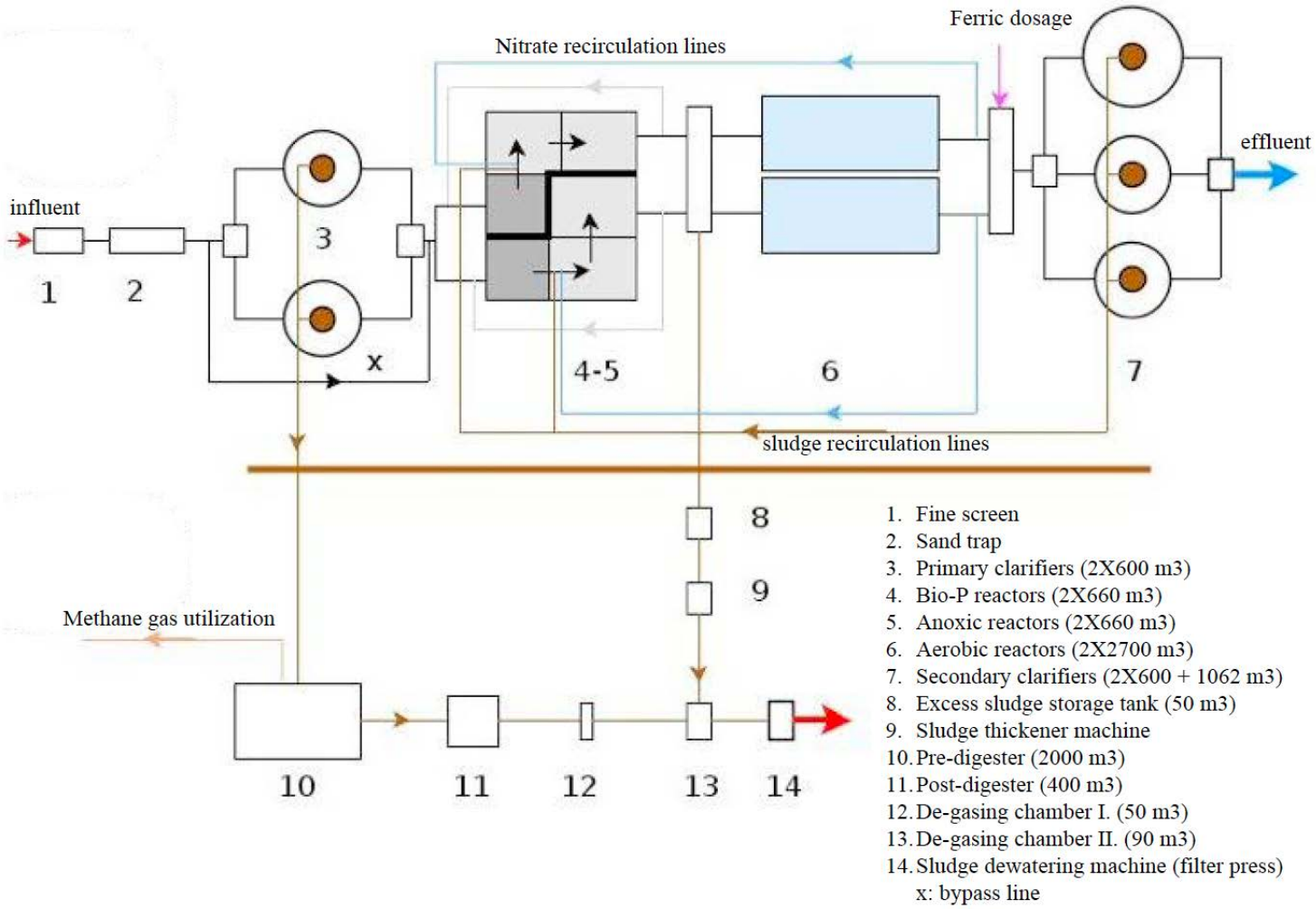
Title: Municipal wastewater treatment plant optimization

The city is located in the agglomeration of an EU country's capital. As more and more people decided to live outside the capital, the surrounding settlements population started to grow rapidly after the early 2000's. The wastewater treatment plant of the city had become overloaded for 2008, and required an upgrade, which ended in 2011. The upgrade covered the entire plant: pre-treatment, biological reactors, secondary clarification, sludge thickening and dewatering, mesophilic sludge digesters, chemical dosage equipment, SCADA and process control.

The city's population grew rapidly even during the construction works of the plant. Till the time the new plant was online, and in full operation, it was considered to be overloaded again. Right after the warranty period, the effluent violations became more and more frequent, mainly for exceeding TN, TP, TSS limits in the effluent. The excess sludge dewatering machine could not handle the hydraulic load the increased excess sludge removal resulted. The MLSS concentration in the biology increased above 6 000 mg/l that resulted continuous filamentous blooming problems throughout the entire year including summertime.

Since the next upgrade of the plant was in a distant future, the operator aimed to restore effluent quality, and avoid fines. Also, it was essential to decrease excess sludge yield, so that the operator can start to reduce MLSS, and control filamentous count.

This overloaded wastewater treatment plant represents a textbook example of where Malatech Bioaugmentation can make a real difference.



Schematic view

Our focus was on increasing the treatment capacity of the biology, we needed to demonstrate that with Malatech bioaugmentation a massive cumulative overload does not require immediate capital investment, new sludge dewatering machine, new reactors, new plant, or expansion.

Bioclean TM as our core technology has been applied, with Vickzyme for the first 4 weeks.

The shock dosage of Bioclean TM was 16 kg/d on week 1, followed by 12 kg/d on week 2, then 10 kg/d on week 3, and 6 kg/d on week 4. The maintenance dosage was 3 kg/d, dosed into the distribution chamber following the primary clarifiers.

Vickzyme was used at 4 kg/d dosage for the first 2 weeks, which has been lowered to 2 kg/d for maintenance.

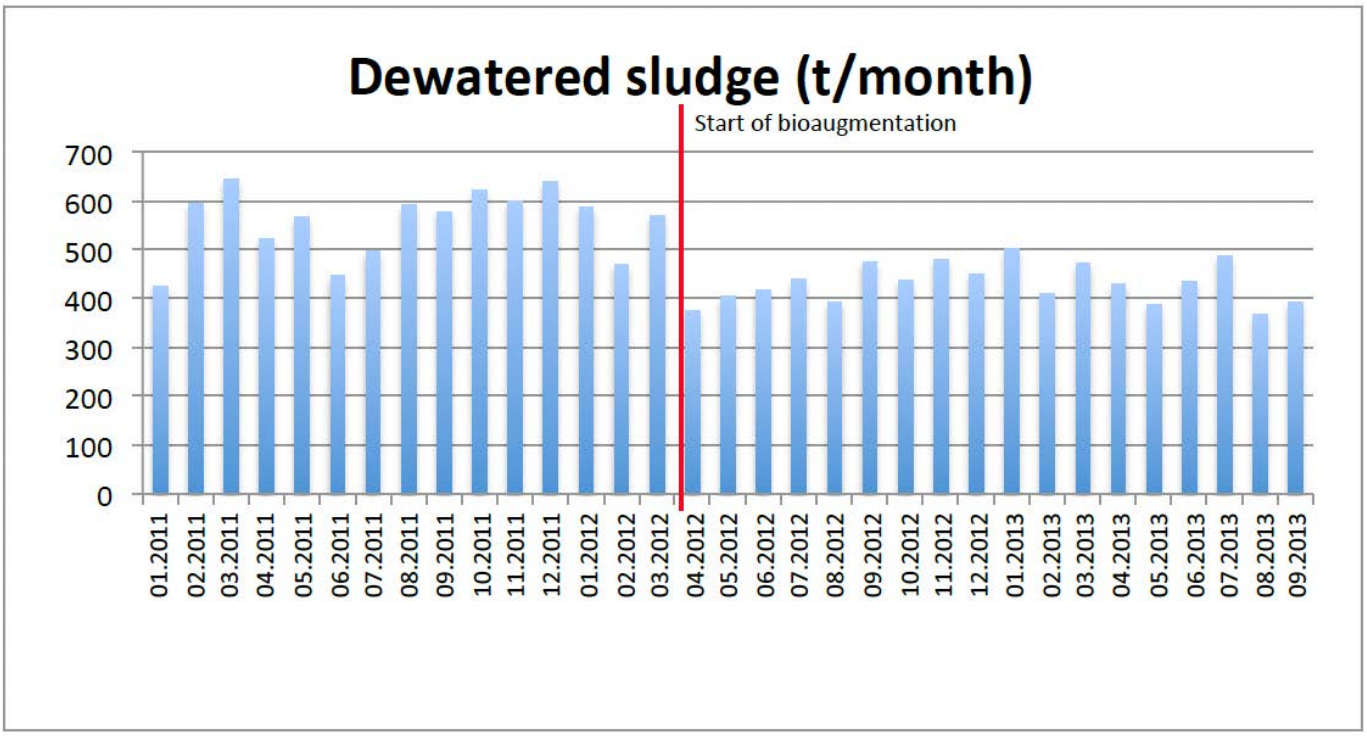
Bioaugmentation started in April 2012.

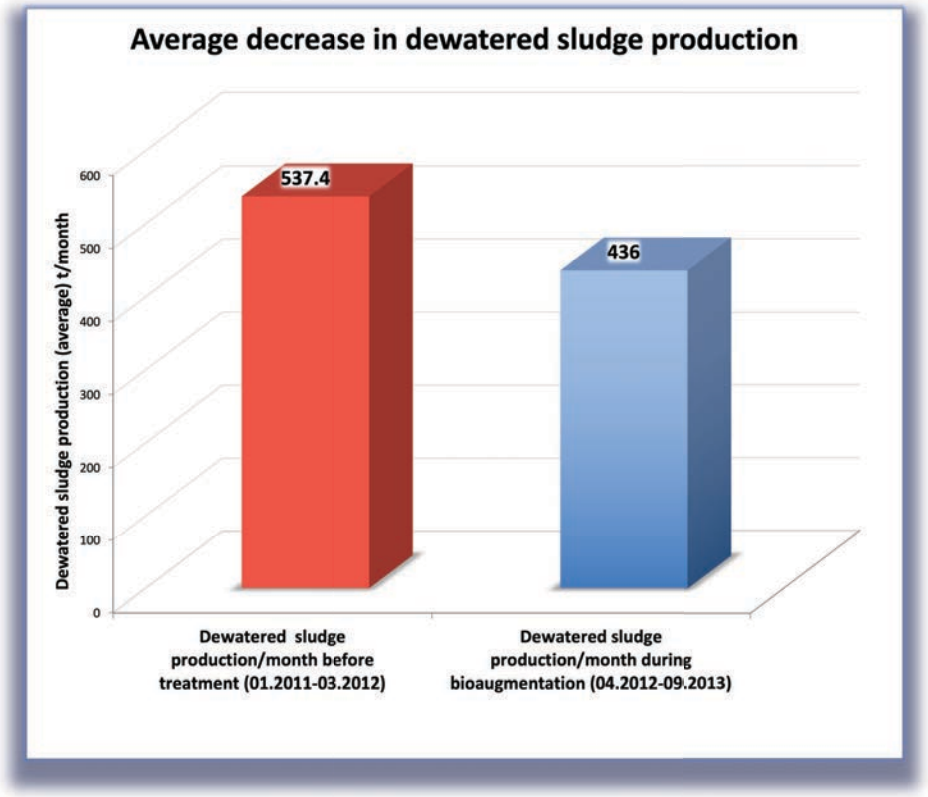
Results:

Excess sludge yield:

After the start of bioaugmentation, the sludge yield has decreased, that meant that the operator was able start to slowly, and gradually decrease the MLSS concentration from 6 400 mg/l to 4 500 mg/l in 3 months. The dewatering machine was running at peak capacity though during this period.

Besides the excess sludge yield reduction, we have shown a great overall decrease in the dewatered digested sludge production as well. The mesophilic digesters are fed with the thickened (5.5-6%) mix of raw and excess sludge. Since the activated sludge part was treated with Bioclean TM, and Vickzyme during the treatment, and our strains in the products are facultative anaerobes, they have stabilized the performance of the digesters as well, resulting a more stable, and increased biogas output, and increased rate of raw sludge hydrolysis in the digesters. As the graph below shows, the plant produced reduced amount of dewatered sludge each month right after the start of bioaugmentation despite slowly increasing cumulative influent C-, and N-load:





Filamentous blooming control:

Bioclean TM includes certain species of all-natural microbes helping flocculant bacteria having a competitive edge against filamentous bacteria. Also, we included strains in Bioclean TM that digest the surface-active organic substances more efficiently than the generic activated sludge. These materials are from the lysing filamentous cells, and they are responsible for the thick foam and scum covering the surfaces of the reactors and the secondary clarifiers when a plant struggles with filamentous rise. As it is shown on the photos below, our treatment had a very visible effect on the foam and scum reduction:



Day 1



Day 28

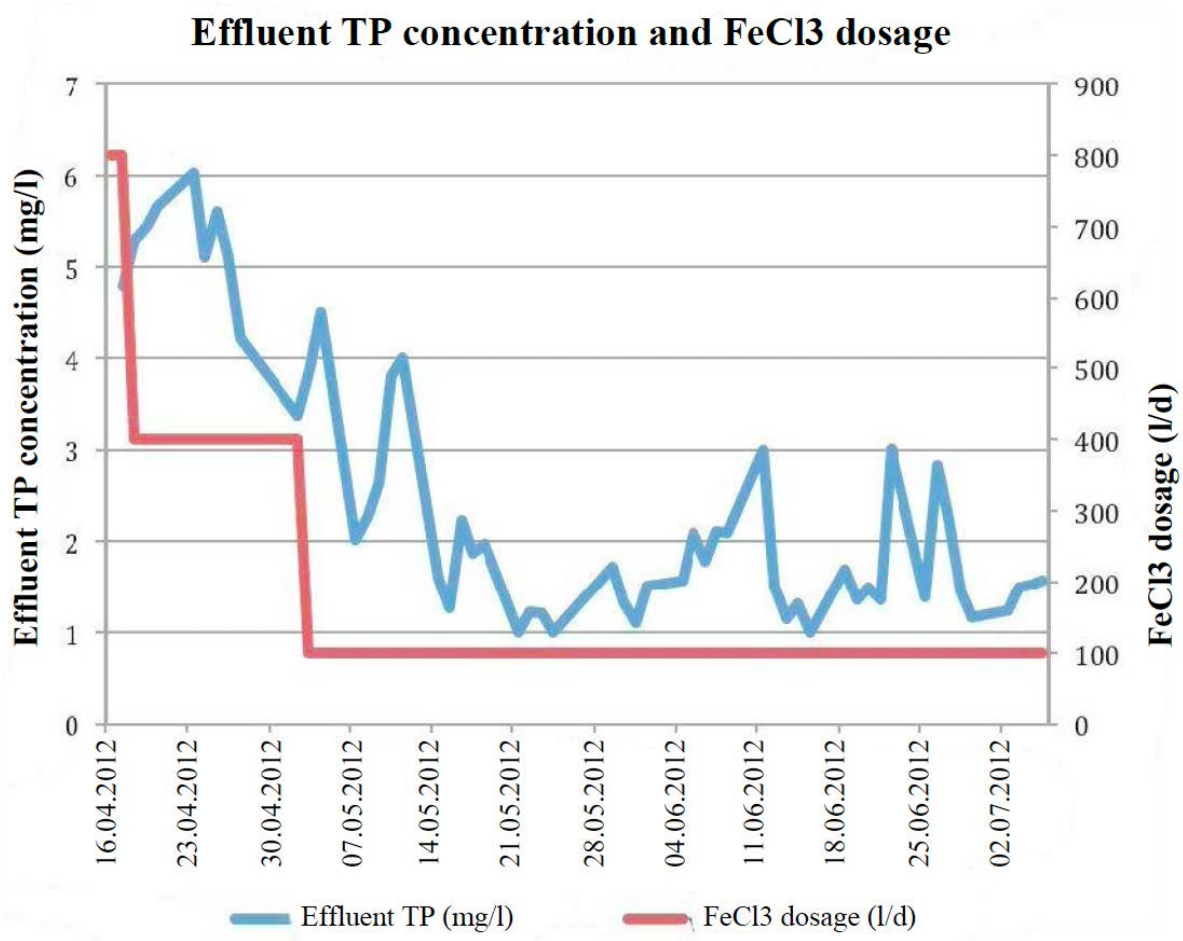


Day 60

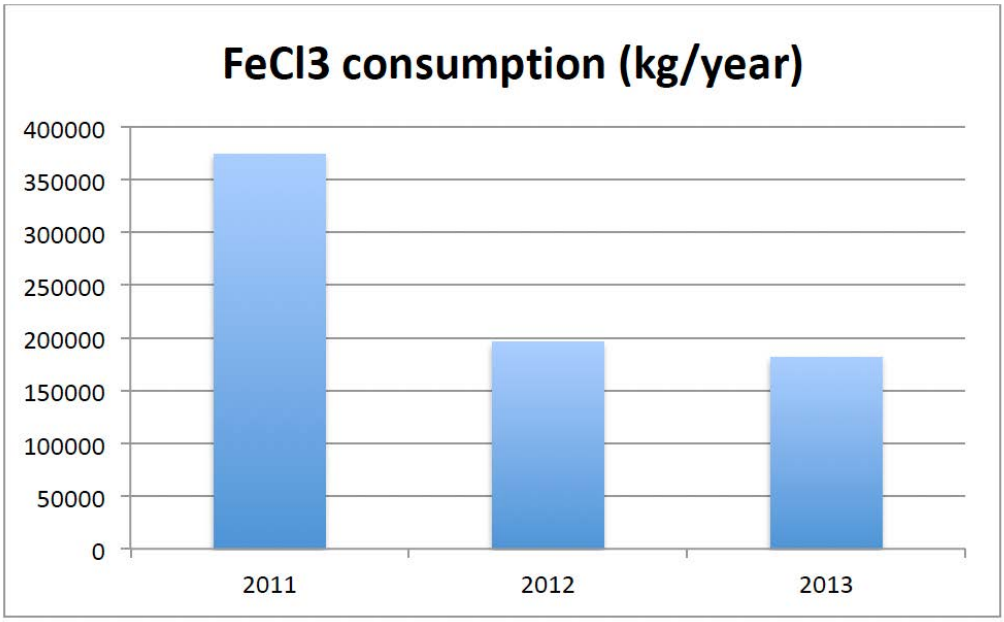
Effluent quality, FeCl3 consumption:

The city is located near a huge river which is the receiver of the treated effluent. The operator was lucky because the effluent requirements were not strict, the location was not classified as environmental sensitive area by the local environmental authority. The requirement for effluent TP was 5 mg/l at maximum that times, TN had to be kept below 15 mg/l, and TSS had to be kept below 35 mg/l. Despite the loose requirements the operator was fined for violating these 3 parameters on a regular basis. The problem was not only the slowly but continuously increasing hydraulic load. The raw wastewater quality was traditionally strong compared to regular European municipal WWTPs at this range. Influent COD peaked at 1 000 mg/l quite frequently while primary clarified COD peaked 732 mg/l. TP often exceeded 20 mg/l while TN was about 75-95 mg/l in average in the primary clarified influent flowing into the biology.

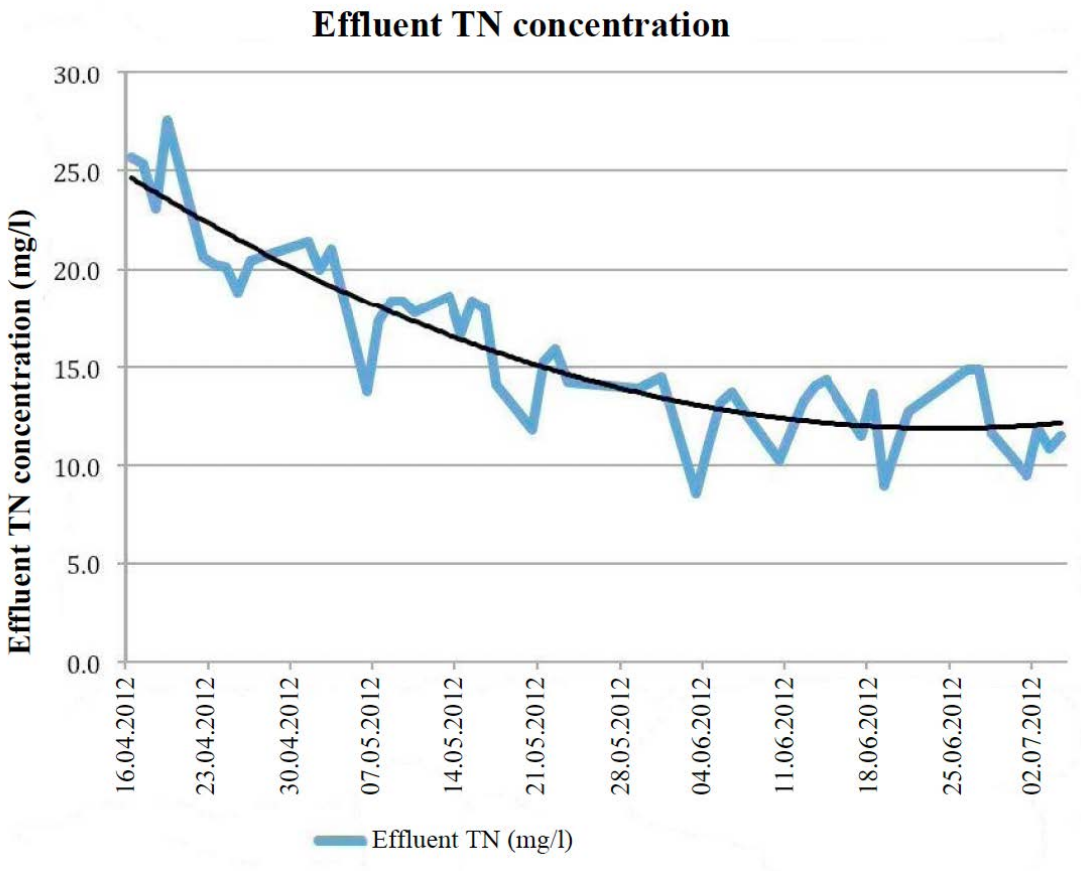
As the results show, Bioclean TM treatment brought down effluent TN comfortably below 15 mg/l in the effluent in a few months after the start of the treatment. The same is true for Total Phosphorus. The plant was able to keep these parameters safely for several years until the next upgrade when our treatment stopped. **The operator was also able to reduce the FeCl3 dosage significantly while having significantly lower TP in the effluent than before.**



Due to rapid load fluctuations from time to time the Bio-P processes were under stress mainly due to Nitrate inhibition. That forced the operator to raise the FeCl3 dosage from time to time. Since the 100 l/d FeCl3 shown on the graph above was not realistic in long term, below we publish the plant's yearly total FeCl3 usage for the year before bioaugmentation, and for 2 years following the start of bioaugmentation. That gives the real picture about the chemical savings:



Reduction in Total Nitrogen concentration for the effluent has also brought the expected results, keeping the effluent TN safely below 15 mg/l:



Effluent TSS has also stabilized, and lowered, and for most of the time kept below the 35 mg/l limit. However, load fluctuations (especially C-load) had an adverse effect on the activated sludge structure, resulting looser flocs than preferred. That is why we show a wider timeline here as well showing occasions when the effluent TSS still exceeded the limit. Malatech Bioaugmentation is a decent tool for increasing the treatment capacity of overloaded WWTPs but we also have boundaries:

