

# Bioclean™

The baseline of bioaugmentation for biological wastewater treatment



Bioclean™ is a concentrated powder of inactivated all-natural microbes isolated from soil, and water. The product is made by fermentation, and has primarily been developed for optimizing the process of industrial, and municipal biological wastewater treatment processes. After decades of R&D, and many upgrades, Bioclean™ has a high number of microbial species combined with enzymatic systems, and nutrients to ensure a broad spectrum of use. As a result of continuous upgrades, the product has become our core technology, and best-selling product, which we use in most of our projects in biological wastewater treatment. Bioclean™ bioaugmentation means your operational window becomes larger, your plant will operate in a more stable, economical way with improved, and stabilized effluent quality.

## BIOCLEAN™ IS USED FOR:

- Excess sludge reduction in activated sludge WWTP's (see also our related product in this subject: [Bioclean ALPHA](#))
- Reduction of energy consumption in activated sludge WWTP's
- Boosting denitrification in activated sludge WWTP's
- Boosting Bio-P step in activated sludge WWTP's
- Effluent quality optimization in activated sludge WWTP's, wastewater treatment ponds, attached growth systems (see also our related products in this subject: [BioGuarde I](#), [Ammonia Guard](#))
- Filamentous blooming, and foam control in activated sludge WWTP's (see also our related product in this subject: [Bioclean ALPHA](#))
- Improvement of FOG breakdown in activated sludge WWTP's (see also our related products in this subject: [Bioclean FOG](#), [BioGuarde II](#))
- Intensification of biological leachate treatment in ponds or activated sludge plants



## HISTORY OF R&D

30 years ago, the initial focus in the selection of microbe species for Bioclean™ was ensuring high resistance for the treated plants' microbial communities towards shock loads, inhibitory, or toxic loads, and providing higher treatment capacity for the plant. That made the technology successful both in industrial, and municipal wastewater

treatment plant optimization projects. Upgrades during the 2000's provided the Bioclean TM abilities to optimize energy consumption, and sludge production of the treated wastewater treatment plants. The aim was to generate higher cost savings for the WWTP operators than the cost of the monthly maintenance dosage of Bioclean TM costs them. The recent upgrades in the past decade added really impressive nutrient reduction (N,P) ability to the product, and a limited ability for filamentous control. For today, after 30 years of the birth of Bioclean TM, the technology has become a "must have" ultimate solution for every WWTP operator worldwide.

## APPLICATION OF BIOCLEAN TM DOSING, PLANT SETUP, TECHNICAL INFORMATION

### IMPORTANT INFORMATION:

Recommended daily dosages are given in ppm based on average m<sup>3</sup>/d hydraulic raw wastewater load!

Application of Bioclean TM usually results net savings on various operational costs which make the product highly profitable for operators by spending way less on the maintenance dosage of the product than the savings on operational costs Bioclean TM generate.

For determining exact dosages for your WWTP, please provide us information by sending us our questionnaire filled with information as much as possible: [Click here for questionnaires!](#)

Dosage of Bioclean TM requires pre-activation of the product by mixing with pure water, and aeration. Our dosing units are easy to install, and use, consume low amount of space, isolated, and have a heating function for outdoor operations at winter. [Click here](#) for more information on the Malatech-S Dosing Unit!

Whenever you have any questions, do not hesitate to [contact us!](#)

### PACKAGING INFORMATION

The product is available in 1 kg double-wall bags, 20 bags make up 1 carton box which is the lowest unit for ordering.

### STORAGE INFORMATION

Keep the product in a cool and dry place below 30 Celsius. Avoid exposure to direct sunlight.



## EXCESS SLUDGE REDUCTION OF ACTIVATED SLUDGE WWTP'S

The application of Bioclean™ can reduce the excess sludge production of an activated sludge WWTP saving significant cost for the operator by adjusting the cumulated yield (Y), and hydrolysing hardly biodegradable particulate organic matter accumulated in the sludge. However, the execution of the process may differ depending on the specific load of the WWTP:

### WWTP'S WITH LOW SPECIFIC LOAD – UNDERLOADED WWTP'S (REDUCTION IN EXCESS SLUDGE PRODUCTION: 8-17%)

#### START THE DOSAGE OF BIOCLEAN™

Week 1: 2-4 ppm per day

Week 2: 1-2 ppm per day

Week 3: 0.5-1 ppm per day

Onwards: 0.15-0.25 ppm per day as daily maintenance dosage.

#### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

After week 3 please revise the MLSS in your reactors.

Underloaded WWTP's usually require a gradual drop

of MLSS due to Bioclean™ treatment, since our bacteria will increase the treatment capacity, and the pace of biodegradation in the system. MLSS reduction needs to start after week 3 of application, and 25-40% reduction of MLSS should be executed in the following 4 weeks while adding the daily maintenance dosage of Bioclean™. e.g. a WWTP, which operates at 4.0 g/l of MLSS before treatment will have to be operated at 2.5-3.0 g/l of MLSS after 2 months of treatment onwards. The treatment usually comes with the reduction of energy consumption as an additional benefit. However, you need to take care about DO control, and make sure the aeration basins are well aerated, and the DO profile is ok. e.g: for a continuous flow long, rectangular aerobic reactor we usually recommend 0.5-0.8 mg/l of DO at the entrance of the reactor, 1.2-1.8 mg/l at the middle of the reactor in length, while 1.8-2.6 mg/l at the end of the aerobic reactor (values may differ on raw wastewater type and reactor layout). In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean™!



## WELL-LOADED WWTP'S WITH ACCURATE SPECIFIC LOAD (REDUCTION IN EXCESS SLUDGE PRODUCTION: 10-19%)

### START THE DOSAGE OF BIOCLEAN TM

Week 1: 2-4 ppm per day

Week 2: 1-2 ppm per day

Week 3: 0.5-1 ppm per day

Onwards: 0.15-0.25 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

After week 3 please revise the MLSS in your reactors. Well-loaded WWTP's usually require a gradual drop of MLSS due to Bioclean TM treatment, since our bacteria will increase the treatment capacity, and the pace of biodegradation in the system. MLSS reduction needs to start after week 3 of application, and 5-15% reduction of MLSS should be executed in the following 4 weeks while adding the daily maintenance dosage of Bioclean TM. e.g. a WWTP, which operates at 4.0 g/l of MLSS before treatment will have to be operated at 3.4-3.8 g/l of MLSS after 2 months of treatment onwards. The treatment usually comes with the reduction of energy consumption as an additional benefit. However, you need to take care about DO control, and make sure the aeration basins are well aerated, and the DO profile is ok. e.g: for a continuous flow long, rectangular aerobic reactor we usually recommend 0.5-0.8 mg/l of DO at the entrance of the reactor, 1.2-1.8 mg/l at the middle of the reactor in length, while 1.8-2.6 mg/l at the end of the aerobic reactor (values may differ on raw wastewater type and reactor layout). In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM! If you are interested in higher sludge reduction from 30%, up to 50%, check [Bioclean ALPHA!](#)

## OVERLOADED WWTP'S WITH HIGHER SPECIFIC LOAD THAN IT CAN HANDLE (REDUCTION IN EXCESS SLUDGE PRODUCTION: 14-22%)

### START THE DOSAGE OF BIOCLEAN TM

Week 1: 4-6 ppm per day

Week 2: 2-4 ppm per day

Week 3: 1-3 ppm per day

Week 4: 0.5-1 ppm per day

Onwards: 0.4-1 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

Bioclean TM is usually applied at overloaded WWTP's for effluent optimization, where excess sludge reduction is a side-effect. Operators should modify the operational setup of the plant like it is written in the "Effluent quality optimization" chapter: after week 4 please revise the MLSS in your reactors. Slightly overloaded WWTP's without major effluent issues can handle the load by keeping the same MLSS than before due to Bioclean TM treatment. Highly overloaded WWTP's usually require a gradual increase of MLSS after the 4th week of Bioclean TM treatment. The maximum concentration of MLSS in the system is defined by multiple factors like aeration system's capacity, reactor volumes, recirculation rates, hydraulic load of the secondary clarifiers, in case of SBR's the surface area of the reactors. In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM!



# ENERGY CONSUMPTION REDUCTION OF ACTIVATED SLUDGE WWTP'S

By increasing the metabolic rate of the activated sludge, optimizing the biochemical processes, and providing a better DO utilization ability for the entire system, the application of Bioclean TM can result massive savings for the operator in energy costs of the plant. However, the execution of the process may differ depending on the specific load of the WWTP:



## WWTP'S WITH LOW SPECIFIC LOAD – UNDERLOADED WWTP'S (REDUCTION IN ENERGY COSTS 8-15%):

### START THE DOSAGE OF BIOCLEAR TM

Week 1: 2-4 ppm per day

Week 2: 1-2 ppm per day

Week 3: 0.5-1 ppm per day

Onwards: 0.15-0.25 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

After week 3 please revise the MLSS in your reactors. Underloaded WWTP's usually require a gradual drop of MLSS due to Bioclean TM treatment, since our bacteria will increase the treatment capacity, and the pace of biodegradation in the system. MLSS reduction needs to start after week 3 of application, and 25-40% reduction of MLSS should be executed in the following 4 weeks while adding the daily maintenance dosage of Bioclean TM. e.g. a WWTP, which operates at 4.0 g/l of MLSS before treatment will have to be operated at 2.5-3.0 g/l of MLSS after 2 months of treatment onwards. The treatment usually comes with the reduction of excess sludge production as an additional benefit. However, you need to take care about DO control, and make sure the aeration basins are well aerated, and the DO profile is ok. e.g: for a continuous flow long, rectangular aerobic reactor we usually recommend 0.5-0.8 mg/l of DO at the entrance of the reactor, 1.2-1.8 mg/l at the middle of the reactor in length, while 1.8-2.6 mg/l at the end of the aerobic reactor (values may differ on raw wastewater type and reactor layout). In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM!

## WELL-LOADED WWTP'S WITH ACCURATE SPECIFIC LOAD ((REDUCTION IN ENERGY COSTS: 5-12%)

### START THE DOSAGE OF BIOCLEAR TM

Week 1: 2-4 ppm per day

Week 2: 1-2 ppm per day

Week 3: 0.5-1 ppm per day

Onwards: 0.15-0.25 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

After week 3 please revise the MLSS in your reactors. Well-loaded WWTP's usually require a gradual drop of MLSS due to Bioclean TM treatment, since our bacteria will increase the treatment capacity, and the pace of biodegradation in the system. MLSS reduction needs to start after week 3 of application, and 5-15% reduction of

MLSS should be executed in the following 4 weeks while adding the daily maintenance dosage of Bioclean TM. e.g. a WWTP, which operates at 4.0 g/l of MLSS before treatment will have to be operated at 3.4-3.8 g/l of MLSS after 2 months of treatment onwards. The treatment usually comes with the reduction of excess sludge production as an additional benefit.. However, you need to take care about DO control, and make sure the aeration basins are well aerated, and the DO profile is ok. e.g: for a continuous flow long, rectangular aerobic reactor we usually recommend 0.5-0.8 mg/l of DO at the entrance of the reactor, 1.2-1.8 mg/l at the middle of the reactor in length, while 1.8-2.6 mg/l at the end of the aerobic reactor (values may differ on raw wastewater type and reactor layout). In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM!

## EFFLUENT TOTAL NITROGEN CONCENTRATION REDUCTION BY 20-60% (COMPARED TO EFFLUENT TN CONCENTRATION BEFORE TREATMENT) AT ACTIVATED SLUDGE WWTP'S

Total Nitrogen removal capacity of an activated sludge can be significantly improved without any risks by our Bioclean TM bioaugmentation technology. The goal of the process is on one hand providing more readily biodegradable COD for the anoxic reactors by improved hydrolysis of hardly biodegradable organic particulate matter, on the other hand the reinforcement of the sludge structure by enlarging the size of the activated sludge flocs, and increasing their density. As a result of Bioclean TM treatment the activated sludge shows a significant improvement in Total Nitrogen removal capacity in the anoxic, and aerobic zones (at anoxic, and aerobic times in SBR reactors). In aerobic zones, denitrification is achieved within the flocs at a way higher rate than before where the DO concentration is not a limiting factor anymore like it is at the perimeter of the flocs. To reduce your TN in your effluent, we recommend you the following process to be executed:



### START THE DOSAGE OF BIOCLEAN TM

Week 1: 2-4 ppm per day

Week 2: 1-2 ppm per day

Week 3: 0.5-1 ppm per day

Week 4: 0.5 ppm per day

Onwards: 0.15-0.25 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

A massive reduction in TN can be expected with good DO management in aerobic reactors/aerobic time without any other modification of the process setup or MLSS. e.g: for a continuous flow long, rectangular aerobic reactor we usually recommend 0.5-0.8 mg/l of DO at the entrance of the reactor, 1.2-1.8 mg/l at the middle of the reactor in length, while 1.8-2.6 mg/l at the end of the aerobic reactor (values may differ on raw wastewater type and reactor layout). There is always an option to maximize TN removal capacity, in order to get really low effluent TN concentrations. In this case we recommend a gradual increase of MLSS after the 4th week of Bioclean TM treatment. The maximum concentration of MLSS in the system is defined by multiple factors like aeration system's



capacity, reactor volumes, recirculation rates, hydraulic load of the secondary clarifiers, in case of SBR's the surface area of the reactors. In most cases the recommended increase is between 10-50%. e.g if a plant runs with 4 g/l of MLSS before our Bioclean TM treatment, depending on customer's expectation for effluent TN values, MLSS should be slowly increased to 5-5.5 or even to 6 g/l (if system parameters allow that increase) in 2 months. In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM!

## BOOSTING BIO-P REMOVAL STEP, DECREASING FERRIC OR ALUM USAGE BY 40-100% AT ACTIVATED SLUDGE WWTP'S

Bioclean TM is available for the intensification of Biological Phosphorus Removal (Bio-P) at every WWTP, where the technological and environmental conditions are given for this biological process in space or time (Dissolved Oxygen-free and Nitrate-free environment, continuously stirred tank reactor, presence of readily biodegradable organics in the bulk solution). By the improvement of the Bio-P bacteria's metabolism, Polyphosphate formation can be boosted by Bioclean TM in the anaerobic reactor (or anaerobic time in case of SBR's), as



well as the excess Phosphorus uptake rate in the aerobic zone (or aerobic time in case of SBR's). A well-executed bioaugmentation with Bioclean TM ensures Total Phosphorus concentrations constantly well below 1.0 mg/l in the effluent without any addition of Ferric or Alum salts. In case of those WWTP's where the load varies at a high range, which has a negative effect on the floc structure of the activated sludge, the performance of Bio-P removal is not stable. By the application of Bioclean TM in such variably loaded WWTP's Ferric or Alum addition cannot be avoided but can be significantly reduced by 40-80% compared to the amount used before the bioaugmentation. We recommend the following dosage, and operational setup to maximize Bio-P removal at your plant:

### START THE DOSAGE OF BIOCLEAN TM

Week 1: 2-4 ppm per day

Week 2: 0.5-2 ppm per day

Week 3: 0.25-1 ppm per day

Onwards: 0.10-0.25 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

Regarding the operational setup of the WWTP a healthy DO management in the aerobic zones/time is always welcome for adequate Bio-P removal. e.g: for a continuous flow long, rectangular aerobic reactor we usually recommend 0.5-0.8 mg/l of DO at the entrance of the reactor, 1.2-1.8 mg/l at the middle of the reactor in length, while 1.8-2.6 mg/l at the end of the aerobic reactor (values may differ on raw wastewater type and reactor layout). Underaeration may result inhibited excess Phosphorus uptake, while overaeration may have a bad impact on Polyphosphate formation by the inhibition of DO in the anaerobic reactor where it may come back with the recirculated sludge of the clarifiers. Hydraulic retention time in the anaerobic zones is key essential as well, it should not be below 2 hours (HRT should be calculated for raw wastewater inlet flow + recirculated sludge to the anaerobic reactor). Regarding sludge age, Bioclean TM optimized activated sludge usually gives the best result

for Bio-P removal when MCRT is between 6-20 days. After the 3rd week of Bioclean™ treatment, we usually recommend a slight increase in MLSS and sludge age (5-15%) compared to the parameters the system operated at before. In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean™!

## EFFLUENT QUALITY OPTIMIZATION AND BIOLOGICAL TREATMENT CAPACITY INCREASE OF OVERLOADED WWTP'S (ORGANIC, NUTRIENT REMOVAL AND NITRIFICATION BOOST) AT ACTIVATED SLUDGE, AND FIXED FILM WWTP'S, FACULTATIVE, AND AERATED WASTEWATER LAGOONS

Bioclean™ is a solution for the owners, and operators of municipal, and industrial WWTP's to increase the biological treatment capacity of their plant without high cost investments. Bioclean™ is able to increase the plant's treatment capacity by 20-30% by only interacting in the biological step of the process. Bioclean™ treatment modifies the microbial community in a way that the WWTP will be able to treat way higher load than before. By the application of Bioclean™ bad settleability of the activated sludge due to pin floc formation or EPS abundance can be adjusted. As a result, sludge washout from secondary clarifiers can be stopped or it will decline significantly. The effluent parameters of the overloaded plant can be optimised, moreover they may be brought down below the mandatory limits with trouble-free operation (COD, BOD, TSS, NH<sub>4</sub>-N, TN, TP). The process of nitrification in the activated sludge is usually hurt or stopped by overload. By Bioclean™ treatment the nitrifying ability of the overloaded plant can be optimised or even can be totally restored.



### START THE DOSAGE OF BIOCLEAN™

Week 1: 4-6 ppm per day

Week 2: 2-4 ppm per day

Week 3: 1-3 ppm per day

Week 4: 0.5-2 ppm per day

Week 5: 0.5-1 ppm per day

Week 6: 0.5-1 ppm per day

Onwards: 0.25-1 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge or fixed film reactor.

1) Most of overloaded plants struggle with DO balance of the aerobic reactor. If you experience lack of Dissolved Oxygen in your system despite your blowers run at maximum frequency for at least 80% of the day, then DO is not sufficient due to overload. After the 3rd or 4th week of Bioclean™ treatment you will see that DO values are rising in the aerobic reactors, and effluent quality starts to improve. At this stage of the treatment, you also may observe a decent improvement in activated sludge settleability, a drop in SVI. COD, BOD, TSS, TP values are about to drop after the first 3 weeks of treatment.



2 a) If nitrification is not a concern, or it works fine, go ahead with 2 b). If nitrification is problematic at your plant, and you would like to kickstart it, turn off the internal (Nitrate) recirculation now, and let it off for some weeks. Only the external recirculation from the clarifiers should operate, and the Bio-P recirculation from anoxic to anaerobic, if you have such. In case of SBR's turn off anoxic times, and go for fill&aerate, full aeration, settling, decanting mode.

2 b) We usually recommend nearly all of our clients to maximize the effect of Bioclean TM treatment by decreasing sludge removal a bit, and let MLSS rise to a level where the hydraulic load of the secondary clarifiers do not struggle, and DO balance of the system runs at optimum.

The maximum hydraulic load of the clarifiers can be computed by this equation:

$$\text{Maximum Hydraulic Load of the clarifiers (MHL)} = (Q_{\text{max}} + Q_{\text{ext.rec}}) * \text{MLSS} / A$$

$Q_{\text{max}}$ : maximum inlet flow in m<sup>3</sup>/d (rainy weather inlet for municipal WWTP's, production maximum for industrials)

$Q_{\text{ext.rec}}$ : Total summarized recirculation from the secondary clarifiers to the first part of the system in m<sup>3</sup>/d

MLSS: Mixed Liquor Suspended Solid (usually referred to as activated sludge) concentration in g/l

A: Total summarized area of the secondary clarifiers in m<sup>2</sup>

The value of MHL should preferably not exceed 100-110 kg/m<sup>2</sup>d for a healthy sludge structure. When sludge structure is compromised, the value should be even lower. Sludge washout must be prevented.

2 c) The other defining factor is the optimal DO balance. Once you start to let MLSS rise, you must have a closer look at DO values at an overloaded plant. Considering no frequency variations (same amount of air flows in the aerobic zones), and the same cumulative load, you need to stop MLSS rise at a level when DO values in the aerobic reactor starts to deteriorate. At this point decrease MLSS by 200-400 mg/l, and maintain that level.

If you manage to reach a healthy sludge age and DO due to Bioclean TM treatment rises above 0.8-1.0 mg/l for the second half of your aeration chamber, you have a good chance to restart nitrification.

3) After week 6, if nitrification is restored completely, you can turn on internal (Nitrate) recirculation with a ratio of 1-2 (recirculation flowrate should be the same to double like your average inlet is in m<sup>3</sup>/d).

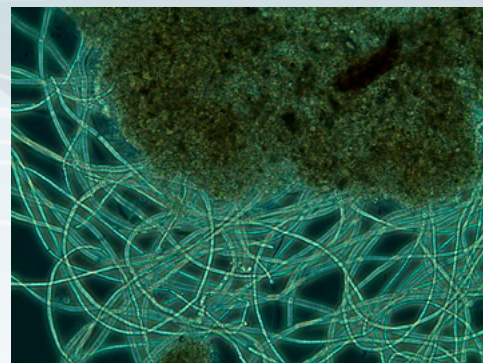
In case of heavy overloaded plants: after week 6 of Bioclean TM treatment, if nitrification is partial, Ammonium concentration is above 1 mg/l but Nitrate concentration goes high, you may observe denitrification in the secondary clarifiers if they are oversized, which could cause rising sludge, and sludge washout. In this case internal recirculation should be turned on as well with a ratio of 1, and MLSS should be decreased by 10-20%.

In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM!

If nitrification cannot be restored even with Bioclean TM (extreme overload), please contact us. There is a solution for restoring nitrification in an unfavourable environment for autotrophic generic nitrifiers by using our heterotrophic nitrifiers ([Ammonia Guard](#)).

## FILAMENTOUS BLOOMING CONTROL AT ACTIVATED SLUDGE WWTP'S

Abundance of filamentous bacteria has a negative impact on the floc structure of the activated sludge, especially settleability of the flocs, which can lead to sludge washout from the secondary clarifiers. Sludge washout is an unwanted phenomenon because it results serious deterioration of effluent quality in case of multiple parameters. Filamentous blooming also has adverse effect on operational conditions of the plant by the foam and scum formation on the biological reactors and on the surface of secondary clarifiers. Causes of filamentous blooming can be multiple: quick rise or drop in the temperature of the bioreactors, seasonal turn of the biology in autumn and spring, underload or overload, high readily biodegradable organic fraction in the influent COD, high fat, oil or grease (FOG) load, lack of macronutrients, micronutrients or trace elements in the influent.



Bioclean TM bioaugmentation is a chemical-free solution for filamentous blooms, and their prevention. By treating your activated sludge with Bioclean TM, you get a broad range of all-natural, GMO-free microbe species to act as a competition for food with the filamentous bacteria, and are able to outpace them, and keep them at bay.

By Bioclean TM bioaugmentation, the seasonal turns of your activated sludge will also become easier for the operator.

### START THE DOSAGE OF BIOCLEAN TM

Week 1: 2-4 ppm per day

Week 2: 0.5-2 ppm per day

Week 3: 0.25-1 ppm per day

Onwards: 0.10-0.25 ppm per day as daily maintenance dosage.

### DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge reactor.

After week 1 please revise your MLSS in your system. Either you struggle with open-floc structure forming, or bridge forming type of filamentous bacteria, you can aid the Bioclean TM process in your system by decreasing your sludge age, and MLSS gradually by 15-20% in 2 weeks' time (if cumulative load, and the technology of the plant allows that).

Bioclean TM will help you fighting against filamentous bacteria at any seasons, any water temperatures in the psychrophilic, and mesophilic range. It will not let them bloom, if you pay attention to keep a constant sludge age, ensure the necessary DO balance in your aerobic zones etc. Your system will still follow seasonal turns, you will see the SVI rise when autumn, and spring turnover comes, but the filamentous blooms will be under control.

If your aim is to run with really low SVI, and very low filamentous count even at wintertime, please check [Bioclean ALPHA!](#)

In case of plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM!



# BIOTECHNOLOGICAL INTENSIFICATION OF FAT, OIL, AND GREASE (FOG) BREAKDOWN AT ACTIVATED SLUDGE WWTP'S

High FOG load in raw wastewater influent can happen frequently in municipal and industrial wastewater treatment plants, which means the activated sludge has to cope with a higher, and different organic load. This can deteriorate the sludge structure, or it can cause filamentous bacteria blooming, which can lead to effluent violations, and operational issues. By Bioclean™ treatment the FOG biodegradation capacity of the activated sludge can be improved to level where the extra FOG load is biodegraded by the activated sludge without hurting its structure or microbial composition.



extra FOG load is biodegraded by the

## START THE DOSAGE OF BIOCLEAR™

Week 1: 4-6 ppm per day

Week 2: 2-4 ppm per day

Week 3: 1-3 ppm per day

Week 4: 0.5-2 ppm per day

Week 5: 0.5-1 ppm per day

Week 6: 0.5-1 ppm per day

Onwards: 0.25-1 ppm per day as daily maintenance dosage.

## DOSING LOCATION

primary treated influent wastewater entering the bioreactors, or first activated sludge or fixed film reactor.

The operational setup of your WWTP does not need too many modifications to execute better FOG removal with Bioclean™. You need to keep an eye on sludge age, we normally recommend to maximize sludge age according to your limits in hydraulic load of the secondary clarifiers, while maintaining good DO balance in the aerobic reactors, and avoiding the increase in filamentous count.

## AEROBIC, AND COMBINED LEACHATE TREATMENT

There are multiple solutions developed for the biological treatment of leachate formed in landfills: the most widespread technologies are the conversion of the leachate pond to a biological pond system by applying surface or submerged aeration, and the activated sludge leachate treatment systems. Either way, in most of the cases, there is a need for the optimization of the effluent parameters since the treatment capacity of the system has serious limitations due to the nature of the raw water: leachate mostly contains high amount of rotten organic substances, but also can have high heavy metal concentration, as well as high salinity. All above mentioned are serious inhibition factors for the biology, and can adversely affect treatment efficiency of the system.



Bioclean™ is usually used for the improvement of treatment capacity, and effluent parameters. By the application of Bioclean™ we are able to optimize the microbial content of the system by introducing microbes which have higher tolerance towards the inhibitory substances mentioned above. As a result, the biological treatment system

will have a population of bacteria which will be able to reduce the pollutant concentrations in the leachate way better than the generic microbial system could do before.

### START THE DOSAGE OF BIOCLEAR™

Week 1: 6-14 ppm per day

Week 2: 5-8 ppm per day

Week 3: 4-6 ppm per day

Week 4: 3-5 ppm per day

Week 5: 2-3 ppm per day

Week 6: 1-2 ppm per day

Onwards: 0.5-2 ppm per day as daily maintenance dosage.

If you operate a pond or pond system without activated sludge, you have nothing else to do than keeping the dosages of Bioclean™, and providing as much Dissolved Oxygen, and adequate mixing in the system as possible.

If you operate an activated sludge or fixed biofilm system for your leachate treatment, please read below:

### DOSING LOCATION

influent leachate entering the bioreactors, or first activated sludge or fixed film reactor.

1) If you experience lack of Dissolved Oxygen in your system despite your blowers run at maximum frequency for at least 80% of the day, then DO is not sufficient due to overload. After the 3rd or 4th week of Bioclean™ treatment you will see that DO values are rising in the aerobic reactors, and effluent quality starts to improve. At this stage of the treatment, you also may observe a decent improvement in activated sludge settleability, a drop in SVI. COD, BOD, TSS, TP values are about to drop after the first 3 weeks of treatment.

2 a) If nitrification is not a concern, or it works fine, go ahead with 2 b). If nitrification is problematic at your plant, and you would like to kickstart it, turn off the internal (Nitrate) recirculation now, and let it off for some weeks. Only the external recirculation from the clarifiers should operate, and the Bio-P recirculation from anoxic to anaerobic, if you have such. In case of SBR's turn off anoxic times, and go for fill&aerate, full aeration, settling, decanting mode.

2 b) We usually recommend nearly all of our clients to maximize the effect of Bioclean™ treatment by decreasing sludge removal a bit, and let MLSS rise to a level where the hydraulic load of the secondary clarifiers do not struggle, and DO balance of the system runs at optimum.

The maximum hydraulic load of the clarifiers can be computed by this equation:

$$\text{Maximum Hydraulic Load of the clarifiers (MHL)} = (Q_{\text{max}} + Q_{\text{ext.rec}}) * \text{MLSS} / A$$

$Q_{\text{max}}$ : maximum inlet flow in m<sup>3</sup>/d (rainy weather inlet for municipal WWTP's, production maximum for industrials)

$Q_{\text{ext.rec}}$ : Total summarized recirculation from the secondary clarifiers to the first part of the system in m<sup>3</sup>/d

MLSS: Mixed Liquor Suspended Solid (usually referred to as activated sludge) concentration in g/l

A: Total summarized area of the secondary clarifiers in m<sup>2</sup>

The value of MHL should preferably not exceed 100-110 kg/m<sup>2</sup>d for a healthy sludge structure. When sludge structure is compromised, the value should be even lower. Sludge washout must be prevented.

2 c) The other defining factor is the optimal DO balance. Once you start to let MLSS rise, you must have a closer look at DO values at an overloaded plant. Considering no frequency variations (same amount of air flows in the aerobic zones), and the same cumulative load, you need to stop MLSS rise at a level when DO values in the aerobic reactor starts to deteriorate. At this point decrease MLSS by 200-400 mg/l, and maintain that level.



If you manage to reach a healthy sludge age and DO, due to Bioclean TM treatment rises above 0.8-1.0 mg/l for the second half of your aeration chamber, you have a good chance to restart nitrification.

3) After week 6, if nitrification is restored completely, you can turn on internal (Nitrate) recirculation with a ratio of 1-2 (recirculation flowrate should be the same to double like your average inlet is in m<sup>3</sup>/d).

In case of heavy overloaded or inhibited plants: after week 6 of Bioclean TM treatment, if nitrification is partial, Ammonium concentration is above 1 mg/l but Nitrate concentration goes high, you may observe denitrification in the secondary clarifiers if they are oversized, which could cause rising sludge, and sludge washout. In this case internal recirculation should be turned on as well with a ratio of 1, and MLSS should be decreased by 10-20%.

In case of activated sludge systems where the inhibition in the raw leachate is massive, and activated sludge settleability is compromised, or plants running with generally high MLSS, and sludge age, or extremely high MLSS, and sludge age (UF membrane systems), please contact us for further assistance, also please [contact us](#) for Complete Process Engineering Assistance service to extract the most of your WWTP with Bioclean TM!

If nitrification cannot be restored even with Bioclean TM (extreme overload), please contact us. There is a solution for restoring nitrification in an unfavourable environment for autotrophic generic nitrifiers by using our heterotrophic nitrifiers ([Ammonia Guard](#)).