

## Bioremediation of Lake Bánk

Lake Bánk, owned by Municipality of town Bánk, is 8 ha in area and 4 m in depth. The tourism value of the lake is irreplaceable for town Bánk. The bioremediation process of the lake begun in July 2007, and the treatments are still going on. The lake gets 4 treatments each year, the biotechnological products applied are Bioclean™ Lake/Pond Clarifier, and Bioclean Aqua.

Besides the bioremediation, SolarBee solar powered water circulating application was installed on the lake.

Circulation and aeration of the lake intensifies the metabolism of microbes in the lake, and thus, also the nutrient-removal processes. Water circulation provides oxidative circumstances, that reduces the number of blue-green algae and pathogen species.

The ecological status assessments before the bioremediation begun have shown a highly

euthrophic status of the lake. The concentration of nutrients, due to infiltrations from the surrounding agricultural areas, were high. Unfortunately the problem of infiltrations is still present.

Before the treatments, the concentration of Ortrophosohate was above 0,2 mg/l. As this is the most typical limiting factor of eutrophication processes, reducing its concentration was extremely important. High relative level of Ortrophosphate makes algae the typical form of plants in the water.

Before the treatment, the algae number of Lake



Figure 2.: Bioremediation treatment process

was measured as high as 18 000 000 individuals/ml, that means the water was highly euthrophic. In terms of the treatment it was lucky that the treatments begun before the summer algae blooms, so it could successfully be avoided already in the first year of the treatments.

pH value of the water is normally under 9, but sometimes, due to the changing of the environmental conditions (like in 2008), it rises above 9. When the pH is above 9, blue-green

algae species become dominant in the water. These species have an adverse effect on the water's oxygen and nutrient balance, and many of these species produce toxins.

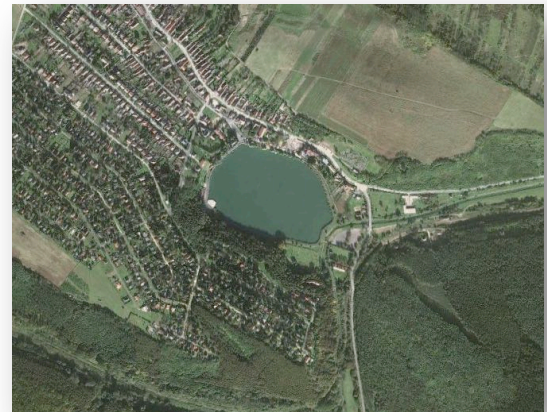


Figure 1. : Satellite image of Lake Bánk (Google Earth)



Figure 3.: SolarBee on Lake Bánk

Installation of SolarBee water circulating unit helps preventing blue-green algae dominance. The constant water exchange between the water surface and deep water, causes aeration. Providing an adequate oxygen balance in the water body prevents the development of circumstances that put blue-green algae into a status of competitive advantage.

Before the treatments began, anaerobic and organic-rich conditions in the lake provided optimum conditions for pathogenic bacteria to bloom. Pathogen number of the lake was quite high, with E. coli number of 250 CFU/ml, and Enterococcus number of 250 CFU/ml. After the treatments began and SolarBee was installed, pathogen numbers decreased rapidly. Heterotrophic microorganisms in the applied Bioclean products are successful nutrient competitors of pathogens. This, and the improving water quality of Lake Bánk lead to pathogen numbers as low as 20 CFU/ml for E. coli and 70 CFU/ml for Enterococcus in one month's time. This made the lake perfectly suitable for recreational activities like swimming and angling. As a result, Lake Bánk now functions as a popular beach and angler's lake, visited by many tourists from Hungary and the surrounding countries.

### Results:

Due to the intensified nutrient-removal processes, Orthophosphate concentration was reduced to under detection limit in a year's time. This helps the limitation of eutrophication processes.

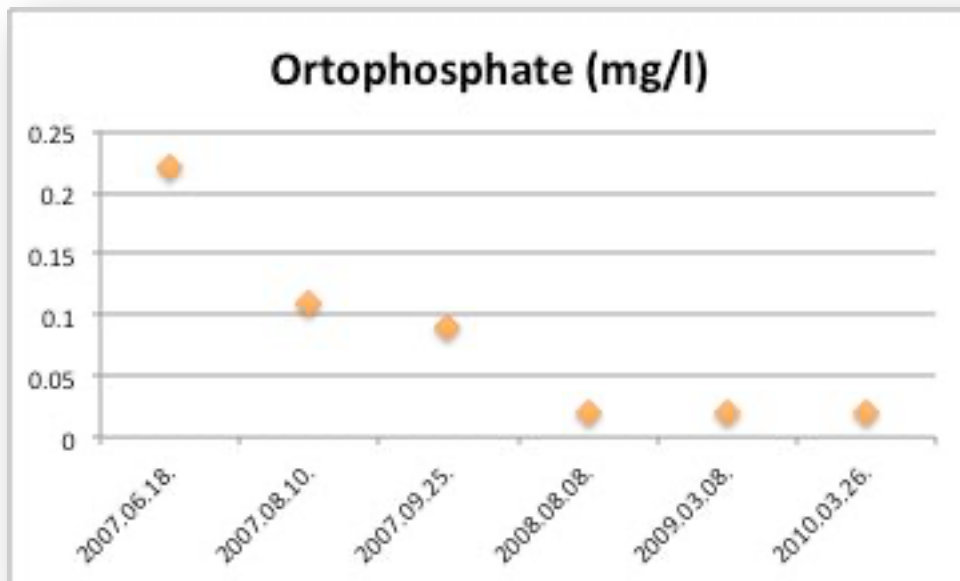


Figure 4. : Changing level of Ortophosphate

The average level of Ammonium also decreased.

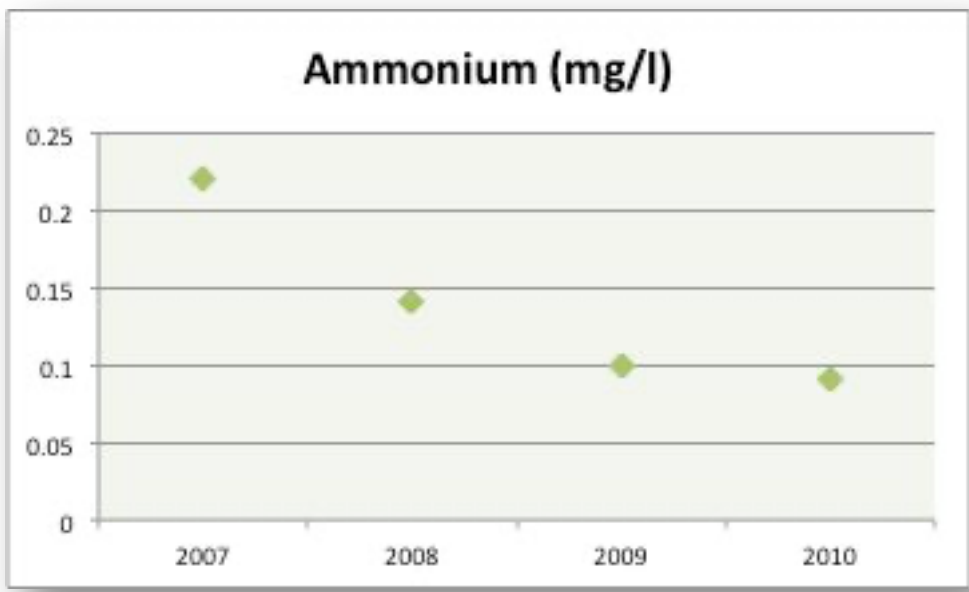


Figure 5. : Changing level of Ammonium

Reduction of nutrient level limits algae blooms. The next diagram shows the changing of algae number measured in water samples from Lake Bánk.

Not only the number of algae, but also the species composition have changed in a favorable way: since 2010, blue-green algae haven't been detected as a dominant taxa in the water.

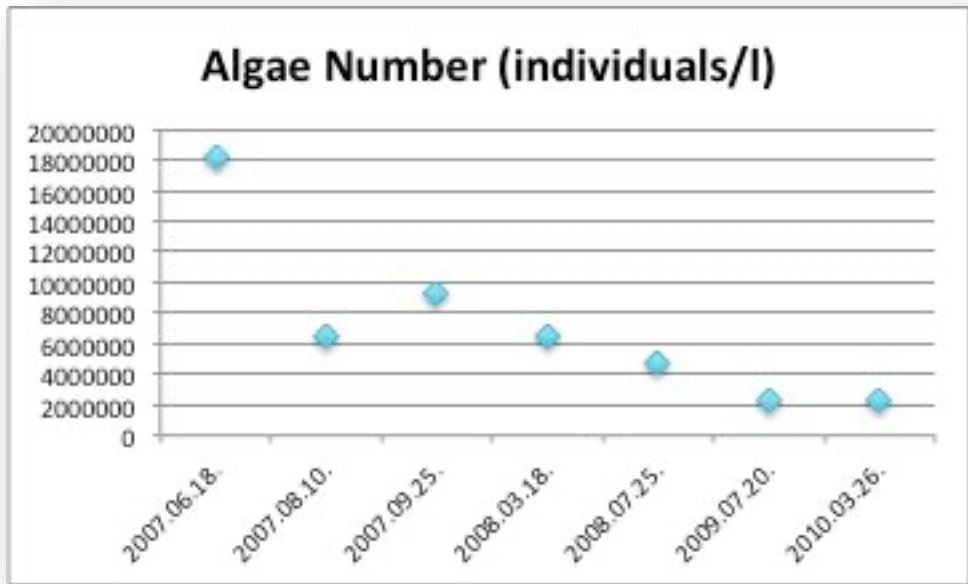


Figure 6.: Changing algae number in the water

Microorganisms in Bioclean™ Lake/Pond Clarifier, intensified by the aeration, decompose the organic fraction of sludge fast. The following diagram shows how the average level of sludge was reduced.

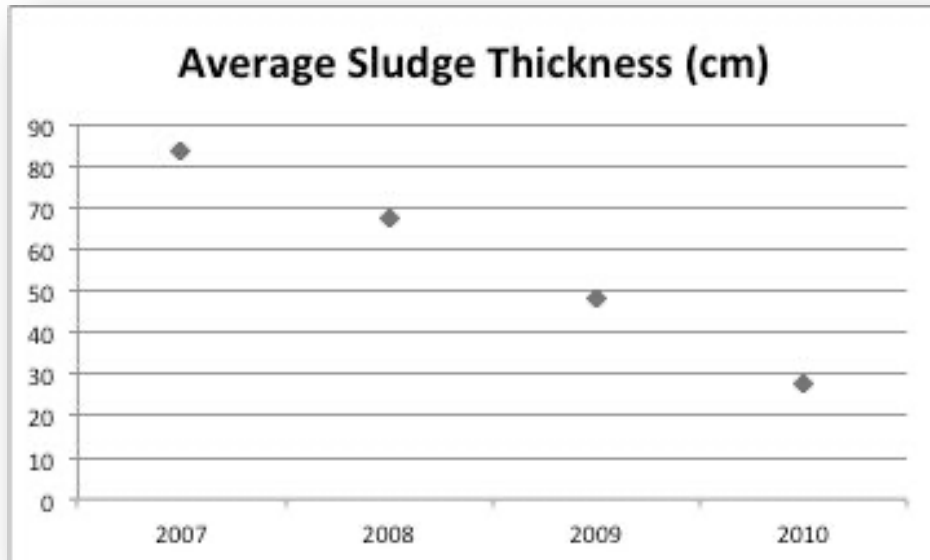


Figure 7.: Changing average level of sludge in the water

As it was previously described in details, number of pathogenic microorganisms decreased significantly due to the treatments and the aeration.

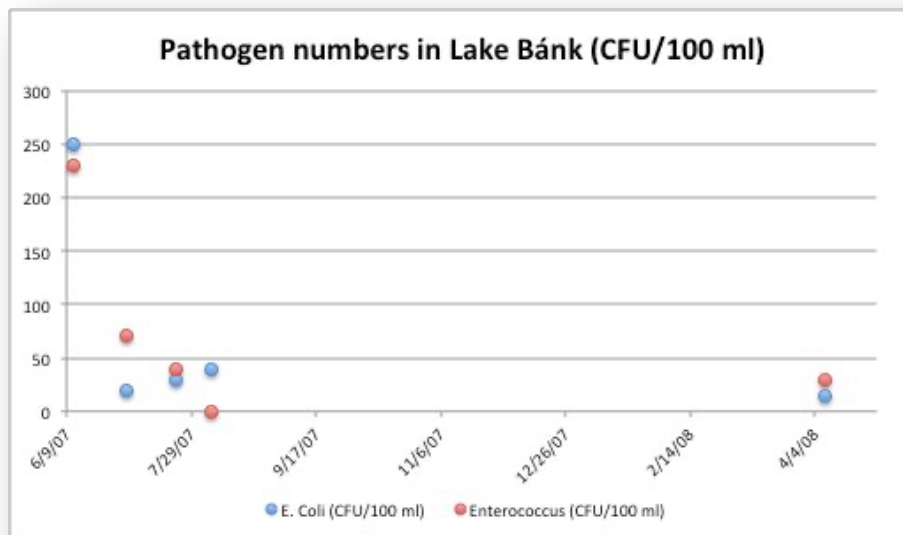
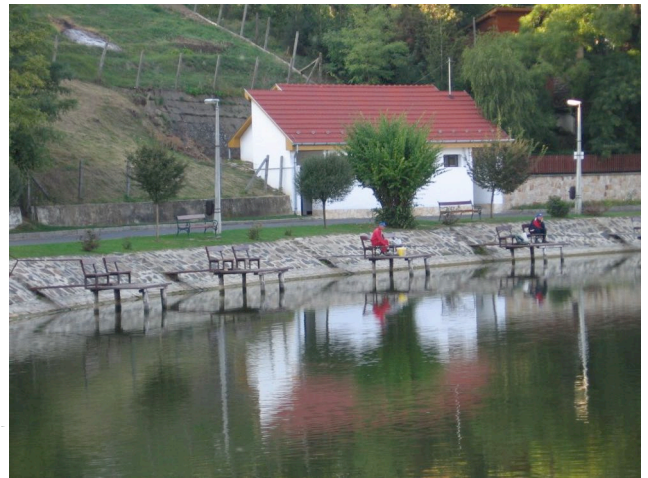


Figure 8.: Pathogen number in Lake Bánk

Stabilization of the sedimentation provides better circumstances for fish and macro-invertebrates.



**Figure 8.: Lake Bánk before and after the treatments**