



After-LIFE Communication Plan

Innovative Technology For Cyanobacterial Bloom Control

LIFE 12 ENV /SI/000783 LIFE Stop Cyanobloom



Project context and aims

The project LIFE Stop CaynoBloom "Innovative technology for cyanobacterial bloom control", took place between July 2013 and December 2016. The focus of the project were cyanobacteria in freshwater systems, demonstration, and optimisation of equipment for their in-lake monitoring and control.

The primary goal of the project was to demonstrate the operation of two robotic vessels with accompanied boathouses and docking stations in two freshwater bodies with a different pattern of cyanobacteria occurrence. The aim of the vessels` operation was to enable early on-line detection and differentiation of cyanobacteria from the rest of the phytoplankton in the water and to prevent further unwanted cyanobacteria proliferation directly in the lake without the addition of chemicals. For this purpose, electrolytic cell was used, producing hydroxyl radicals, which are strong oxidants, directly from water.

Main results

During the 42 months of the project, we established two boathouses with automatic docking stations and two robotic vessels with accompanying equipment. A two-year operation of the vessels has been accomplished in which we optimised the navigation and information system for on-line measurements and remote control, as well as software for measured data transfer, analysis and presentation. Simultaneous use of submersible phycocyanin and chlorophyll fluorescence sensors in continuous flow monitoring chamber proved to be an appropriate solution for on-site and on-line detection and quantification of cyanobacteria. With several different size scale controlled experiments performed in the laboratory and natural environment, we managed to demonstrate selective activity of electrochemical oxidation on cyanobacteria, preventing their further proliferation and enabling controlled release and inactivation of cyanotoxins.

The results confirmed that combined use of fluorescence sensors would significantly reduce the required number of complex and costly laboratory analyses of extraction of photosynthetic pigments and determination of phytoplankton biovolume, which are used to define the eutrophication status of the water body and the risk of blooms of cyanobacteria. At the same time, on-line monitoring would provide spatially and a temporally accurate picture of the phytoplankton development in the water body. This is for example of high importance for a commercial fish ponds, accumulations for abstraction of drinking water or bathing waters, where regular and real-time information is needed to provide fast respond in case of unwanted cyanobacterial occurrence.

Future communication activities

Website

Arhel will cover the costs and further maintain the website, at least three years after the end of the project with its resources. The website will be upgraded with reports on new promotional activities, published results and information for acceleration of commercialization. The website visits will be tracked to adjust the products and services to market needs.

Long term monitoring indicators: more than 50 visits to the website each month; increase the visits from other countries besides Slovenia

Scientific Publications

At least one more article will be submitted to Peer reviewed journal in 2017 with the results of the performed on-line monitoring activities and cyanobacterial control with electrochemical oxidation. Arhel and partnering institutions on the publication will share the publication costs.

Long term monitoring indicators: Published scientific article three years after the end of the project: at least 1.

Oral scientific communications

Project partners will regularly track open calls for abstracts of the conferences and fairs to take the opportunity to present project results and promote the technology. The scientific meetings from the following fields will be taken into account:

- Cyanobacteria and harmful algal blooms control
- Toxicology
- Lake and reservoir management
- Commercial fishing and aquaculture
- Water and wastewater treatment
- Environmental protection

Slovenian conferences and scientific meetings will be taken into account, as well as meetings abroad. The visit of the following conferences (not exclusively) is possible:

- Second Slovenian Congress on Water = Drugi slovenski kongres o vodah, 19. – 20. April, 2017, Podčetrtek, Slovenija
- 12th SDEWES Conference Dubrovnik 2017. Conference on sustainable development of Energy, Water and Environment System, 4 – 8 October, Dubrovnik, Croatia.
- 7th Croatian Water Conference, 2018, Opatia
- Conference VIVUS, 2018, Naklo, Slovenia
- International conferences on Environmental & food monitoring: ISEAC 40, Santiago de Compostela, Spain, 2018
- Congress of Slovenian toxicology society
- Global Water Summit 2017, Apr. 24-25, 2017, Madrid, Spain
- Watec Israel 2017, Sep. 12-14, 2017, Tel Aviv, Israel, Trade Show/Exhibition,
- Aquatech Amsterdam 2017, Oct. 31, 2017 - Nov. 3, 2017

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- Sustainable Use and Management of Soil, Sediment and Water Resources; 14th International Conference, 26–30 June 2017, Lyon, France
- 11th International Conference on Toxic Cyanobacteria, 2019, Poland
- 4th IWA Symposium on Lake and Reservoir Management 2017 (IWA L&RM 2017) will be held in Shanghai, China from May 22-26, 2017.
- 29 May – 2 June 2017, XVI World Water Congress, Cancun, Mexico
- 29 May – 2 June 2017, 14TH IWA LEADING EDGE CONFERENCE ON WATER AND WASTEWATER TECHNOLOGIES Florianópolis, Brazil
- 13 June 2017, WWT 4TH ANNUAL WATER INDUSTRY ENERGY CONFERENCE Birmingham
- 5 – 9 July 2017 EWRA 2017: 10TH WORLD CONGRESS ON WATER RESOURCES AND ENVIRONMENT, Athens
- 28 – 30 August 2017, 2ND INTERNATIONAL CONFERENCE AND EXPO ON WATER MICROBIOLOGY & NOVEL TECHNOLOGIES: New Revolution in Water Microbiology and Technology for Sustainable and Safe Future Philadelphia, USA
- 3 – 4 October 2017 11TH EUROPEAN WASTEWATER MANAGEMENT CONFERENCE & EXHIBITION Leeds
- 22 – 24 May 2018 WATER POLLUTION 2018: 14th International Conference on Monitoring, Modelling and Management of Water PollutionA Coruña, Spain
- 14 – 18 May 2018 IFAT: WORLD'S LEADING TRADE FAIR FOR WATER, SEWAGE, WASTE AND RAW MATERIALS MANAGEMENT Munich, Germany
- 25 – 26 June 2018 ICWPC 2018: 20TH INTERNATIONAL CONFERENCE ON WATER POLLUTION AND CONTROL Paris, France
- 15 – 19 October 2018 17TH WORLD LAKE CONFERENCE Kasumigaura, Ibaraki, Japan
- 21 – 22 November 2018 WWEM 2018: 8TH INTERNATIONAL CONFERENCE AND EXHIBITION ON WATER, WASTEWATER & ENVIRONMENTAL MONITORING Telford
- Oct 19, 2017, 7th International conference on aquaculture and Fisheries Location: Rome, Italy
- Oct 23, 2017 - Oct 24, 2017 9th World Aqua Congress 2017 Location: Dubai, UAE
- Oct 29, 2017 - Nov 1, 2017 2017 Algae Biomass Summit Location: Grand America Hotel, Salt Lake City, Utah
- VIII međunarodna konferencija Water & Fish, Poljoprivredni fakultet u Zemunu, Srbija, 2018.

Arhel and collaborating institutions presenting the technology on different events will cover the costs of conference visits.

Long term monitoring indicators: Number of the oral or poster presentation on different events in the next three years: ≥ 5

General communication

We intend to follow the following area of communication:

- In-lake on-line phytoplankton monitoring for real-time data acquisition and early warning on harmful algal blooms
- Unmanned robotic vessels for water monitoring, water sampling and in-lake manipulation
- Application of electrochemical oxidation as in-lake method for cyanobacteria and cyanotoxin control and disinfection purposes in freshwater systems (aquaculture, drinking water reservoirs, bathing waters)
- Use of electrochemical oxidation in drinking water treatment
- Application of electrochemical oxidation as the fourth stage of wastewater treatment to remove micropollutants from municipal wastewater and sewage coming from centres with higher use of pharmaceuticals (e.g. hospitals, nursing homes) or other

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micropollutants (waste water: high hydraulic loads, low mass load of pollutants) – in connection to LIFE PharmDegrade project

- Application of electrochemical oxidation as a wastewater treatment approach for industrial effluents with high contamination load of chemicals and low biodegradability, e.g. wastewater from pharmaceutical industry (wastewater: low hydraulic loads, high mass load of pollutants) – in connection with LIFE PharmDegrade project

Potential end users will be addressed by individual company visits and marketing campaigns. Articles will be written for general press and professional journals (some options are: Ekolist, WaterWorld, Water & Wastewater International, The Water Network, Aquaculture Magazine).

Long term monitoring indicators: Number of demonstrations and conversations held: ≥5. First commercial reference for in-lake cyanobacteria control in 2018.

Other dissemination activities

- Setting up a new collaborative project to continue with the development.
- We will be responsive to LIFE events in Slovenia and EU.
- Connection with Slovenian Chamber of Commerce in further replicability and transferability of the results.
- Presentation of the technological solution at Slovenian Innovation Forum, etc.

Future plans with the LIFE Stop CyanoBloom robotic vessels

It is our strong belief that the research activity should not stop at achieving the goals of the existing LIFE project. We will put our efforts to continue with the project activities with the emphasis on optimising the technology operation in different geographical environments (e.g. cold Nordic climate and warm Mediterranean climate) and for water bodies with different trophic status (oligotrophic drinking water reservoirs versus eutrophic fishponds). Further development is expected in energy optimisation of anode oxidation and selection of electrode material adapted to low water environment with low conductivity. The potential of triggering the lytic cycle with induction of proliferation of phages in treated cyanobacterial cells is planned to be evaluated.

We will look for new financial opportunities for further research and development. After presenting the achieved results, we will start with the presentations of the technology and services at identified end-users. We evaluate that the approach is suitable among others for fish ponds and aquaculture, irrigation reservoirs, lake water management for tourism purposes, drinking water abstraction and protection of endangered freshwater habitats. For the first market replication of the technology, freshwater aquaculture was planned.

Both robotic vessels will be offered into test operation to end-users looking for lake monitoring service and early direct in-lake cyanobacterial control. The vessels will be offered into use free of charge. The user will cover the operational and needed maintenance costs.

Project coordinator

ARHEL projektiranje in inženiring d.o.o.

- Application of electronics and informatics in environmental solutions.
- Development of individual solutions with a broad range of applications
- Customer-specific R&D
- Embedded program solutions
- Production and testing of final products
- Serial production
- Turnkey solutions
- Electronics, mechanics and sensors prototype development

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