



The Identification of Cell Free Phycocyanin as an Indicator of Toxin Release

- Goal:** Installation of an early warning system of dissolved cyanotoxins in waterworks (provided that the cyanobacteria are toxic)
- Method:** Identification of cell bound and dissolved (free) phycocyanin in raw water and treatment steps
- Means:** Analysis of fluorescence spectra at 650nm and 700nm

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Common project of TZW (Dr. Wido Schmidt) and bbe Moldaenke. This work was funded by the BMBF (Germany)



Experimental Conditions for a Pilot Water Treatment Plant (PWT)

Experimental conditions for pilot water treatment plant (PWT)

Filter DN 240, size: 4400 x 240 cm

Filter material:

hydroanthracite: 900 mm; diameter (DM) = 1.40 -2.25 mm

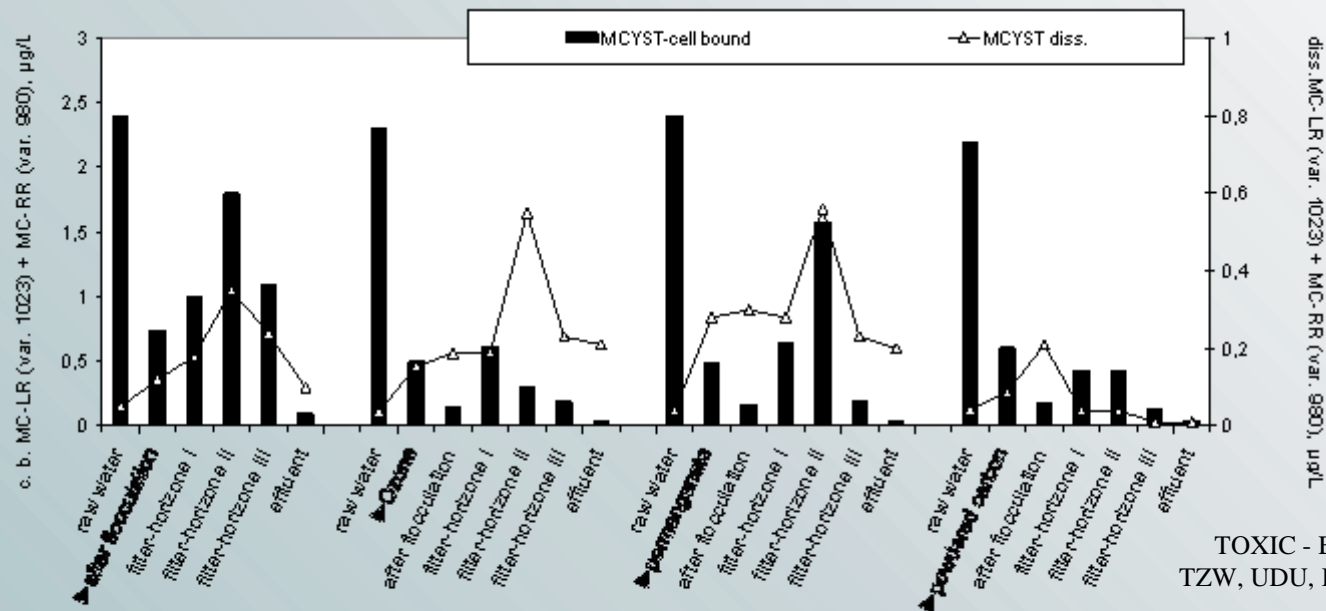
Sand: 1000 mm; DM = 0.71-1.25 mm

Gravel: 100 cm; DM = 2.00-3.15 mm

	Treatment stage	Chemical	Dose, g/m ³	Retention time in the PWT, min
			Filter size, cm	Filter material, mm
1	Flocculation	Aluminium sulphate Praestol 2540 TR	2.6 - 3.0 0.1	8
	Filtration			64
	Pre-ozonation	Ozone	0.8 - 1.0	7
2	Flocculation	Aluminium sulphate Praestol 2540 TR	2.6 - 3.0 0.1	8
	Filtration			64
	Permanganate	Potassium permanganate	0.67	7
3	Flocculation	Aluminium sulphate Praestol 2540 TR	2.6 - 3.0 0.1	8
	Filtration			64
	Powdered-activated carbon	ADSORBA- N	10	7
4	Flocculation	Aluminium sulphate Praestol 2540 TR (polyacrylamide based)	2.6 - 3.0 0.1	8
	Filtration			64



Removal in a Treatment Train: Are the Microtoxins cell-bound or dissolved?

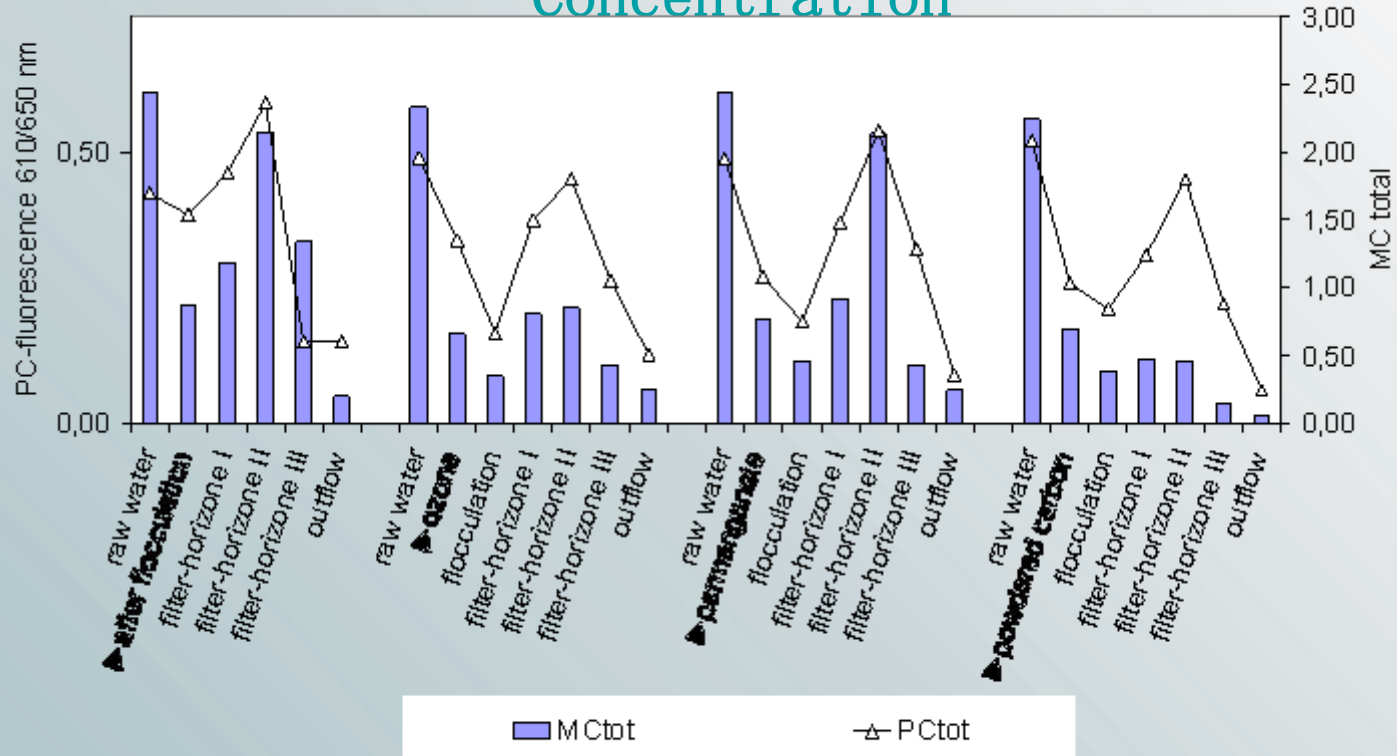


TOXIC - EVK1-2001-00182,
TZW, UDU, DHI, UEX, UAL, ULO

Differing treatment steps change the concentrations of cell-bound and free microtoxins. Free toxins are not well removed (except by treatment with powdered carbon)



Total PC in Comparison to Microcystin Concentration



The correlation is not very good...



For Waterworks Monitoring, the Identification of cell-bound and free Cyanotoxins is important

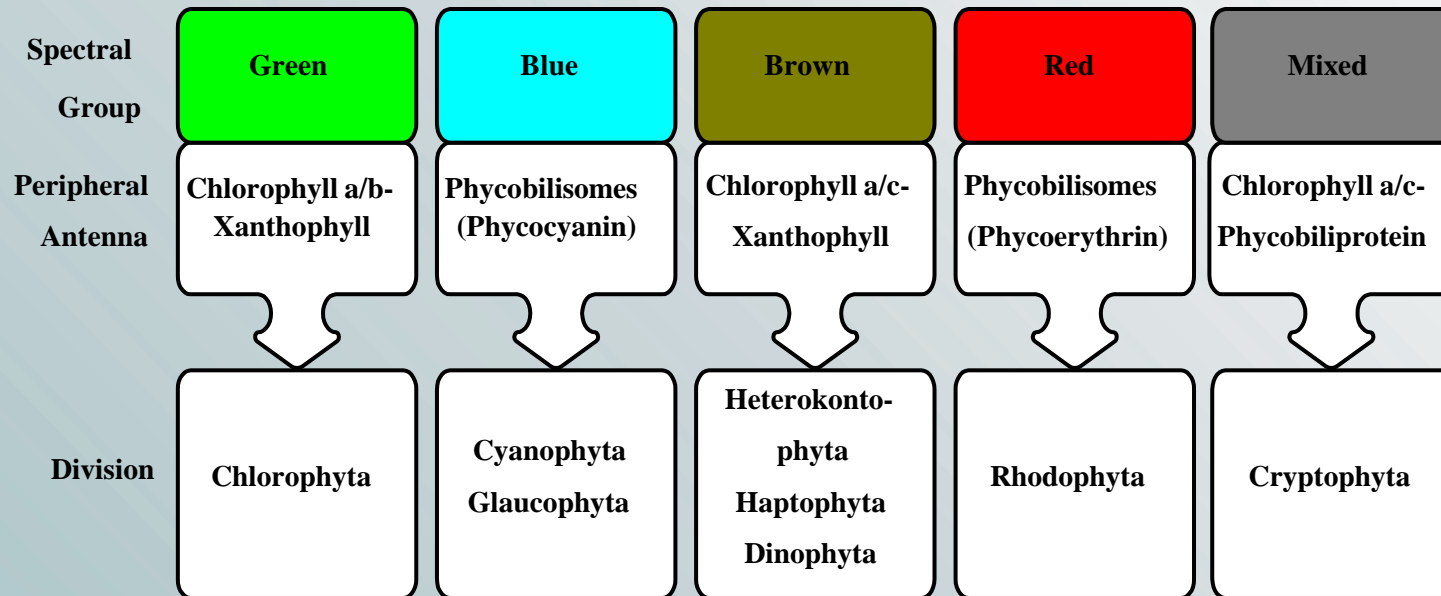
Can we obtain any automatically gathered information about the state of the algae/toxins/the release of the toxins? This would enable the operator to change the treatment in a way that fewer toxins are free-floating

A possible solution is the determination of free PC as an indicator. Free PC is Phycocyanin which has left the cells and appears in the water column as the free toxins

How to perform such a measurement?



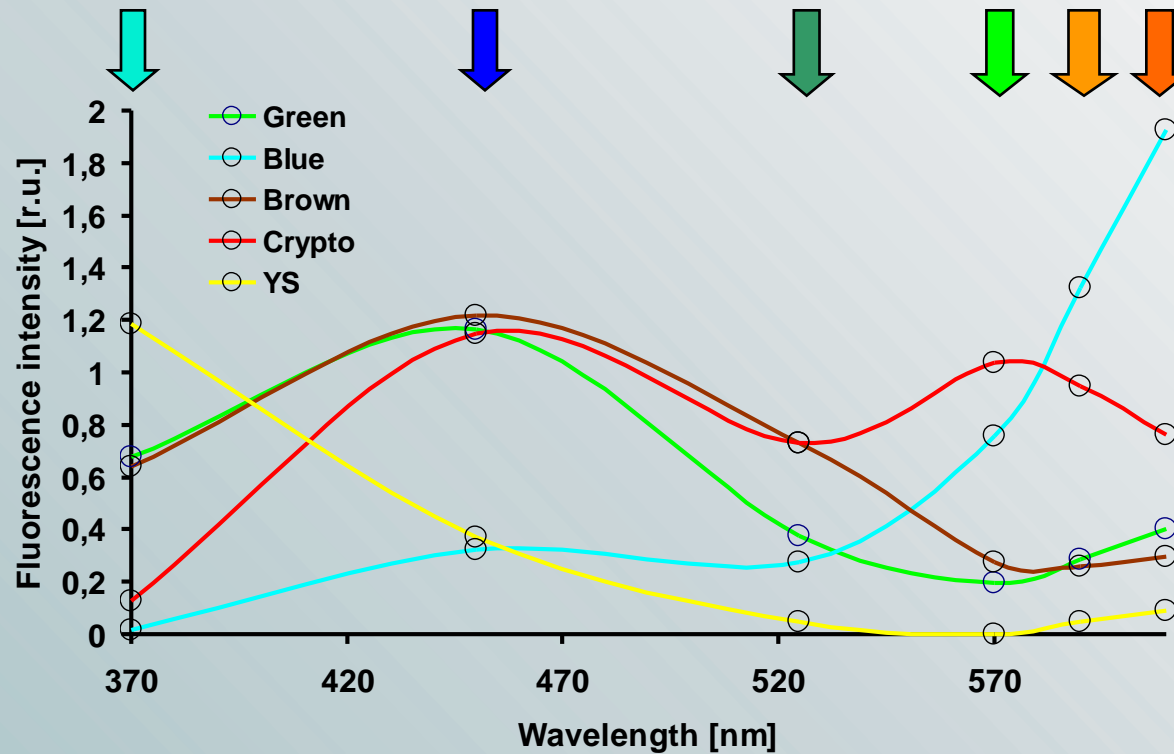
Information from Spectral Groups of Phytoplankton



Algae pigments and their relation to taxonomical algae classes

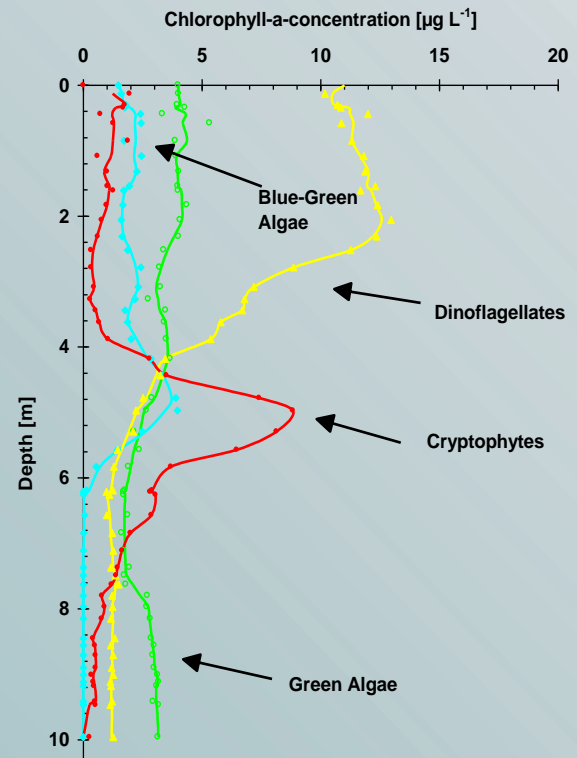


Normspectra (Fingerprints)

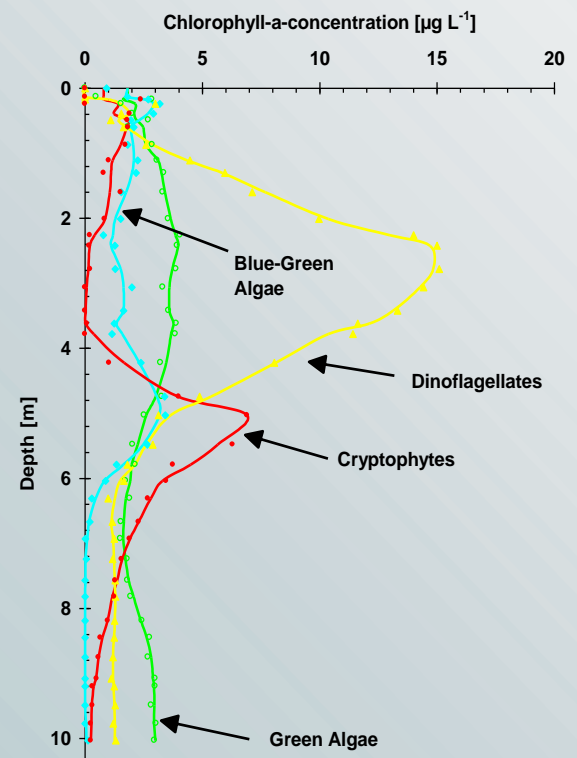




Application Example with the bbe FluoroProbe – Migration of Dinoflagellates in Eutrophic Plussee



9:30 am



2:00 pm





Instruments with Algae Class Differentiation Using Multi-Variate Analysis



FluoroProbe
Depth Profiling



AlgaeTorch
Rapid Bathing Water Analysis



AlgaeLabAnalyser
Laboratory Analysis



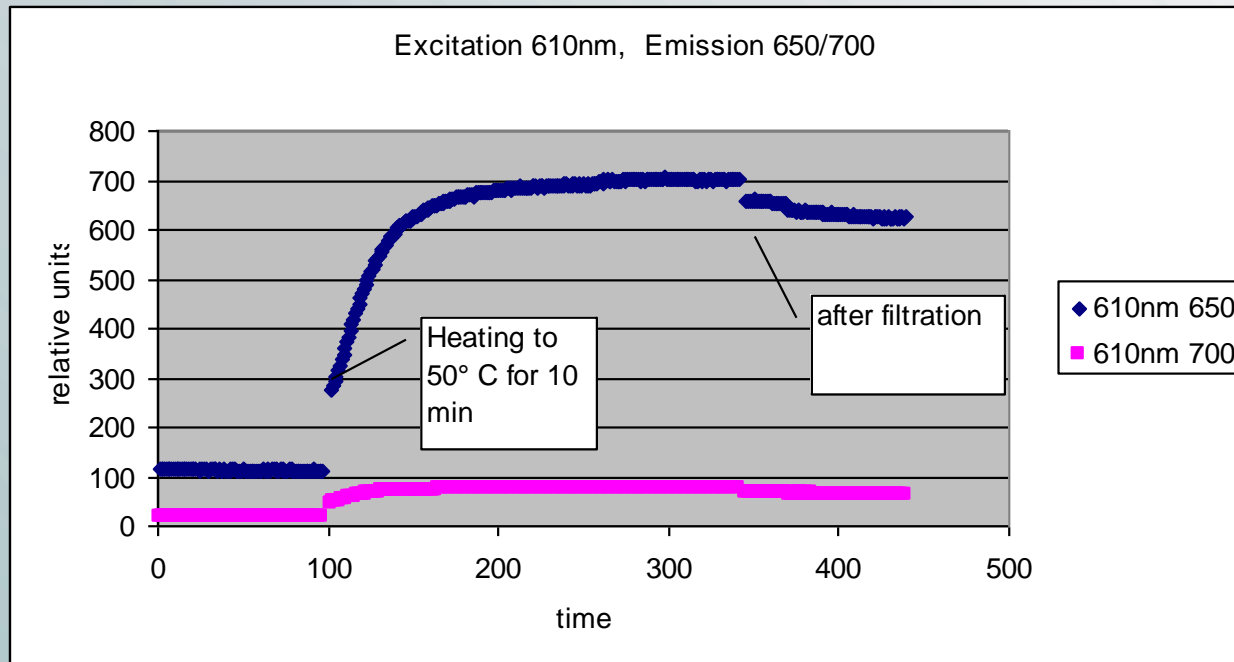
BenthoFluor
Adapter for
Benthic Algae



AlgaeGuard
Online Monitoring

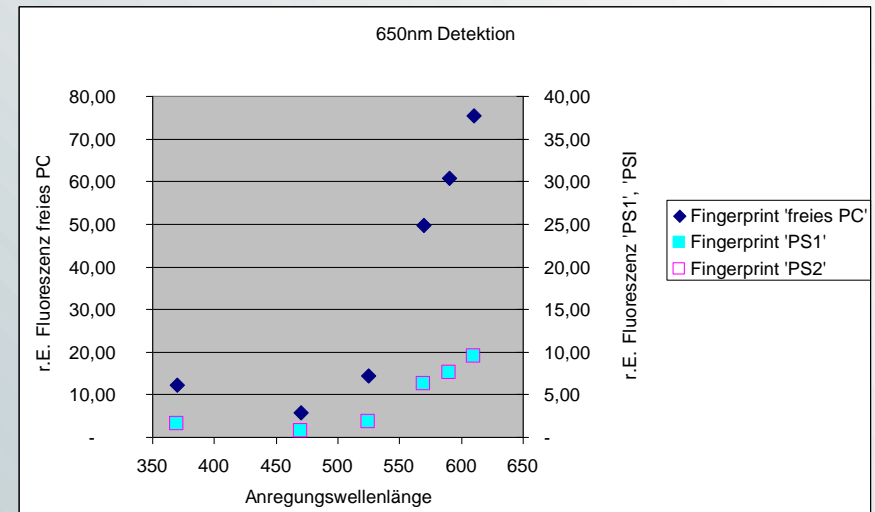
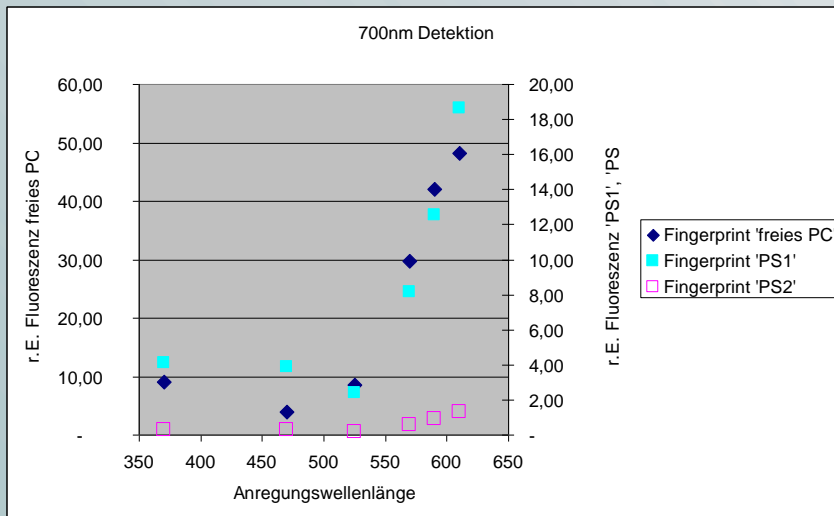


Breaking cells release free PC –
the relative fluorescence of free PC is higher
than the fluorescence of bound PC



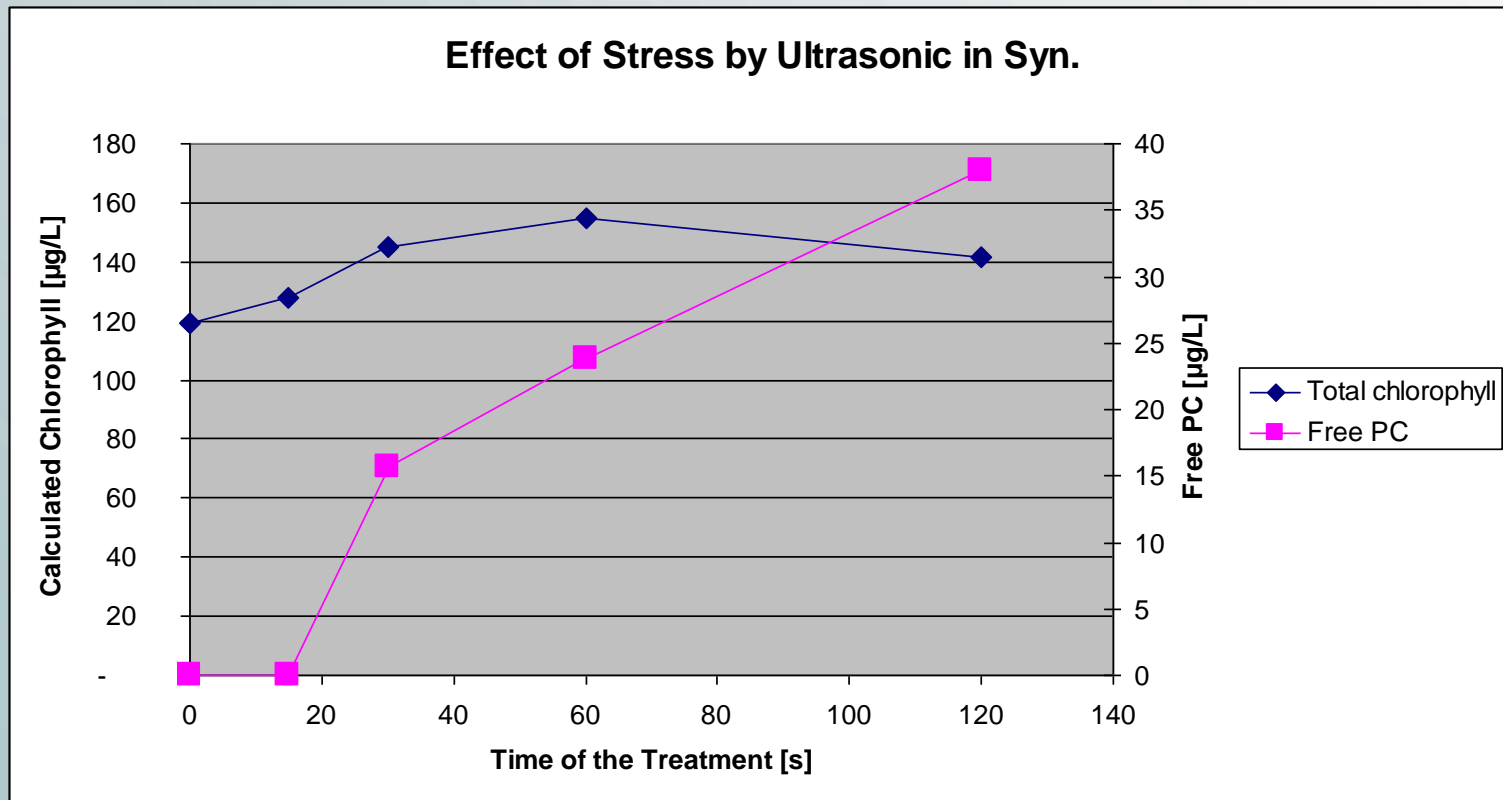


Fingerprint System of free PC, PSI-Fluorescence and PSII-Fluorescence



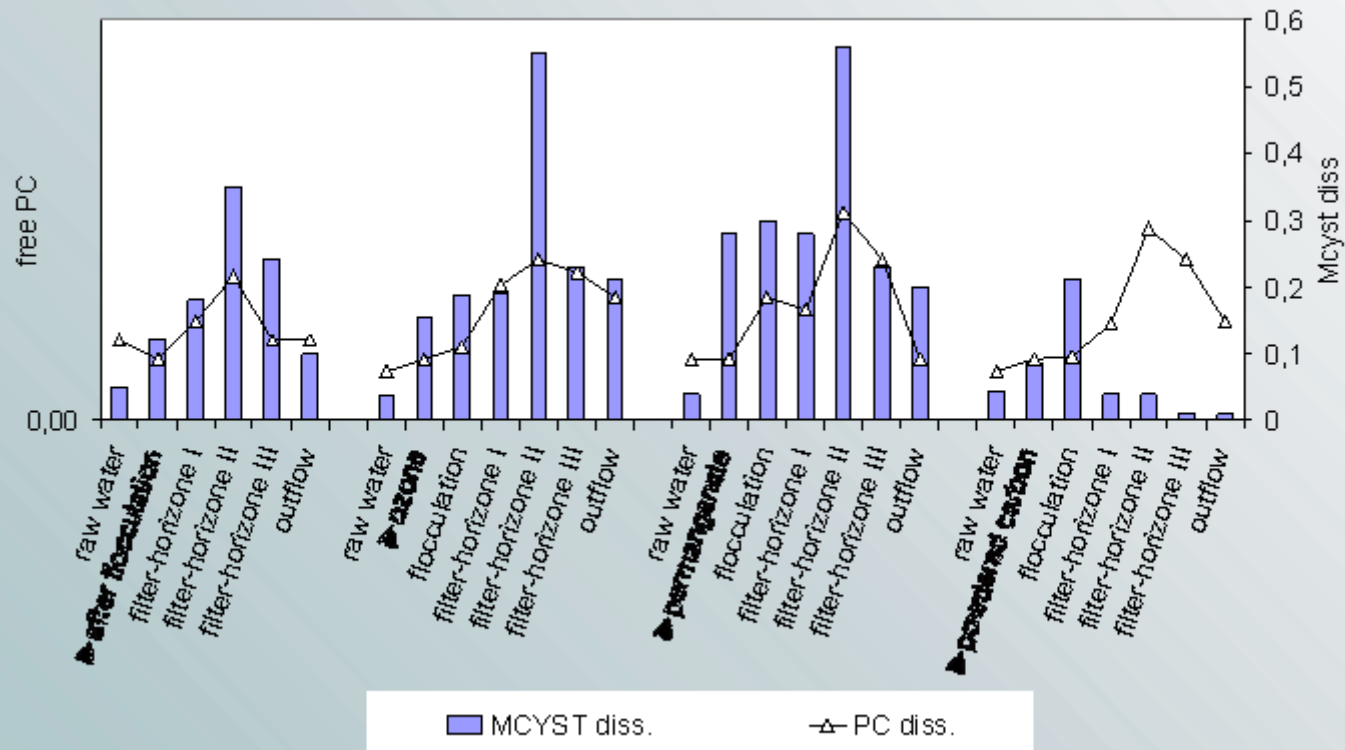


Demonstration of a transition from bound to free PC





Correlation between free PC and dissolved Microcystins





Efficiency of Free PC as an Indicator for Microtoxin Removal

	Early warning against dissolved microcystins
Chlorine (pre-oxidation, disinfection)	++
Chlorine dioxide	-
Permanganate (pre-oxidation)	++
Ozone (pre- and main-ozonation)	(+)
Powdered-activated carbon	+

- ++ efficient early warning
- + limited early warning with
- (+) not yet defined
- no early warning



Thanks for Listening!

Can it help?

Any Questions?