



bbe IO cells

***New Measuring Instrument for the
Indicative Investigation of Ballast Water***



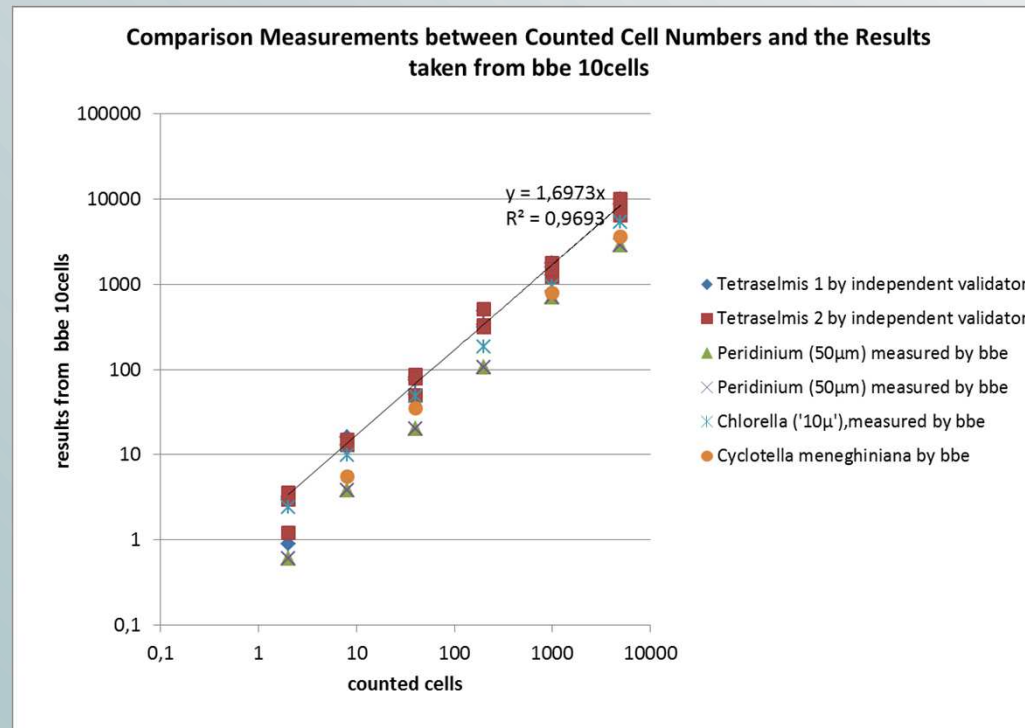


The Best First: the Advantages of bbe IOcells

- Resolution: 1-2 cells/ml
- Very simple operation
- Measurement within approx. 1 min
- Based on fluorescence (f_{variable})
- No chemicals
- No 'infection' by the sample-

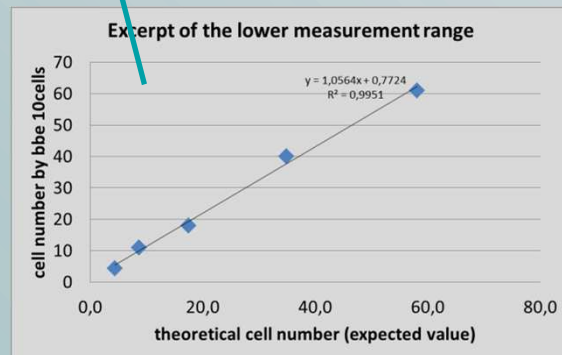
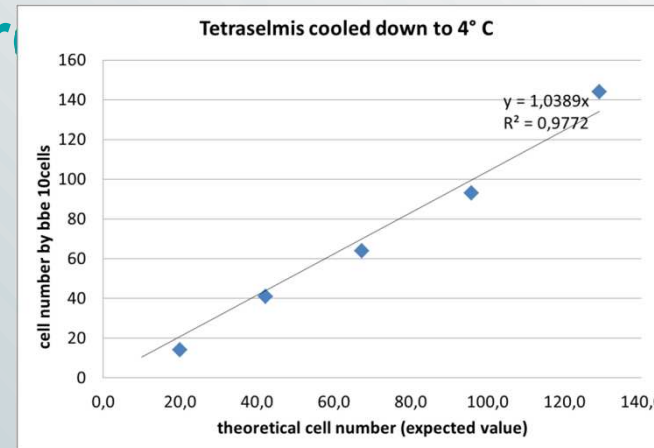
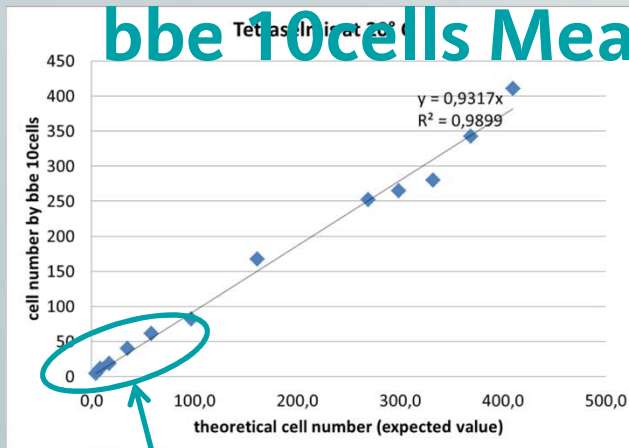


Results from Dilutions of Algae Species in the Range of 10µm - 50µm Cell Size





Hardly any Influence of the Temperature on bbe 10cells Measurement



The deviation of the slopes is less than 10% at 16° C temperature difference, and therefore within the deviation limits for repetitions at 20° C



PAM AlgaeLabAnalyser

- Measurement of the chlorophyll-a concentration by chlorophyll fluorescence
- Algae class differentiation
- Weak relation to cell numbers
- Genty





Principle of the Genty-Measurement to Detect the Activity of the Algae



$$Genty = 100 * \frac{f_m - f_0}{f_m} [\%]$$

Non-Active Algae – fluorescence response independent from the background light, the same proportion of the excitation energy decays in form of fluorescence

Active Algae - energy distributed in chemical reaction, thermal loss and fluorescence

Theoretically: active algae = $f(\text{chl}) \times Genty$



UV Treatment: How much Energy is Needed

9mJ/cm²
200 J/Liter =
100%
Resolution
0,1µg/l
50cells Tetras.
=400cells
Talassio

Day 1 treatment	Chlorophyll ALA			
	Tetraselmis suicica	Microcystis aeruginosa	Thalassiosira sp./ Peridinium sp	Gesamt
Sample/ Replica	µg/L	µg/L	µg/L	µg/L
0% Dosis				
1. Replica	1,54	0,23	2,30	4,07
2. Replica	1,67	0,21	2,38	4,26
3. Replica	1,75	0,23	2,47	4,45
50% Dosis				
1. Replica	1,99	0,25	1,74	3,98
2. Replica	2,16	0,22	1,61	3,99
3. Replica	2,22	0,32	1,70	4,24
100% Dosis				
1. Replica	2,05	0,23	1,09	3,37
2. Replica	2,25	0,30	1,50	4,05
3. Replica	2,19	0,27	1,57	4,03
150% Dosis				
1. Replica	1,48	0,00	0,82	2,30
2. Replica	1,84	0,00	1,21	3,05
3. Replica	1,84	0,00	1,39	3,23
200% Dosis				
1. Replica	1,58	0,00	0,94	2,52
2. Replica	1,63	0,00	0,99	2,62
3. Replica	1,40	0,00	0,82	2,22
400% Dosis				
1. Replica	0,77	0,00	0,44	1,21
2. Replica	0,91	0,00	0,35	1,26
3. Replica	0,85	0,00	0,57	1,42

Day 5 darkness	Chlorophyll ALA			
	Tetraselmis suicica	Microcystis aeruginosa	Thalassiosira sp./ Peridinium sp	Gesamt
Sample/ Replica	µg/L	µg/L	µg/L	µg/L
0% Dosis				
1. Replica	0,66	0,09	1,36	2,11
2. Replica	1,6	0,25	1,98	3,84
3. Replica	1,69	0,23	2,04	3,97
50% Dosis				
1. Replica	1,03	0,28	1,25	2,55
2. Replica	0,66	0,15	0,97	1,78
3. Replica	1,24	0,29	1,22	2,75
100% Dosis				
1. Replica	1,1	0,16	1,11	2,37
2. Replica	1,14	0,26	1,24	2,64
3. Replica	1,16	0,24	1,18	2,58
150% Dosis				
1. Replica	0,88	0,08	0,96	1,92
2. Replica	1,05	0,16	1,04	2,25
3. Replica	1,13	0,22	1,19	2,54
200% Dosis				
1. Replica	0,77	0,13	0,89	1,78
2. Replica	0,79	0,14	0,84	1,77
3. Replica	0,68	0,25	0,66	1,59
400% Dosis				
1. Replica	0,35	0,00	0,32	0,67
2. Replica	0,56	0,00	0,12	0,68
3. Replica	0,25	0,00	0,21	0,46

Day 20 growth	Chlorophyll ALA			
	Tetraselmis suicica	Microcystis aeruginosa	Peridinium	Gesamt
Sample/ Replica	µg/L	µg/L	µg/L	µg/L
0% Dosis				
1. Replica	46,72	2,66	0	49,39
2. Replica	31,06	3,28	0	34,35
3. Replica	33,92	3,27	0	37,19
50% Dosis				
1. Replica	1,51	0,03	0	1,55
2. Replica	1,66	0,04	0	1,7
3. Replica	0,07	0,01	0	0,08
100% Dosis				
1. Replica	0,07	0	0	0,07
2. Replica	0	0	0	0
3. Replica	0,02	0,01	0	0,02
150% Dosis				
1. Replica	0	0	0	0
2. Replica	0,25	0	0	0,25
3. Replica	1,21	0,01	0	1,23
200% Dosis				
1. Replica	0	0	0	0
2. Replica	0	0	0	0
3. Replica	0,1	0,03	0	0,13
400% Dosis				
1. Replica	0,00	0,00	0,00	0,00
2. Replica	0,00	0,00	0,00	0,00
3. Replica	0,00	0,00	0,00	0,00



Effects on UV-treated Ballast Water

Day 1	Chlorophyll ALA	Aktivität ALA	10cells
Sample/ Replica	Total Chl	PAM Aktiv.	10cells
	µg/L	%	cells/ml
0% Dosis			
1. Replica	4,07	51,81	1466
2. Replica	4,26	52,01	1796
3. Replica	4,45	53,7	2098
50% Dosis			
1. Replica	3,98	28,37	525
2. Replica	3,99	33,96	537
3. Replica	4,24	26,16	401
100% Dosis			
1. Replica	3,37	31,05	236
2. Replica	4,05	28,21	427
3. Replica	4,03	31,17	484

Day 1	Chlorophyll ALA	Aktivität ALA	10cells
Sample/ Replica	Total Chl	PAM Aktiv.	10cells
	µg/L	%	cells/ml
150% Dosis			
1. Replica	2,30	17,13	183
2. Replica	3,05	23,89	294
3. Replica	3,23	24,59	537
200% Dosis			
1. Replica	2,52	21,13	208
2. Replica	2,62	14,14	198
3. Replica	2,22	13,33	143
400% Dosis			
1. Replica	1,21	8,11	34
2. Replica	1,26	6,41	25
3. Replica	1,42	10,56	37



Effects on UV-treated Ballast Water

Day 5 darkness	Chlorophyll ALA	Aktivität ALA	10cells
Sample/ Replica	Total Chl	PAM Aktiv.	10cells
	µg/L	%	cells/ml
0% Dosis			
1. Replica	2,11	52,48	710
2. Replica	3,84	45,13	568
3. Replica	3,97	43,89	759
50% Dosis			
1. Replica	2,55	27,89	96
2. Replica	1,78	41,23	36
3. Replica	2,75	24,94	105
100% Dosis			
1. Replica	2,37	31,14	36
2. Replica	2,64	28,52	75
3. Replica	2,58	35,06	200

Day 5	Chlorophyll ALA	Aktivität ALA	10cells
Sample/ Replica	Total Chl	PAM Aktiv.	10cells
	µg/L	%	cells/ml
150% Dosis			
1. Replica	1,92	33,1	18
2. Replica	2,25	44,48	62
3. Replica	2,54	46,6	82
200% Dosis			
1. Replica	1,78	29,15	14
2. Replica	1,77	27,31	25
3. Replica	1,59	44,09	42
400% Dosis			
1. Replica	0,67	6,12	7
2. Replica	0,68	4,25	5
3. Replica	0,46	7,58	9



Effects on UV-treated Ballast Water

Day 20 under light	Chlorophyll ALA	Aktivität ALA	10cells
Sample/ Replica	Total Chl	PAM Aktiv.	10cells
	µg/L	%	cells/ml
0% Dosis			
1. Replica	49,39	18,32	2201
2. Replica	34,35	13,03	1960
3. Replica	37,19	16,97	1752
50% Dosis			
1. Replica	1,55	6,43	54
2. Replica	1,7	2,96	51
3. Replica	0,08	--	4
100% Dosis			
1. Replica	0,07	--	2
2. Replica	0	--	1
3. Replica	0,02	--	2

Day 20	Chlorophyll ALA	Aktivität ALA	10cells
Sample/ Replica	Total Chl	PAM Aktivität	10cells
	µg/L	%	cells/ml
150% Dosis			
1. Replica	0	--	1
2. Replica	0,25	6,72	0
3. Replica	1,23	32,03	18
200% Dosis			
1. Replica	0	--	0
2. Replica	0	--	0
3. Replica	0,13	0	6
400% Dosis			
1. Replica	0,00	--	0
2. Replica	0,00	--	1
3. Replica	0,00	--	0



Advantages and Disadvantages of Indirect Methods of Algae Counting in the Range of 10-50µm

	10cells	PAM	ATP	FDA
Cell counting	-	-	-	-
Resolution	++	-	0	0
Time needed	++	++	0	?
Costs	0	0	0	0
Use of chemicals	++	++	0	-
Simple measurement, no. of steps needed	++	++	-	-
Transportable	++	++	++	++
Affected by temperature	++	++	-	-



We have found an extremely suitable method to be able to measure ballast water concentrations (algae) in the range of $10\mu\text{m}$ - $50\mu\text{m}$ upto far below 10 cells/ml.

This idea has now been implemented by the new IOcells instrument.

Many thanks for your attention!