

Indicative Tools for Commissioning Tests of BWMS: bbe 10cells

After performing over 140 commissioning tests in 2022, it became obvious that the choice of equipment is an important factor since time and space is usually limited on vessels. Therefore, Ankron Water Services GmbH is keeping up to date with indicative tools for ballast water analysis. Of course, we have our verified standard methods for evaluation of ballast water samples, but we are always interested to see which monitoring devices are available.

Ankron Water Services is performing a survey with various indicative tools also known as Compliance Monitoring Devices (CMD). This time **bbe 10cells** from the German company bbe Moldaenke GmbH was assessed.

1. Background

The aim of commissioning testing of ballast water management systems is to verify that the type approved system is working properly the way it is installed and operated. The regulation entered into force on 1st of June 2022. All ballast water management systems installed after the deadline are obligated to perform biological commissioning testing after installation and class survey is completed. Commissioning testing of ballast water management systems is subjected to regulation BWM.2/Circ.70/Rev.1 it defines that, organisms in the size class $\geq 50 \mu\text{m}$ and $\geq 10 \mu\text{m}$ to $< 50 \mu\text{m}$ must be within the limits of the D-2 discharge standard (Table 1).

The ballast water analysis is divided into two options: detailed analysis or indicative tools. Detailed analysis refers to the standard methods for ballast water evaluation and consist of direct count of living organisms by microscopy. Indicative tools, also known as compliance monitoring devices, give an indication on organism counts or risk indication based on D-2 standard, as a result. All methods that can be used as indicative tools are listed in BWM.2/Circ.42/Rev.2.

Table 1: Scope for commissioning testing of D-2 standard for discharge of ballast water.

Organisms	Unit	Limit
$\geq 50 \mu\text{m}$	Org m^{-3}	<10
$\geq 10 < 50 \mu\text{m}$	Org ml^{-1}	<10

2. bbe 10cells

The bbe 10cells is a compliance monitoring device and suitable for measurements of algae in the size range $\geq 10 < 50 \mu\text{m}$. The results are given in living algae cells per mL as well as a risk indication by traffic light. The settings are based on the D-2 standard, showing a red light for organism counts larger 9 org/mL. The bbe 10cells detects algae by a modified and patented pulse amplitude modulation procedure to determine an estimated amount of living organisms per mL in the sample. The number of living organisms is based on a calculated estimation. It achieves a detection limit of one living cell per mL.



Figure 1: bbe 10cells during testing at Ankrón.

3. Detailed method vs. CMD

Several dilution series were prepared with various numbers of Tetraselmis algae. The concentration of living algae was detected by fluorescence microscopy (detailed method) and bbe 10cells (compliance monitoring device). The results are displayed in Figure 2.

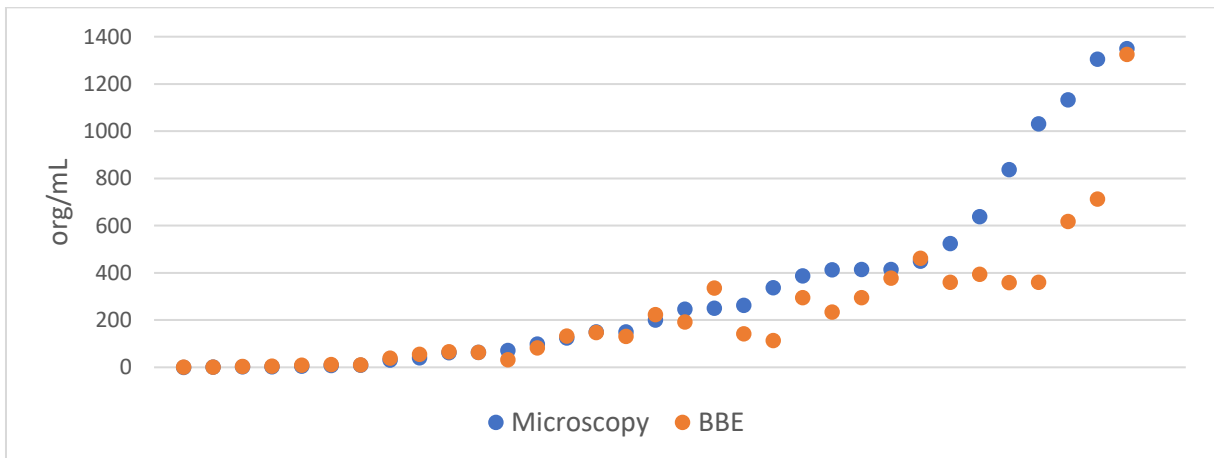


Figure 2: Comparison of detailed method (microscopy) to bbe 10cells (CMD) measurements.

The results show that the deviation from bbe 10cells to microscopy gets larger with higher organism counts. The bbe 10 cells is a device especially designed to verify the D-2 standard with its limit of less than 10 living organisms per 1 mL. Therefore, it has a high accuracy within this range of measurement.

4. ATP based CMD vs. bbe 10cells

The determination of ATP is a widely used indicative tool for ballast water analysis. During 20 commissioning tests the results of the bbe 10cells were compared to the ATP CMD. Since the ATP CMD gives a result in pg/mL ATP instead of org/mL, only the risk indication of both devices was compared. The results are summarized in Table 2. Figure 3 shows sampling of ballast water during commissioning testing.

Table 2: Comparison of ATP CMD to bbe 10cells measurements.

Total number of tests	Compliance with D-2		Non-compliance with D-2	
	bbe 10cells	ATP CMD	bbe 10cells	ATP CMD
20	16	18	4	2

Both CMDs showed similar results for ballast water samples except for two measurements. The deviation of results is likely to occur for samples containing algae close to 10 μm in diameter, since both methods are using different kind of filters to eliminate algae smaller than 10 μm . For these two measurements the ATP CMD detected <10 org/mL (risk indication green) while bbe 10 cells detected 11 org/mL.



Figure 3: Sampling process for ballast water.

5. Conclusion

The bbe 10cells gives fast and reliable results and is very easy to use. It does not require intense training beforehand. The obtained results did match the detailed method as well as the reference CMD. It should be noted that the algae suspensions are inhomogeneous solutions, and therefore always show a certain deviation within the measurement of the same batch.

It is of advantage that the bbe 10 cells does not require any chemicals and that the consumables consist of a syringe and a filter only. This makes it very suitable for the application on board of vessels. The device is small in size and can be carried on board with no effort.

Organisms smaller 10 μm are excluded and the D-2 relevant size range $\geq 10 < 50 \mu\text{m}$ is measured only. All pros and cons are listed below (Table 3).

Table 3: pros and cons of bbe 10cells.

pros	cons
+ easy to handle	- plastic consumables
+ small and light weight	- F0 and Fm values of PAM measurement not shown
+ gives result in org/mL	- detects algae only
+ comes in suitcase	
+ low detection limit	
+ fast result	
+ battery for field use	
+ no chemicals	
+ no storage limitations for consumables	
+ robust	
+ organisms $< 10 \mu\text{m}$ are removed	

If you are interested in our commissioning program or verification of Compliance Monitoring Devices, please contact claudia.vonderhoeh@ankron.de

So far, we evaluated:

Turner Designs Ballast-Check 2

Hach BW680

LuminUltra's 2nd Generation ATP Testing

Chelsea Technologies FastBallast

Bbe Moldaenke's bbe 10cells

If there is a certain CMD that you would like us to assess, please let me know.

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