

Aqua-Trace[®] for Monitoring Bioburden in Cooling Towers

Aqua-Trace[®] is an easy to use 'single shot' water testing device which can provide an immediate measurement of bioburden (microbiological activity) in cooling tower systems. Current test methods e.g. Dip slides take 1-2 days to produce a result, in practice this means if a system is out of control potentially damaging levels of planktonic micro-organisms and biofilms can form. The consequence of such a situation can be the development of conditions which support the growth of Legionella, possible corrosion effects and a reduction in plant efficiency.

Reproducibility of the Test

Replicate testing using the Aqua-Trace[®] devices with ATP solutions has been found to give results with a Coefficient of Variation of less than 15% and with cooling tower samples, a coefficient of variation of 15-20%.

Sensitivity of the Test

The minimum level of ATP required for a detectable signal is around 1 femto mol/sample.

This is equivalent to $\sim 10^3$ bacteria and the limit of detection for microbial cells should be considered as around 10^4 per ml.

Interference

At normal working concentrations biocides or chemicals will not tend to quench the bioluminescence reaction.

Interpretation of Results

Aqua-Trace® can be used in cooling towers to monitor changes in water systems and as an instantaneous measurement of microbiological activity. It should be noted that ALL micro-organisms will be detected by the system (including general Aerobic bacteria, Sulphate Reducing Bacteria, nitrogen cycle bacteria, yeast and fungi, algae and Legionella!) and consequently there is unlikely to be a good correlation between ATP counts and dipslide or aerobic plate counts. This is a key benefit of ATP testing as it measures general increases in bioburden as opposed to only quantifying the growth of those organisms restricted to growth under dip slide or aerobic media conditions.

An indication of any deviation from the norm can be further investigated by using the Free ATP test to indicate whether the increase in Total ATP is due to microbial growth or some other type of contamination.

After biocide treatment even if it is effective the Total ATP may remain high depending on the mode of action of the biocide. The Free ATP test can be used to indicate whether a high Total ATP is due to the biocide being ineffective or whether it has been effective but the ATP has been released into solution.

Some caution must be exercised in the interpretation of the difference between Total and Free. The difference is an indication as to the source of contamination in a sample but cannot be used across the board as a method of enumerating micro-organisms.

Examples:**Cooling Tower Waters**

	Total ATP	Free ATP
Sample 1	5000	1500
Sample 2	5000	4900
Sample 3	250	150
Sample 4	3600	100
Sample 5	3031	3906
Sample 6	142	242

Sample 1

The levels of Total ATP and Free ATP are both high but the difference is such that a significant part of the Total ATP is likely to be microbial.

Sample 2

The levels of Total and Free ATP are very similar and as such most of the ATP detected is not from viable micro-organisms. This can occur after effective biocide treatment in that the ATP is released from micro-organisms.

Sample 3

The levels of both Total and Free are low but still significantly different. The level of organisms is likely to be less than 10^4 per ml.

Sample 4

The Total ATP is high and Free ATP low indicating a detectable level of micro-organisms.

Samples 5 and 6

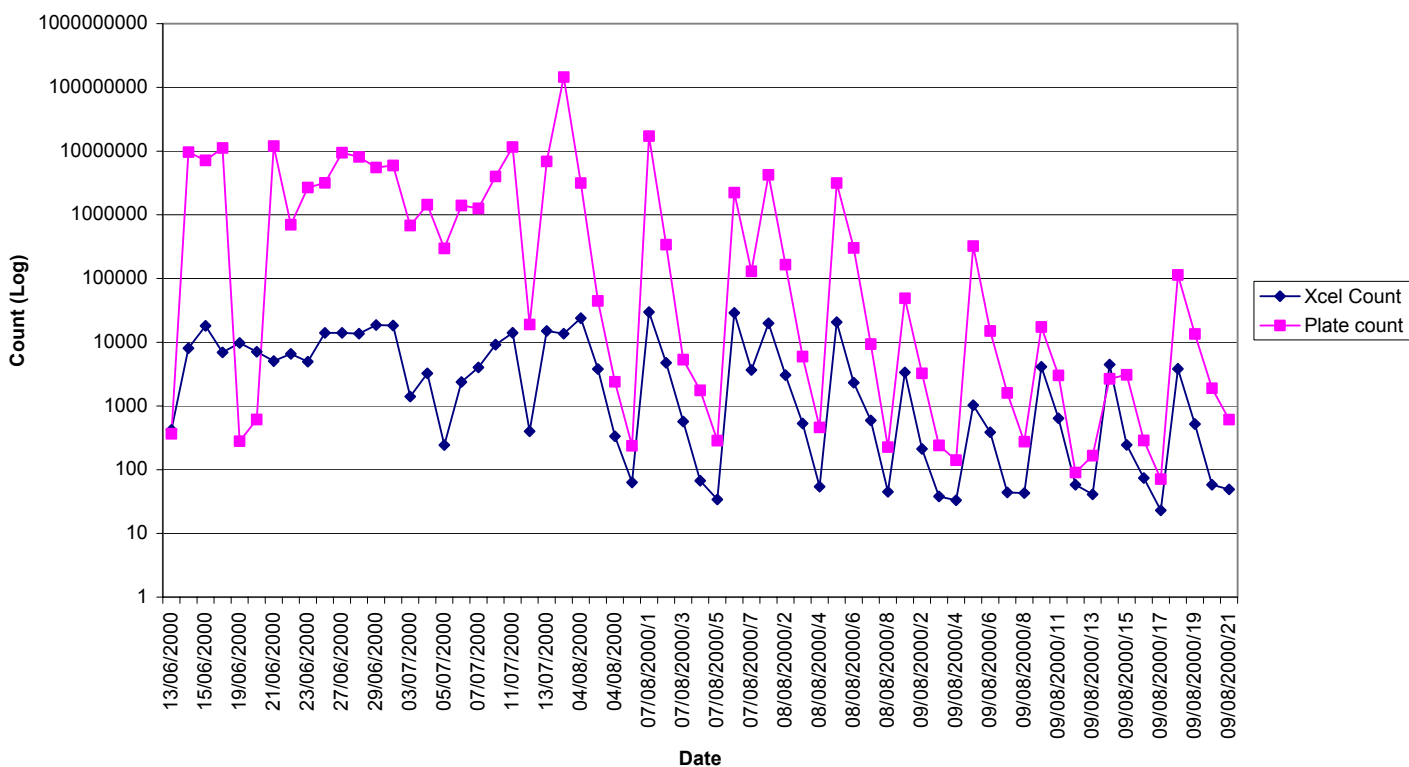
The Free is higher than the Total but the difference is within what might be expected from replicates of the same test. Note the difference between Total and Free for sample 1 and 4 and for samples 2 and 3 is equal but this does not mean the microbial counts are equal.

Example of a real system.

Comparison Between Plate count results and Xcel Total ATP Counts as Relative Light Units, testing was carried out on cooling tower waters at a large food processing site, (plate counts were measured as Total Viable Count per ml).

This system used a bromine based biocide programme to control the build up of Bioburden.

Comparison between plate counts and Xcel RLUs over time



Regression analysis carried out on this data showed a good correlation between the two monitoring techniques (R squared of 0.73).

As mentioned previously this may not be the case in all systems as the degree of correlation will depend on the types of micro-organisms present, high levels of S.R.B. or nitrogen bacteria will not be detected by aerobic viable counts but will be detected by *Aqua-Trace*[®].

Regular monitoring of individual systems allows the establishment of baseline readings, any change from these levels will give a warning that corrective action should be undertaken to avoid the system going out of control. It is possible to set 'Corrective' limits but these will be dependent on the type of biocide used in a given cooling water system, e.g. for the above system it is possible to set the following control limits:-

Biotrace Count	Total ATP (RLUs)	Comment
	<300	Excellent Control
	<750	Good Control
	750 - 1500	Alert situation
	>1500	System out of Control