An Evaluation of the Effectiveness of Water ATP Test Devices for Operating Temperature and Signal Decay

Dias R., Rowlands B.C., Holmes J.T., Winter G., Pressdee K., Legge K., Taylor H.R.

Food Industry Centre, Cardiff Metropolitan University, Cardiff, CF5 2YB

Contact: Ryan Dias. Email: rdias@cardiffmet.ac.uk

Introduction

Water Adenosine Triphosphate (ATP) testing is important in several food and drink processes to assess standards of hygiene. It helps to monitor the quality of water used for food processing and to evaluate the effectiveness of Clean-in-Place (CIP) rinses, for example in brewing and dairy industries. Potentially, the ATP test devices can be used across a broad range of environmental temperatures. Environmental temperature can be influenced by several factors such as the climatic temperature or temperature control within a manufacturing facility. Furthermore, processing areas within the same manufacturing facility, could have different ambient temperatures. The purpose of this study was to evaluate six leading brands of water ATP test devices to determine which device had the broadest operating range and the optimum ATP signal retention 60 seconds after activation.

Methods

The performance of the ATP test devices was evaluated at 10°C, 15°C, 20°C, 25°C, 30°C and 35°C, using an environmental chamber. All devices were tested using a solution, which had a concentration of 5 x 10^{-9} M ATP. Testing was completed using the exact instructions provided by the device manufacturer. Ten repeat samples were completed for each test device type at all temperatures. The optimum operating temperature range for each device was determined by calculating the percentage change in signal activity at different temperatures, relative to the maximum activity. The signal decay was assessed by reading the luminometer result immediately after activation (0 seconds) and at 60 seconds after activation.

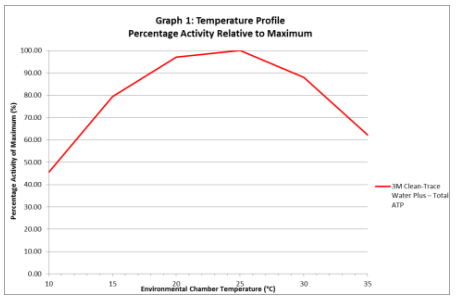
Discussion

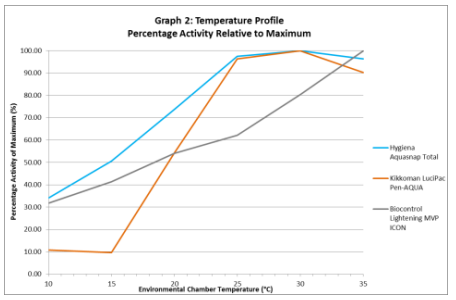
The optimum performing test device, with regards to temperature, depends on the typical environmental temperature to be encountered during testing. The most desirable output would produce a relatively 'flat' profile, which would suggest that minor changes in environmental temperature do not have a considerable impact on the results. Therefore, the results of this study suggest that the 3M Clean-Trace Water Plus – Total ATP device (Graph 1) had the optimum performance with little change within the 15°C to 30°C range. The Neogen Accupoint Water device (Graph 3) gave similar readings over a narrower range (15°C to 25°C). The Kikkoman LuciPac Pen-AQUA device and Hygiena Aquasnap Total device (Graph 2) retained at least 80% of the maximum value at the higher temperature range of 25°C to 35°C. The results of this study suggest that the Charm Sciences Water Giene device (Graph 3) and Biocontrol Lightening MVP ICON device (Graph 2), whilst producing different profiles, (maximum at 20°C and 35°C respectively) were highly temperature dependent.

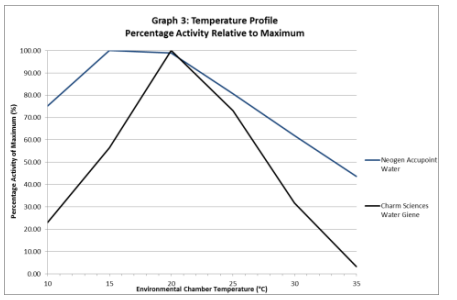
The manufacturer's instructions for the Hygiena Aquasnap Total device (Hygiena, 2012), specify that the results must be read in the luminometer within one minute of activation. The manufacturer's instructions for the Biocontrol Lightning MVP Icon device (Biocontrol, 2013) state that the results must be read within two minutes of activation. The manufacturer's instructions for the 3M Clean Trace Water Plus – Total ATP device (3M, 2012) state that the device must be read immediately after activation. The manufacturer's instructions for the Kikkoman LuciPac Pen-AQUA, Neogen Accupoint Water and Charm Water Giene devices do not specify any timescale for reading the results post device activation.

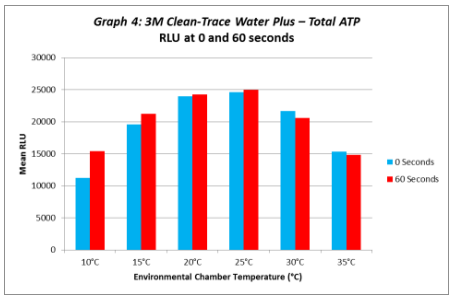
Results

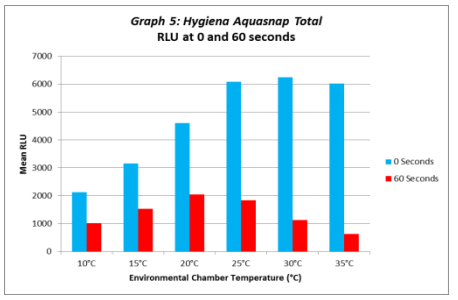
The results of the temperature profiling and signal decay experiments are illustrated below:

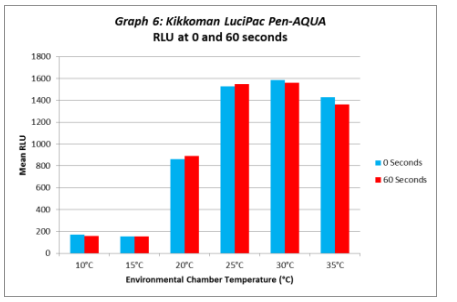


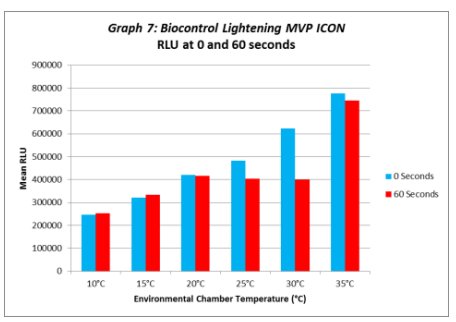


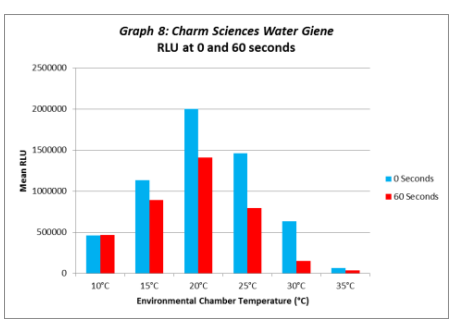


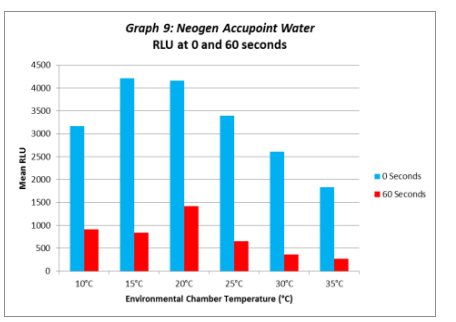












The results suggest that there is a slight difference in the signal intensity for the results read immediately (0 seconds) and 60 seconds after activation for the 3M Clean-Trace Water Plus – Total ATP device (Graph 4) and Kikkoman LuciPac Pen-AQUA device (Graph 6) .

With regard to the Biocontrol Lightening MVP ICON device (Graph 7), the signal intensity was slightly different at 10°C, 15°C, 20°C and 35°C but a greater difference was observed at 25°C and 30°C. This suggests that these temperatures (25°C and 30°C), had a negative effect on the performance of the device, with regard to retention of the ATP signal. With regard to the Hygiena Aquasnap Total device (Graph 5) and Neogen Accupoint Water device (Graph 9), the results indicate that there was a considerable decrease in signal intensity 60 seconds after activation, compared to the results read immediately after activation (0 seconds). This was also observed for the Charm Science Water Giene device (Graph 8) at all temperatures, with the exception of the extremes temperatures (10°C and 35°C).

The results of the temperature decay experiment suggest that the Biocontrol Lightening MVP ICON, Hygiena Aquasnap Total, Neogen Accupoint Water and Charm Science Water Giene devices are highly time dependent and, therefore, consistency in timing from activation to result reading is critical to ensure the accuracy of the results. The timing specifications advised in the manufacturer's instructions for the Hygiena Aquasnap Total device (read within one minute) and Biocontrol Lightening MVP ICON device (read within two minutes) could lead to highly variable and inaccurate results.

Significance

The selection of the appropriate water ATP test device, should be based on the intended environmental temperature at which it will be used. The time taken to read the result, following device activation, is also critical to ensure the accuracy and reliability of the results.

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