

Real Time Monitoring of Assimilable Organic Carbon in Raw Drinking Water



“Growth of bacteria in drinking water distribution and storage systems can lead to proliferation of health hazards.”

The Present Situation

Water utilities are faced with the dilemma of having to balance between escalating demands to reduce the level of disinfectant by-products (DBPs) in their drinking water supply but at the same time they also have to ensure that the presence of microorganisms in it is severely restricted.

Acceptable methods for determining the causes of bacterial regrowth and predict their presence in water distribution systems have typically involved collecting data from the field and then statistically interpreting the results. However, cost factors usually mean that this approach is limited to low frequency of sampling and the limited number of sampling sites. Testing only for chemical parameters such as Total or Dissolved Organic Carbon (TOC, DOC) prove inadequate for monitoring

By CheckLight Ltd

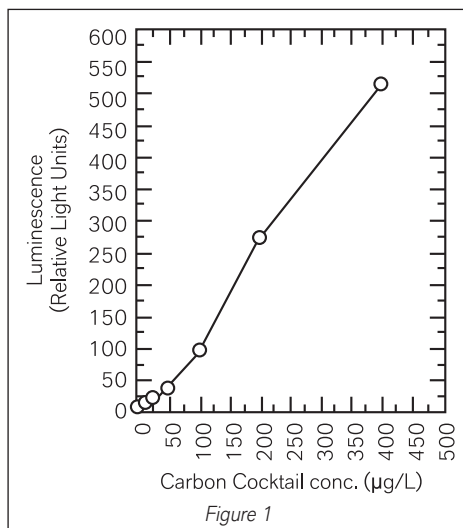


Figure 1

bacterial regrowth potential because it has been shown that the fraction of the total carbon pool available in water for biodegradation can be very small and is generally highly variable. Ironically, the one test that is acceptable, AOC, is in itself problematic because the methodology involves a long delay time before results can be obtained. The test involves inoculating the collected water samples with a bacterial inoculum (intrinsic population or a

standard culture). Only after a period varying between 5-30 days can the increase in viable counts and/or the decrease in DOC can then be determined. Obviously, results obtained after such a long time are only valuable as historical information for the records but have little practical value for the authority in its effort to control the quality of the drinking water. As a result of this unsatisfactory situation, the authorities usually have to guess the real state of the water and either over or under disinfect it with the consequent waste of money or breach of fiscal quality standards.

The Problem

Growth of bacteria in drinking water distribution and storage systems can lead to proliferation of health hazards, to the development of unacceptable taste and odor and to water turbidity. The rate of regrowth of bacteria in water after the disinfection process is influenced mainly by the concentration of Biodegradable Organic Carbon (BDOC) or Assimilable Organic Carbon (AOC) present in the water. Both parameters represent the fraction of the Dissolved Organic Carbon (DOC) that can be metabolised by bacteria in a given period of time. Urbanisation creates storm water runoff from paved areas and the sequential use and return of waters to rivers and lakes increases the absolute mass of biodegradable organic matter present in source waters. Urbanisation also generates an increase in the water service area with the consequential greater complexity in operating of the distribution system. This often results in an increase of water residence time in the system and a reduction in disinfectant residual at some locations. Poor disinfection increases the rate of bacterial regrowth in the distribution system. What the water utility, in this case, was looking for was a Biodegradable Organic Matter (BOM) measurement method that could provide real-time precise measurements to enable effective management of water treatment regime and achieve consistent water quality within budget.

The Solution

CheckLight was able to demonstrate that its proprietary AOC test kit could provide the means to measure in real-time the levels of readily available organic carbon in raw drinking water sources. Acquiring this vital information would enable the water utility provider to take timely preventative action to avoid bacterial regrowth, optimally organise its disinfection program and reduce the presence of excess toxic DBPs in the water.

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The CheckLight Method

CheckLight's specially formulated reagent is exposed to serial dilutions of the sampled water. Final readings are obtained after only two hours of incubation at ambient temperature from measuring biological luminescence that subsequently develops in the samples. The level of luminescence is proportional to the concentration of available organic carbon. Figure 1 shows resultant measurements

of standard carbon cocktail used as reference and positive control in test system. The correlation is straightforward: the more luminescence, the higher the concentration of AOC.

The Results

In order to verify the accuracy and reliability of the CheckLight test, 26 samples were collected from different raw drinking water sources along the Israeli Water Carrier system. Samples were

then measured using both CheckLight's AOC test and the standard 7 days test. Figure 2 shows the accurate correlation that was obtained from identical samples, between the standard AOC test (measured in ug acetate/L) and the CheckLight AOC test (measured in ug carbon cocktail/L). A high correlation ($r=0.864$) was found between the results of two testing methods.

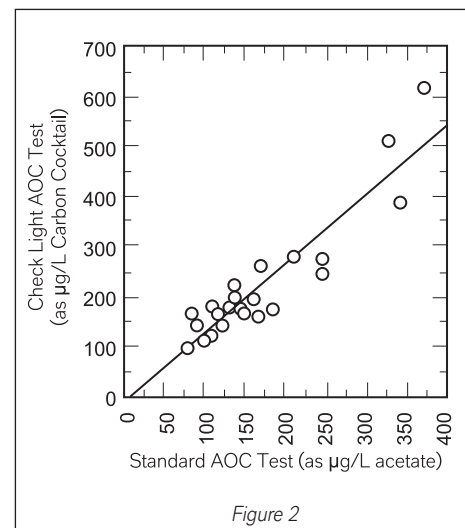


Figure 2

The Outcome

The water utility operators were pleased with the results from this comparison and can now regularly use these test kits to measure quality of their raw water at source instead of the standard tests that they conducted up till now. These kits are favoured by the authorities because of the following reasons:

- ▶ Time saving - Accurate and meaningful results of dozens of samples can be obtained within two hours.
- ▶ Easy to use - Personnel do not require special laboratory skills to use kits.
- ▶ Reliable - The data is highly correlative with standard tests.
- ▶ Cost effective - It enables frequent monitoring for rapid response to changing conditions.

These test kits are also being successfully used to monitor water at various pre/after-filtration steps in reverse osmosis and desalination processes. Optimising the timing of filter backwash, and providing real time detection of operation failure. They are also ideal for easily monitoring brackish and seawater.

About the Contributor

Founded in 2001 by Dr. Nirit Ulitzur, CheckLight Ltd is a private company, based in Israel. Since its foundation CheckLight has engaged in developing and marketing technologies for drinking water quality testing applications. Its technologies are based on the scientific work carried out by Professor Shimon Ulitzur, a world renowned expert in the field of marine bioluminescence who has dedicated over thirty years to researching the field.

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