Soleris® and cooling water management

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Introduction

Proper monitoring and control of water used to cool thermally-processed food and beverage products is essential to ensure the microbial load of this water is kept at acceptable levels. High microbial contamination in cooling water can lead to potentially dangerous food safety concerns and microbial food quality issues.

A good cooling water monitoring program allows for faster corrective actions to properly treat the water to decrease the microbial load to safe levels, or to replace it. Existing control and critical control points within a Hazard Analysis and Critical Control Point (HACCP) plan for microbial content in cooling water are reinforced by rapid verification tools such as total plate count, aerobic plate count, or total viable count. Likewise, verification of these points allow for greater reliability for the microbial intervention processes around cooling water. Increased reliability of control points and enhanced traceability helps reduce the risk of contamination, and protects the brand value of the product.

Rapid evaluation of cooling water's microbial condition through the use of the Soleris microbial detection system allows manufacturers to maximize the re-use of cooling water in their facilities, resulting in more efficient and reliable processing. Given this, Neogen performed a study to evaluate the use of the Soleris microbial detection system and the non-fermenting total viable count vial (NF-TVC) in the evaluation of cooling water samples obtained from a food processing company that utilizes retorts to thermally process product.

The study was designed in two parts: The first part aimed to determine the impact of a supplement added to the vial to neutralize the inhibitory properties of residual sanitizers. The second part of the study sought to determine the effects of the chosen supplement to ensure bacterial recovery did occur with the Soleris system and the results could be confirmed with official Bacteriological Analytical Manual (BAM) methods.

How Soleris works

The heart of the Soleris system is its ready-to-use vial. The unique vial technology measures microbial growth by monitoring carbon dioxide (CO_2).

Samples of up to 5 mL are added to Soleris vials prefilled with microbial growth medium. These vials are then placed into the Soleris unit, which monitors changes in the chemical characteristics of the medium, and reagents change color as

metabolic processes occur. Color changes in the vial's agar plug are monitored every six minutes and expressed as optical units. These changes are recorded in the computer, thus enhancing traceability. The more organisms there are in the sample, the faster the agar plug changes color and the faster Soleris records detection.

Methods

Each study used 0.6 mL of sterile sodium thiosulfate aseptically added to a 100 mL sample.

Parameter 1: Supplement study

Objectives

Cooling water was submitted to Neogen's Technical Services department for evaluation in the NF-TVC vial. The purpose of this study was to develop a method to overcome the inhibitory properties of cooling water as determined by historical control data. Solutions of sodium thiosulfate and ascorbic acid were added to the samples individually to determine an optimal concentration and time frame to maximize the sensitivity of the non-fermenting total viable count (NF-TVC) vial. In addition to the solutions, samples were inoculated with a bacterial cocktail of *Citrobacter freundii* (ATCC 6879), *Pseudomonas aeruginosa* (ATCC 10145) and *Staphylococcus aureus* (ATCC 6385). Sterile deionized water inoculated with identified cultures was included as a positive control with uninoculated sample reserved as a negative control. All experimental results were verified by cultural confirmation consistent with BAM methodologies.

Results

Fifteen samples were evaluated with various additives in an attempt to neutralize antimicrobial agents within the cooling water. The concentration of the bacterial cocktail was determined at the time of inoculation and is recorded below as colony-forming units/milliter (cfu/mL). The average detection times (DT) are included with no detection after 24 hours designated as nondetectable (NDT).

Cooling water with various supplements

Supplements	N	cfu/mL	Average DT
No supplement	3	4.7×10^1	NDT
Ascorbic acid 0.1	3	4.7×10^1	9.8
Ascorbic acid 0.05	3	4.7×10^1	9.9
Sodium thiosulfate	3	4.7×10^1	9.6
Uninoculated	3	Absent	NDT

Discussion

Results demonstrated the addition of a neutralizing compound was necessary to offset residual cleaning agents or sanitization chemicals that may have been added to the cooling water. The "no supplement" experiment had an inoculation level of 4.7×10^1 cfu/mL and did not yield a detection time. The addition of sodium thiosulfate showed the lowest average detection time and therefore was selected as an appropriate option for water treatment before microbial testing occurs.

Parameter 2: Fit for purpose

Objectives

The purpose of this experiment was to examine the effects of sodium thiosulfate in bacterial recovery using the NF-TVC vial and the Soleris system. Sodium thiosulfate was added to cooling water samples and inoculated with a bacterial cocktail of *C. freundii* (ATCC 6879), *P. aeruginosa* (ATCC 10145) and *S. aureus* (ATCC 6385). Samples were then inoculated in the NF-TVC vial. All experimental results were verified by cultural confirmation consistent with BAM methodologies.

Results

The table below shows an extension of the first set of results with the addition of supplement. The concentration of the bacterial cocktail was determined at the time of inoculation to be 6.5 $x10^1$ cfu/mL. This inoculation level and recovery time demonstrate the utility of Soleris for monitoring bacterial load in cooling water testing applications in which antibacterial interventions are used. Often, retort plants have action levels for additional microbial interventions at 100 cfu/mL. The results show actionable results from Soleris are available in approximately 10 hours.

Supplement			
Sample	**DT (hours)**	**Sample**	**DT (hours)**
1	9.7	9	9.7
2	9.6	10	9.9
3	9.5	11	9.8
4	10.0	12	9.8
5	10.0	13	9.8
6	9.7	14	9.7
7	9.6	15	10.1
8	9.7	16	9.5

Summary

The study demonstrates the inhibitory properties of the cooling water and the Soleris system's ability to detect bacterial contamination with the addition of sodium thiosulfate using the NF-TVC vial.

As noted in the results, the Soleris system can properly detect levels of bacterial contamination in cooling water in 10 hours or less. This method and the faster detection times allow food and beverage processors to determine the microbial content of cooling water in a rapid manner, allowing for process control decisions that could impact food safety and food quality earlier. The faster microbial interventions are implemented, the lower the risk becomes for product contamination in retort operations that use recycled cooling water.