Impact of ATP and microbiological indicator testing – in combination – on cleaning and sanitation effectiveness and food product quality

Effective environmental monitoring programs (EMPs) rely on hygiene monitoring as an integral component. A robust hygiene monitoring program that utilizes both ATP testing and microbiological testing can help food manufacturers meet regulations, assess the effectiveness of their cleaning and sanitation operations, and support food safety and quality. To develop a framework in which both methods could be utilized by a variety of food manufacturing facilities, the Cornell University Department of Food Science and 3M Food Safety conducted a multi-phase study in a ready-to-eat (RTE) food manufacturing facility using the 3M™ Clean-Trace™ Hygiene Monitoring and Management System and 3M™ Petrifilm™ Plates. Results showed effective equipment surface cleaning and sanitation, and improvements in the facility's environmental hygiene and the microbiological quality of food produced. As the facility became cleaner, fewer failing test results occurred, enabling a decrease in the frequency of testing while keeping the cleaning and sanitation process under control. The 3M™ Clean-Trace™ Hygiene Monitoring Software played a critical role by facilitating data collection and analysis as well as identifying and justifying opportunities for improvements in cleaning and sanitation. This study can be used as guidance to help other food manufacturers achieve similar results.

Introduction

Food manufacturing facilities, regardless of size or product produced, must comply with established regulations for food safety and quality. Regional and local regulations can require control of biological and chemical hazards to prevent product contamination caused in production environments. For example, in the United States, food manufacturing surfaces are required to be cleaned and sanitized as frequently as necessary to prevent contamination of products.[1,2]

Meeting these requirements can be accomplished through a robust environmental monitoring program (EMP) that utilizes both adenosine triphosphate (ATP) bioluminescence testing and microbiological indicator testing. Hygiene monitoring can evaluate the effectiveness of cleaning and sanitation procedures. ATP bioluminescence testing is a widely accepted method of hygiene monitoring that can indicate in real time whether cleaning and sanitation have been effective. In addition, microbiological indicator testing provides results to verify sanitation status.

Using ATP bioluminescence testing and microbiological indicator testing, in combination, can provide an assessment of cleaning and sanitation operations. However, to utilize these tools most effectively, a systematic framework for the introduction and application of these tools is also needed.

The Cornell University Department of Food Science and 3M Food Safety conducted a multi-phase study[3] in a ready-to-eat (RTE) food manufacturing facility to evaluate the effectiveness of using ATP bioluminescence testing and microbiological indicator testing in a framework and their combined impact on cleaning and sanitation efficacy, cleanliness of the processing environment and microbiological product quality.

"This study demonstrates the power of a robust hygiene monitoring program – combining ATP testing with microbiological indicator testing – to strengthen current sanitation programs and ultimately improve the safety and quality of food for consumers. In addition, hygiene monitoring results can be used to develop a data-driven cleaning and sanitation program that is effective and efficient, which can help reduce costs. As a standard, the industry should be using this method to verify cleaning and sanitation programs. It's key."

– Randy Worobo, Ph.D., Professor of Food Microbiology, Cornell University Department of Food Science

Methods

As the three-phase study began, 30 sites were identified for ATP and microbiological testing, based on relative difficulty of cleaning and sanitation, with a preference for sites considered harder to clean.

During Phase 1, ATP testing of the 30 sites per day for 3 weeks using the 3M™ Clean-Trace™ Hygiene Monitoring and Management System verified cleaning and sanitation procedures and established baseline results. Microbiological testing of the environment was performed, in parallel, for yeast and molds, lactic acid bacteria and aerobic microorganisms. Environmental samples were collected from adjacent surfaces using 3M™ Quick Swabs and tested using 3M™ Petrifilm™ Rapid Yeast and Mold Count Plates, 3M™ Petrifilm™ Lactic Acid Bacteria Count Plates and 3M™ Petrifilm™ Rapid Aerobic Count Plates.

During Phase 2, results from Phase 1 were used to identify and target sites that needed enhanced cleaning. Enhanced cleaning included increased time spent cleaning and some disassembly of equipment to access hard-to-clean areas. ATP and microbiological testing were maintained for 30 sites per day for 6 weeks.

In Phase 3, the 3M™ Clean-Trace™ Hygiene Monitoring Software was used to randomize sites and optimize sampling. ATP testing and microbiological testing were conducted on 18, rather than 30, sites per day for 16 weeks, while maintaining the modified cleaning practices.

In Phases 1 and 3, food product samples were collected during production and evaluated using 3M Petrifilm Rapid Yeast and Mold Count Plates, 3M Petrifilm Lactic Acid Bacteria Count Plates and 3M Petrifilm Rapid Aerobic Count Plates to determine the impact of targeted cleaning on the microbial quality of products.

Results and Discussion

Environmental Quality

During study phases 1, 2 and 3, 960 environmental samples were evaluated with both the 3M Clean-Trace Hygiene Management and Monitoring System and 3M Petrifilm Plates.

In the ATP testing results, the proportion of sites that failed to meet the minimum sanitary requirements day-to-day was highest during Phase 1 but steadily decreased during Phase 2 before leveling off in Phase 3.

Microbiological testing results for aerobic count and lactic acid bacteria from complementary surface sampling correlated with the ATP testing results, showing a significant reduction in failures from Phase 1 to Phase 3 ($p<0.001$).

Microbiological Product Quality

In this food manufacturing process, the product underwent two thermal processing steps: an initial heat-treatment of 88°C to reduce microbial load in raw materials, followed by an in-package pasteurization. After implementation of targeted cleaning, quantitative data from packaged, pre-pasteurized food products indicated a significant reduction in the load of microorganisms from Phase 1 to Phase 3.

Implications for Food and Beverage Manufacturers

During the study, the combined use of 3M Clean-Trace Hygiene Monitoring and Management System and 3M Petrifilm Plates enabled optimization of cleaning and sanitation. This resulted in improvements that were observed in the manufacturing facility's environmental hygiene and the microbiological quality of food produced.

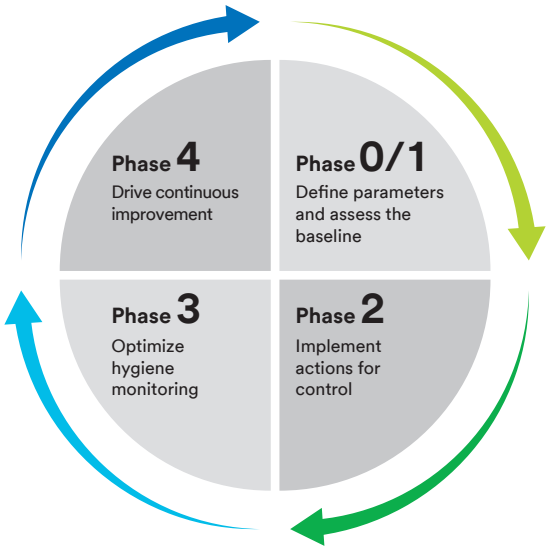
As the study progressed and the facility became cleaner, fewer failures in testing occurred. These results enabled the team to confidently decrease the number of test sites yet control the cleaning and sanitation process to ensure it delivered the desired results.

In addition, the study established a framework so that in the future, when the facility encounters cleanliness problems or observes unwanted trends in swab failures, they could take appropriate actions to reestablish control of their cleaning and sanitation.

The 3M Clean-Trace Hygiene Monitoring Software also played a critical role in the process through data collection and analysis of performance. Data and data analysis by the software helped identify and justify opportunities for improvements in cleaning and sanitation.

"The combination of 3M's Clean Trace System and Petrifilm Plates have helped us to significantly improve our overall plant sanitation. We are able to quickly identify areas that need more thorough cleaning and take corrective action."

– Co-Proprietor, RTE Food Manufacturing Company



Considerations for Implementation in Your Facility

In this study, ATP bioluminescence testing and microbiological indicator testing were demonstrated to be complementary tools for assessing and improving the cleaning and sanitation status of a food manufacturing environment. The results showed an improvement in microbiological quality of the product following targeted cleaning.

This study also describes a framework that utilizes the 3M Clean-Trace Hygiene Monitoring and Management System and 3M Petrifilm Plates, which food manufacturers can use to implement hygiene monitoring and microbiological testing as part of a robust environmental monitoring program.

As you implement or expand your environmental monitoring program in your facility, here are several questions to consider:

1. How did you select your test sites?
2. Do you know how the pass and fail limits were established?
3. Can you quantitatively confirm that your cleaning and sanitation process is in control?

Please contact 3M Food Safety to discuss how we can assist you in optimizing your process.

Learn more about hygiene monitoring and environmental monitoring at

www.3M.com/EnvironmentalMonitoring

References

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3M Food Safety
3M Center, Building 275-5W-05
St. Paul, MN 55144-1000 USA

1-800-328-6553
3M.com/foodsafety

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