

How One Company Eliminated Listeria Using Chlorine Dioxide Gas

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The previous article discussed the various [decontamination options available to eliminate *Listeria*](#). It was explained why the physical properties of gaseous chlorine dioxide make it so effective. This article focuses on one company's use of chlorine dioxide gas decontamination for both contamination response and for preventive control.

The summer of 2015 saw multiple ice cream manufacturers affected by *Listeria monocytogenes*. The ice cream facility detailed in this article never had a supply outage, but ceased production for a short amount of time in order to investigate and correct their contamination. After a plant-wide review of procedures, workflows, equipment design and product testing, multiple corrective actions were put into place to eliminate *Listeria* from the facility and help prevent it from returning. One such corrective action was to decontaminate the production area and cold storage rooms using chlorine dioxide gas. This process took place after the rest of the corrective actions, so as to decontaminate the entire facility immediately before production was set to resume.

Responsive Decontamination

The initial decontamination was in response to the *Listeria monocytogenes* found at various locations throughout the facility. A food safety investigation and microbiological review took place to find the source of the contamination within the facility in order to create a corrective action plan in place. *Listeria* was found in a number of locations including the dairy brick flooring that ran throughout the production area. A decision was made to replace the flooring, among other equipment upgrades and procedural changes in order to provide a safer food manufacturing environment once production resumed. Once the lengthy repair and upgrade list was completed, the chlorine dioxide gas decontamination was initiated.

The facility in question was approximately 620,000 cubic feet in volume, spanning multiple rooms as well as a tank alley located on a different floor. The timeline to complete the decontamination was 2.5 days. The first half-day consisted of safety training, a plant orientation tour, a meeting with plant supervisors, and the unpacking of equipment. The second day involved the setup of all equipment, which included chlorine dioxide gas generators, air distribution blowers, and a chlorine dioxide gas concentration monitor. Gas injection tubing was run from the chlorine dioxide gas generators throughout the facility to approximately 30 locations within the production area. The injection points were selected to aid its natural gaseous distribution by placing them apart from one another. Gas sample tubing was run to various points throughout the facility in locations away from the injection locations to sample gas concentrations furthest away from injection points where concentrations would be higher. Sample locations were also placed in locations known to be positive for *Listeria monocytogenes* to provide a more complete record of treatment for those locations. In total, 14 sample locations were selected between plant supervisors and the decontamination team. Throughout the entire decontamination, the gas concentration monitor would be used to continuously pull samples from those locations to monitor the concentration of chlorine dioxide gas and ensure that the proper dosage is reached.

As a final means of process control, 61 biological indicators were brought to validate that the decontamination process was effective at achieving a 6-log sporicidal reduction. 60 would be placed at various challenging locations within the facility, while one would be randomly selected to act as a positive control that would not be exposed to chlorine dioxide gas. Biological indicators provide a reliable method to validate decontamination, as they are produced in a laboratory to be highly consistent and contain more than a million bacterial spores impregnated on a paper substrate and wrapped in a Tyvek pouch. Bacterial spores are considered to be the hardest microorganism to kill, so validating that the process was able to kill all million spores on the biological indicator in effect also proves the process was able to eliminate *Listeria* from surfaces. The biological indicators were placed at locations known to be positive for *Listeria*, as well as other hard-to-reach locations such as the interior of production equipment, underneath equipment and inside some piping systems.

In order to prepare the facility for decontamination, all doors, air handling systems, and penetrations into the space were sealed off to keep the gas within the production area. After a safety sweep for personnel, the decontamination was performed to eliminate *Listeria* from all locations within the production area.

Validation

The decontamination was only deemed to be complete once all 14 sampling locations read the appropriate dosage for a 6-log sterilization level kill. After the gas was removed, the decontamination team entered to recover the biological indicators, while plant personnel entered to take swab samples throughout the production areas. Biological indicators were processed by dropping the spore strip into growth media and incubating it for 36 hours. If any spores were left viable on the spore strip they would multiply and cause the growth media to change color, offering a quick method of validating the process. After processing, all 60 biological indicators came back negative for growth, while the positive control biological indicator exhibited growth within 24 hours of incubation. Swab results taken by plant personnel all came back negative for *Listeria monocytogenes* as well. Production resumed within the facility 48 hours later *Listeria* free.

Preventive Decontamination

Once the facility was rid of its *Listeria* contamination and production resumed, facility supervisors put forth a plan to decontaminate the facility on an annual basis as a preventive measure. This was to be done in addition to their traditional sanitation program during a yearly shutdown event. As traditional sanitation methods have difficulties eliminating pathogens from hard-to-reach areas, they provide a reduction of pathogens more so than an elimination of pathogens in those crevices. Chlorine dioxide gas provides a complete decontamination due to its ability to penetrate into crevices further than pathogens can hide, sterilizing all surfaces within the facility.

The company performed a risk assessment by reviewing their environmental monitoring results to pinpoint the areas to be included within the preventive decontamination. The tank alley located separately from the production area was considered to be a lower risk and was not included in the scope of the yearly preventive decontamination. The entire production area was included to provide a baseline sterility level and reduce the risk of contamination. As pure chlorine dioxide gas does not leave a residue, it can safely be used on a routine basis to provide sterilization of food contact surfaces and production equipment.

The preventive decontamination project was successful in resetting the production area back to a sterile environment. Biological indicator and environmental swab results both came back negative for growth, validating the process' efficacy. This instilled greater confidence within facility management that the facility would run cleaner and safer than ever before.

Conclusion

Responsive decontamination is hugely important, but preventive decontamination has evolved from being the future of contamination control to its present. Recurring contaminations often times are brought about by cracks and crevices providing pathogens a place to thrive and avoid being removed during traditional sanitation. In order to reach every crack and crevice in and around all equipment, a decontaminating agent such as chlorine dioxide gas, which is easily distributed throughout and penetrates into every crack, is required for successful decontamination. Failure to eliminate all pathogens will result in recontamination over time as surviving pathogens have time to multiply to large enough numbers where they can be transferred to other locations in the facility and cause a more widespread contamination. These recurring contaminations cost more money in the long run, especially if they are discovered by FDA and USDA inspectors. Chlorine dioxide gas has been proven to be a successful decontaminating agent capable of killing pathogens in areas that other sanitation methods fail to reach. In today's food safety landscape, preventive decontamination is essential, and chlorine dioxide gas offers the process advantages to reduce the risk of contamination and recall.

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