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ANALYSING STERAMIST IHP SUCCESS IN CDMO THROUGH AVID BIOSERVICES' FACILITY INTEGRATION

A comprehensive analysis of SteraMist ionised Hydrogen Peroxide (iHP) in pharmaceutical development and manufacturing spaces via bespoke facility automation and integration to adhere to GMP standards.

INTRODUCTION

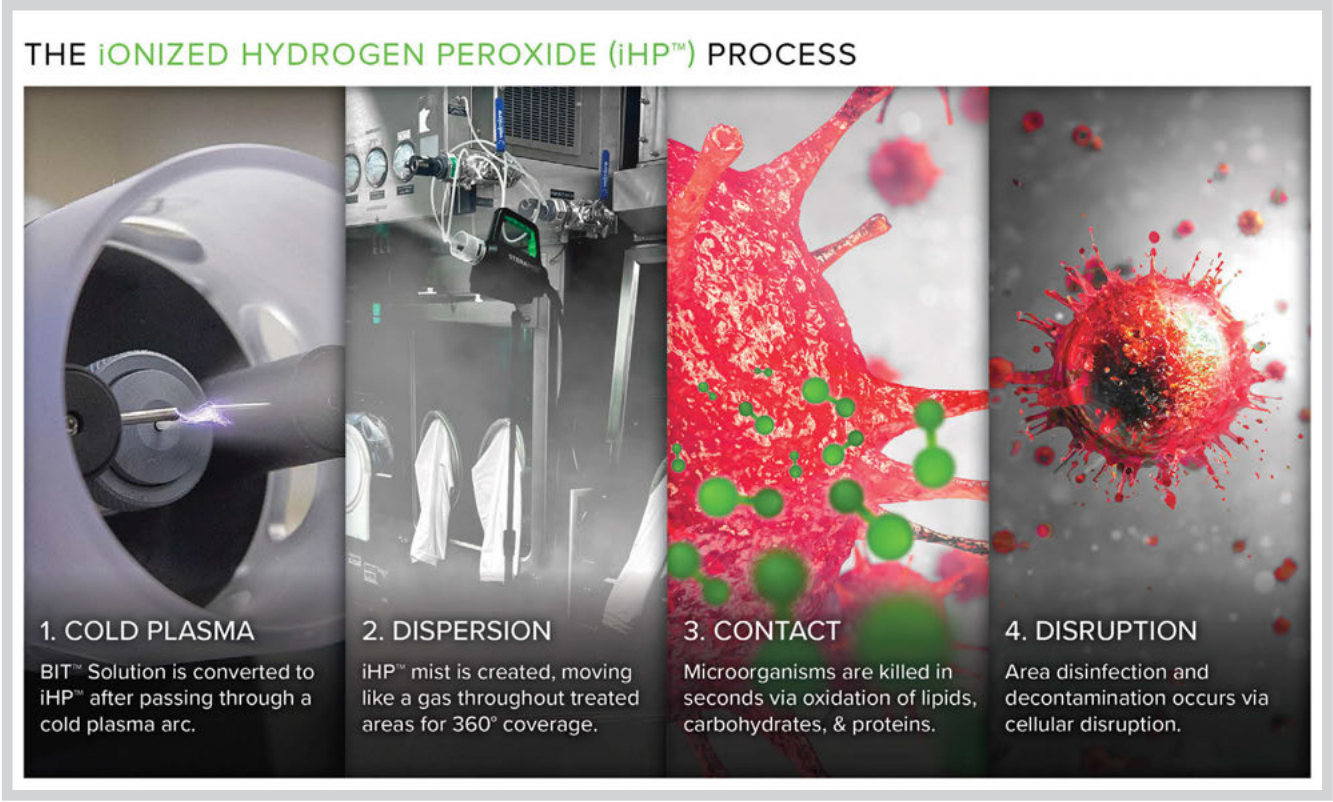
Given the crucial role of gene therapy in the landscape of advanced medicines, the need for world class GMP manufacturing of viral products has increased significantly. Additionally, the need for stricter quality control protocols, including the implementation of Annex 1 contamination control strategies, helps ensure optimal environments and successful production. Avid Bioservices, a leader in biopharmaceutical manufacturing for over three decades, specializes in strict adherence to GMP guidelines through the use of state-of-the-art facilities with a focus on mammalian protein manufacturing as well as production of viral vectors for cell and gene therapy with the completed construction of a 53,000-square-foot facility dedicated to viral vector manufacturing.

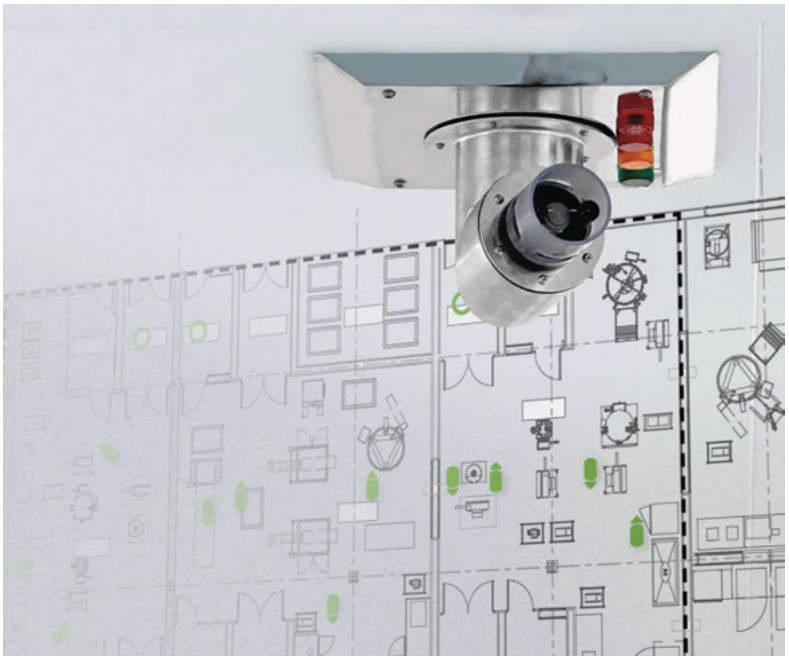
By using a solution with a sole active ingredient of 7.8% hydrogen peroxide and precisely calibrated cold plasma, SteraMist iHP creates powerful hydroxyl radicals

Avid was first introduced to SteraMist and ionized Hydrogen Peroxide (iHP) technology through their presence at Interphex, a leading global pharmaceutical and biotechnology event, initially showing interest in the capabilities of the portable SteraMist Select Surface Unit (now known as the SteraMist Integrated System [SIS] Standalone). Designed to provide the highest degree of injection control to the end user, the system offers a variety of applications within research and development environments with uncompromising adherence to GMP standards. With a need that goes beyond a single portable system, Avid discussed the strict requirements of its dedicated upstream, downstream, and fill suites – all are an ideal fit for fully integrated SteraMist iHP technology.

A PROVEN DISINFECTION LEGACY

The development of ionized Hydrogen Peroxide was made possible by a Defense Advanced Research Projects Agency (DARPA) grant, directly responding to the bioterrorism of the 2001 anthrax attacks. The resulting science positioned itself as the perfect alternative to the destructive nature of vaporized hydrogen peroxide, chlorine dioxide, and other commonly used lab space techniques. By using a solution with a sole active ingredient of 7.8% hydrogen peroxide and precisely calibrated cold plasma, SteraMist iHP creates powerful hydroxyl radicals that avoid the





The development of ionized Hydrogen Peroxide was made possible by a Defense Advanced Research Projects Agency (DARPA) grant

lengthy turnover and corrosion of vaporized hydrogen peroxide and similar methods. The scope of SteraMist began to expand after realizing the full application potential within a wide variety of industries and against a growing number of pathogens and spores. To further establish itself as an industry-leading solution, SteraMist became the first EPA-registered combination of solution and technology and still maintains an ongoing list of certifications and registrations.

As opposed to alternative hydrogen peroxide-based disinfection methods, the unique inclusion of cold plasma in the ionized Hydrogen Peroxide (iHP) process takes the science of disinfection a step further. Rather than relying on large droplet sizes or a high concentration of hydrogen peroxide, the resulting submicron particles are able to maneuver into crevices that often play host to hidden colonies of bacteria and spores, avoiding saturation by amplifying the cellular disruption ability of each radical. As a result, unique environmental requirements for each facility space can be met multiple times faster than alternative methods, noxious fumes are avoided in repopulated areas, and the lifespan of equipment and critical surfaces can be reliably extended.

To further ensure the highest-quality disinfection experience against a growing number of microorganisms and GMP standards, SteraMist has also undergone extensive third-party testing to further prove the science. Of that testing, critical priority was placed on discovering the surface compatibility of ionized Hydrogen Peroxide on a variety of common and uncommon surfaces often in need of high-level decontamination, such as those found in life sciences and aerospace industries (including grades 304 & 316 stainless steel). Even after extreme cases of 160+ hours of consecutive injections and full submersion in un-ionized SteraMist BIT solution, results indicated a superior level of material compatibility when compared to alternative hydrogen peroxide competitors commonly found in leading laboratories. Paired with a repeated six-log (99.9999%) validation against Geobacillus stearothermophilus, SteraMist delivers a preferred controlled environment experience in the face of strict GMP standards.

THE SYSTEM OFFERS A VARIETY OF APPLICATIONS WITHIN RESEARCH AND DEVELOPMENT ENVIRONMENTS

SCOPE OF WORK

Before seeking to implement a new disinfection method, Avid primarily relied on manual cleaning routines within their cleanroom protocols. Common techniques would include the use of cleaning agents, mopping floors, and wiping down equipment. While manual cleaning remains an industry-standard practice, Avid sought a new decontamination that would be “effective, reliable, and provide value above traditional practices” to ensure an optimal environment while observing a GMP and Annex 1 controlled contamination strategy. In order to accommodate their new viral vector campus, their chosen decontamination would have to meet extremely strict prerequisites in several critical categories.

First and foremost, microbial neutralization must consistently reach a reduction threshold of 6-log or greater – a milestone consistently reached and validated by SteraMist ionized Hydrogen Peroxide technology. Secondly, compliance must be considered in the wake of recent updates to established Annex 1 contamination control strategies, data management, and GMP, GLP, and ISO standards. Third, the disinfection must have a minimal impact on daily operations to ensure adherence to a dynamic facility schedule and reduce potential losses in project time and profits. Lastly, the installation must consider and complement their chosen method of modular laboratory construction. After thorough consideration, extensive risk assessments, and ROI analysis, SteraMist iHP was ultimately selected as their optimal decontamination solution.

THE PRODUCT

In addition to an extensive line of portable iHP disinfection and decontamination systems, SteraMist offers the additional flexibility of full facility customization, integration, and automation solutions. Over time, key components of SteraMist iHP technology have been isolated and optimized, allowing for seamless implementation into custom designs, modular equipment, and existing workflows, making it a popular choice for a wide variety of laboratory environments.

The fully integrated Custom Engineered System (CES) makes the most of SteraMist as a scalable technology, providing a facility with a centralized control cabinet that hosts critical iHP components to control the injection of iHP into any number of spaces. To further ensure complete compliance with emerging Good Laboratory and Manufacturing Practices (GLP, GMP), SteraMist

integration also features comprehensive BMS interaction and custom injection parameters with thorough cycle reporting.

Customized Engineered Systems also feature comprehensive data security, including digital USB exporting and printing. Active directory integration and password authentication reduce wireless tampering or falsification, easily conforming to the electronic record-keeping, validation, and data retention guidelines of 21 CFR Part 11 to provide proactive quality audit protection - all required for GMP and GLP standards.

The first Custom Engineered System installation was commissioned at Dana-Farber Cancer Institute in 2016 to decontaminate specialized equipment prior to barrier entry. "Integrating SteraMist into a decontamination room "allowed for increased biosecurity within the research facility" stated the Director of Dana-Farber's Research Core Facilities. "By processing all materials and equipment through this room we have shown a significant decrease in the presence of Corynebacterium bovis. Before using [SteraMist,] we found it challenging to eradicate this pathogen because depopulation and restricted access is not possible. Because this technology is safe and effective, we can use it anytime and anywhere to reduce bacterial load on a consistent basis and control the spread of disease."

Since that initial installation, SteraMist has been extensively integrated into modular cage washing chambers and refined iHP implementation to increase scale, reduce downtime, and maximize surface compatibility. Additionally, modified SteraMist products originally designed to accommodate unique facility prerequisites at facilities such as Alexion and Sloan Kettering have been adopted into an installation standard with the SIS line of turnkey iHP solutions.

MEETING THE NEED

Built to cutting-edge cleanroom specifications, the new Avid campus requires a delicate balance of functionality and security, making it an ideal host for the installation of a SteraMist Custom Engineered System. Opting for modular cleanroom construction, Avid meticulously created CDMO lab spaces with unidirectional product and personnel flow in mind. The simple installation of SteraMist has proven to be the ideal complement to their design, allowing for the strategic placement of applicator and control panel placement to optimize their process at every stage of injection.

As a direct impact system subject to Quality Management systems, SteraMist's intelligent BMS interaction provides critical control over environmental monitoring and key area isolation. This level of control, paired with the ability to decontaminate non-preconditioned areas, allowed Avid to schedule and execute cycles of iHP decontamination in specific areas while continuing production in non-treated spaces. Cycles could be run, and areas could re-open within the space of a manufacturing shift, allowing for a completely autonomous, passive decontamination experience with no need for prolonged shutdowns or evacuation.

To further ensure the highest standard of repeatable reductions in these critical stages of manufacturing, the installed system will also undergo an extensive system validation and qualification (IOQ) by both TOMI and Avid to ensure all critical performance parameters are successfully and reliably met with each cycle. After another successful milestone of integrating SteraMist systems into a CDMO space, Avid Biosciences' Director of Project Engineering stated that "[he is] confident that his integrated iHP system will set a new standard for large biotech and pharmaceutical facilities", additionally stating that he is "looking forward to the installation of additional iHP systems in the future".

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