IDT BIOLOGIKA

# Optimisation of Hydrogen Peroxide Decontamination ensures reproducible Inactivation Results and high Product Safety

## Understanding Critical Influencing Factors of Hydrogen Peroxide Bio-Decontamination is key for reliable Process Parameter

White Paper by
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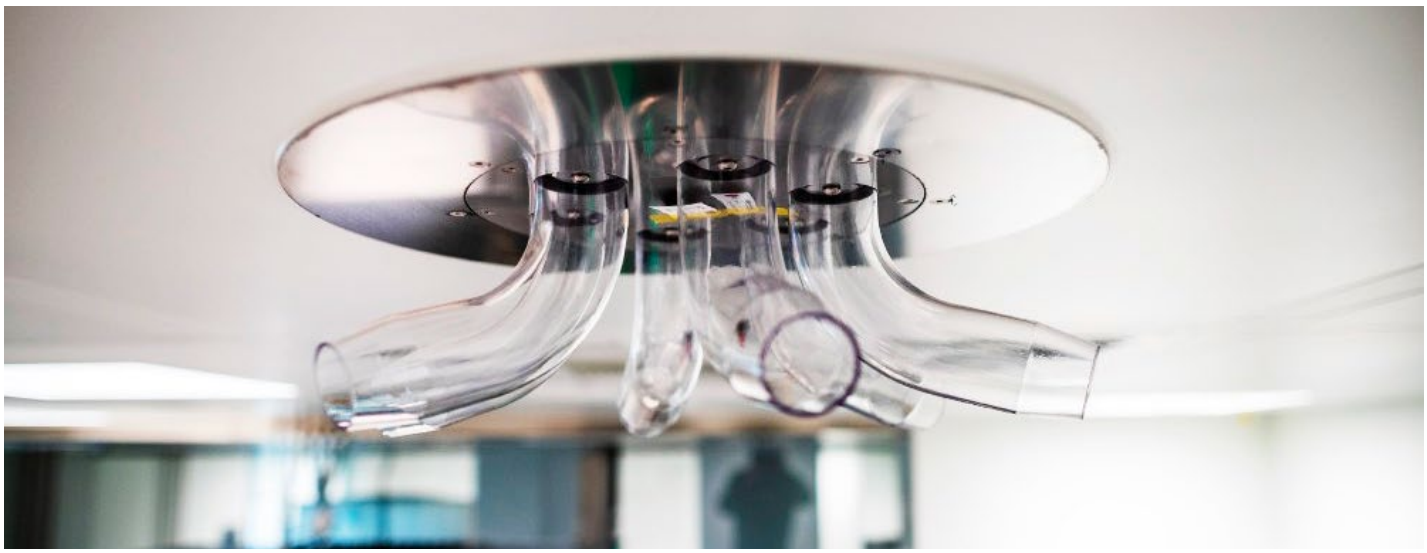
# Optimisation of Hydrogen Peroxide Decontamination ensures reproducible Inactivation Results and high Product Safety



**Understanding Critical Influencing Factors of Hydrogen Peroxide Bio-Decontamination is key for reliable Process Parameter**

Due to its material compatibility, decomposition into harmless by-products, low explosion risk and broad-spectrum activity against fungi, bacteria, viruses and spores, $H_2O_2$ increasingly replaces alternative decontamination agents for gas processes. Since then, isolators, clean benches, RABS and clean rooms are decontaminated using vaporized $H_2O_2$.

As a comparatively innovative fumigation technology, $H_2O_2$ decontamination is still not fully understood. Depending on room conditions, special generator systems and the variety of process influencing factors, cycle development appears to be a multi-parameter problem (Fig. 1). In particular, the mode of action of fumigation in the gaseous or liquid phase is controversially discussed. While various technologies actively contribute to increasing the water concentration in the fumigated space and enable a so-called wet process, the associated condensation is actively avoided in a dry process. Furthermore, several studies suggests that the inactivation of contaminants such as bacterial spores and viruses by fumigation is different regardless of their resistance to chemical and physical treatments.

At IDT Biologika, we carefully consider every single influencing factor and constantly work on optimising the entire fumigation system. The production of highly critical products such as vaccines, gene therapy and im-munotherapy products requires reliable, reproducible and effective decontamination processes.

Through detailed planning with technical experts as well as preliminary tests, individual fumigation programmes are created taking into account room-specific characteristics. Such processes must be validated for inactivation of the relevant microorganism in production areas. Since most of our facilities are designed for multiproduct use, validation for each single microorganism is difficult to perform. Based on an in depth tenacity assessment of the production microorganism worst case scenarios were developed and represented by standardized viral and microbial bioindicators. We learned that some viruses might be more difficult to inactivate than microbial spores due to specific conditions of their formulation and size.

Modelling of hydrogen peroxide fumigation processes and numerous experimental investigations revealed key process parameter for reliable decontamination. Inactivation efficacy is influenced by many parameter (Fig. 1) and some of them are critical for success.

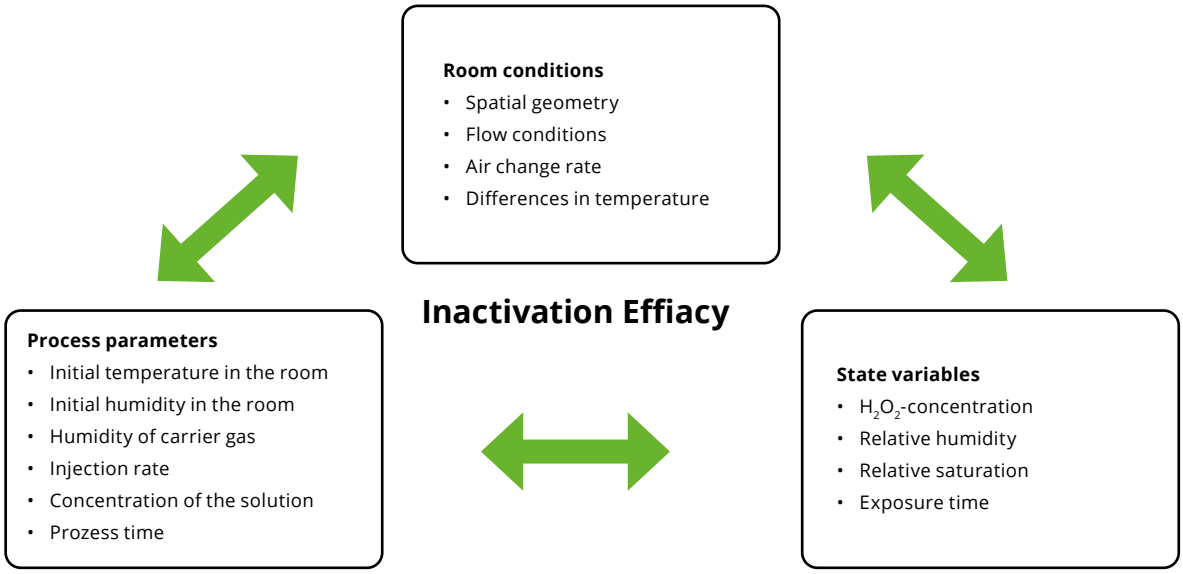



**Fig. 1: Numerous factors influencing inactivation efficacy of $H_2O_2$ decontamination must be taken into account for cycle development.**

Our cleanrooms are decontaminated with $H_2O_2$ using a fully automated stationary fumigation system sup-plied by *Ortner Reinraumtechnik GmbH* that carries out the gassing in four central phases (Fig. 2).

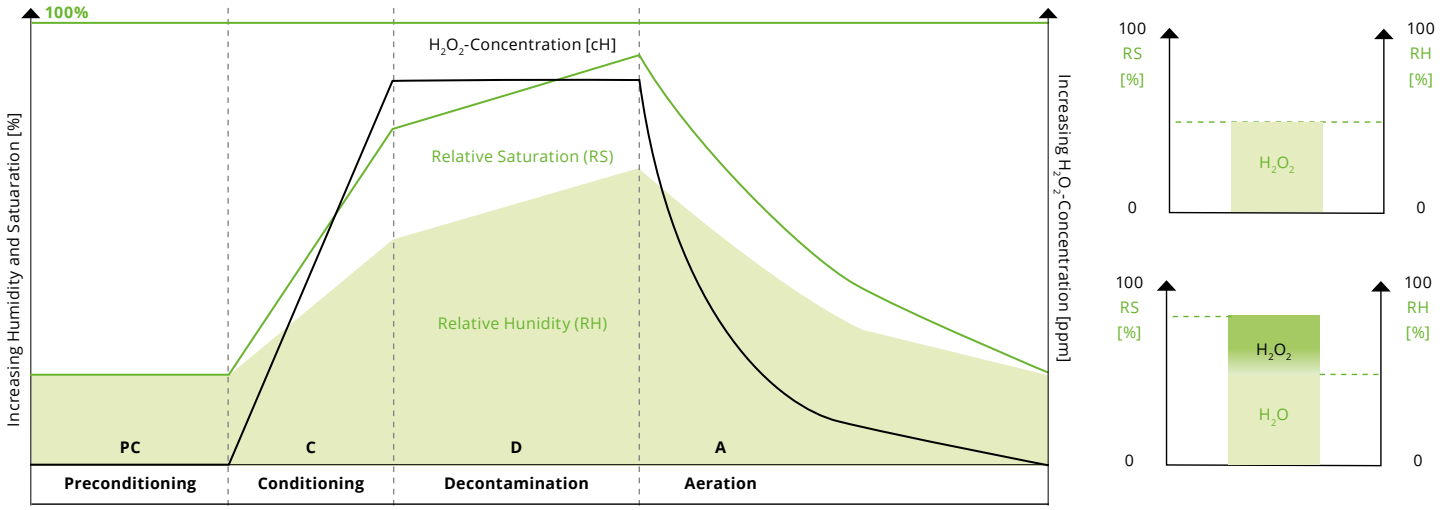



**Fig. 2: In order to achieve a sufficiently high effectiveness in the four phases of fumigation, a room-specific definition of the process parameters influencing the variables $H_2O_2$-concentration, relative humidity and sat-uration is necessary.**

During preconditioning (PC), both a defined humidity and temperature are adjusted in the room to be gassed. The starting conditions significantly influence the course of the process. In the conditioning phase (C), $H_2O_2$ concentration, relative humidity as well as relative saturation in the room are increased to well confirmed values. Through flash evap-oration, an aqueous $H_2O_2$ solution is converted into gas. The defined injection rates and transfer into the room by a carrier gas flow are important.

Strategically positioned ceiling nozzles distribute the biocidal gas evenly into all corners of the room. Biocidal conditions are constantly maintained in the decontamination phase (D) for a proven effective time to achieve GMP-compliant inacti-vation of potential contaminants for up to 6 logs.

In aeration phase (A) the biocidal oxidant is discharged. Typi-cally, the aeration phase is the most time-con-suming phase and significantly prolongs the overall process.

The effectiveness of our fumigation processes against var-ious contaminants is regularly checked within the scope of revalidations (Fig. 3). Both bioindicators with spores of Geo-bacillus stearothermophilus and indicator viruses are placed at worst case positions within the room and exposed to fu-migation. By demonstrably in-activating the initial population by at least 4 log, we enable complete decontamination of the room accord-ing to the expected bioburden.

**Fig. 3: Revalidations at worst case positions show that our fumigation processes are effective against bacterial spores and viruses in all corners and niches of the production rooms.**

Our long years expertise and close cooperation with specialised companies assure that our fumigation processes are highly effective and safe. We use the advantages of both opposing process theories of the dry and wet process and strike an ideal balance between the effectiveness of the fumigation and oxidative stress on our production areas. Nevertheless, we are constantly investing in the further investigation of physical and thermodynamic influencing factors and interactions in order to understand and to optimise our processes. For example the process times, especially the aeration phase, can be reduced as much as possible for the benefit of production.
IDT Biologika used an experimental airlock as a test system (Fig. 4). Concrete parameter settings for the long-term optimisation of cleanroom gassing have already been defined in the course of numerous test trials.

**Fig. 4: IDT Biologika is working on the constant optimisation of gassing with the $H_2O_2$-airlock from *Ortner Reinraumtechnik GmbH*.**

In the future, the optimisation approaches will be adapted step by step for cleanroom gassing of additional facilities and new conditions. Especially for new, demanding production processes, we are able to use the airlock as a test system to firstly test the effectiveness of our decontamination processes for new production organisms if required, and secondly to flexibly adapt them to new more resistant contaminants. In this way, we guarantee our customers perfectly decontaminated production units for aseptic production of biologicals.

## About IDT Biologika

At IDT Biologika, we are constantly working to improve and develop our production processes for now more than 100 years. We pay special attention to decontamination for safe production. Our objective is to design a process that is reproducibly effective against both spores and viruses, while at the same time being efficient and compatible with our material. Carefully planned trials and test runs in the clean rooms, technical modifications as well as the ongoing testing of specific parameter settings at the airlock constantly bring us closer to our claim: the technically highest possible decontamination to ensure safe production processes and safe products.
Our key focus is on understanding and implementation of innovative technologies, reproducibility and sustainability of our processes.

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