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Are Decontamination Chambers Right For You?

By Kevin Lorcheim

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Examining the applications and economies for decontamination of common vivarium equipment and materials.

Lowering energy usage and limiting carbon footprints have become an important theme across the world—in our homes, on our roads, and in our workplaces. Using less energy eases the strain on the environment, which becomes increasingly vital as our population and industries continue to grow. Vivariums have been increasingly committed to joining the green movement with newer, more efficient products being introduced to help cut down on water, power, and time. One of the newest methods of reducing energy consumption in a vivarium or research facility is the use of a decontamination chamber.

Decontamination chambers offer a completely sealed chamber for the decontamination of equipment and materials entering or leaving a barrier facility, or for decontaminating equipment within the facility. While autoclaves use steam and high temperatures to decontaminate the items within, decontamination chambers use chemical sterilants such as chlorine dioxide gas and vapor phase hydrogen peroxide.

Utility and Energy Consumption

Autoclaves use a lot of energy in their daily operation. They require a substantial amount of steam as a means of increasing the temperature within the chamber, and steam is used constantly throughout the day for the steam jacket which keeps the chamber walls warm to minimize condensation of steam injected into the chamber during the cycle. Autoclaves also use a large amount of water. Some water is heated for steam production, and more water is used to cool the waste steam prior to its disposal down the drain. Effluent steam and condensate must be cooled from its 212°F temperature to below 140 °F, as most municipalities require—and autoclaves traditionally cool down the effluent steam by mixing it with cold water. These are costly and energy consuming operational expenses.

Decontamination chambers use no steam during their decontamination cycle, whether using vapor phase hydrogen peroxide or chlorine dioxide gas. Decontamination chambers do need to use some water to raise the humidity level within the chamber. Increased humidity levels are necessary for spore-log reduction as they cause the spore to swell and crack, creating openings for the sterilant to enter. Decontamination chambers utilizing chlorine dioxide gas use approximately one cup of water per cycle. Decontamination chambers utilizing vapor phase hydrogen peroxide introduce humidity during its vaporization of a 35% hydrogen peroxide - 65% water solution, so the water is part of the consumable and not a separate addition. The use of steam by autoclaves also leads to increased wear on animal caging. Steam gets absorbed into

the cages and can cause fissures in the plastic over time. An animal facility can replace up to 10% of its caging per year, with weakened caging an underlying cause for most breakages. Eliminating steam usage with bulk autoclaves can help reduce the replacement rate of a facilities caging, thereby offering a rather high savings potential.

In terms of infrastructure, bulk autoclaves necessitate a larger footprint and more system equipment than decontamination chambers. A bulk autoclave with an interior chamber size of around 300 ft^3 has a footprint of 120-130 ft^2. Decontamination chambers of the same 300 ft^3 interior have a footprint of around 45 ft^2. In addition, the price of a decontamination chamber is significantly less, as much as half, than a bulk autoclave.

Bulk autoclaves feature an all-in-one design, with the chamber and decontamination system all as one. Decontamination chambers feature a detached decontamination system, meaning that the chamber and sterilant generator are separate items and often purchased separately. There is a benefit of being able to use the sterilant generator (chlorine dioxide gas or vapor phase hydrogen peroxide) apart from the decontamination chamber and for other parts of the facility. This allows increased flexibility as the facility can use one sterilant generator to be used in both the decontamination chamber and in rooms, isolators, biological safety cabinets, HEPA housings, and many other target chambers.

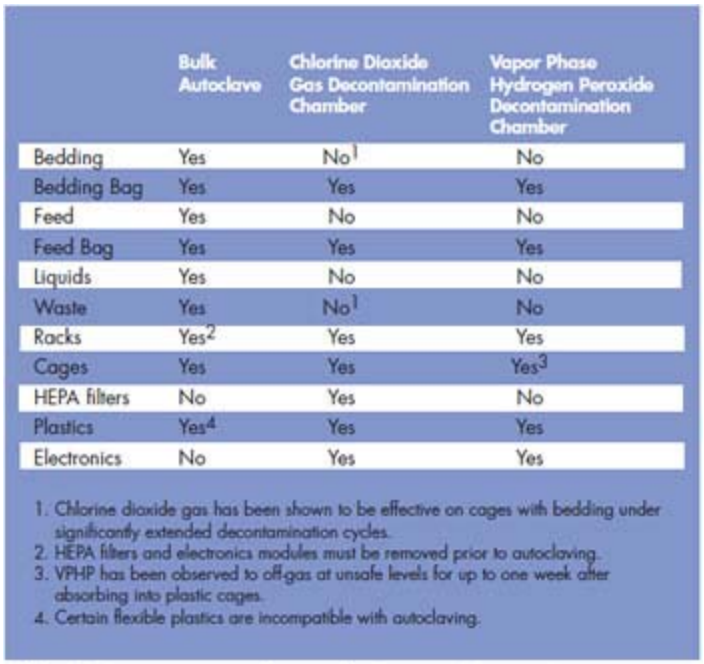
So are Decontamination Chambers the Right Decision for You?
Considering the potential for energy savings on water and steam production, one can see the environmental benefits between decontamination chambers and bulk autoclaves. Price and facility space savings also make decontamination chambers an attractive option.

After calculating the fixed and operational costs, the next step is to examine what applications your facility has and what you are interested in decontaminating. Table 1 shows common items and where they can be decontaminated.

Bulk autoclaves are able to decontaminate bedding, feed, liquids, and waste by heating up the entire load. Chemical decontamination of those items becomes difficult as the agents have trouble penetrating the material loads. The benefit of chemical decontamination as opposed to thermal decontamination is that heat-sensitive materials and equipment are able to be decontaminated. This allows electronics, plastics, and HEPA filters to be decontaminated as most are compatible with chemical decontamination methods.

As of now, chemical decontamination cannot fully replace the utility of thermal decontamination. For facilities that purchase irradiated bedding and/or feed, decontaminating the outside of the bags would be sufficient as the actual product has already been decontaminated. This leaves liquids and wastes as the only materials these facilities would need to autoclave. In these circumstances, the facility might be able to utilize a smaller and more energy efficient autoclave in conjunction with the decontamination chamber rather than a bulk autoclave.

A solution for some facilities has been to use a decontamination chamber instead of an additional or back-up bulk autoclave. This allows a facility to limit the use of their primary bulk autoclave in an effort to save water and steam when possible. It also gives the facility the flexibility to decontaminate electronics, dense organic loads, liquids, and waste between the two options. Combination chambers involving autoclaves or rack washers are additional options for facilities looking to further increase their flexibility and cost savings.



	Bulk Autoclave	Chlorine Dioxide Gas Decontamination Chamber	Vapor Phase Hydrogen Peroxide Decontamination Chamber
Bedding	Yes	No[1]	No
Bedding Bag	Yes	Yes	Yes
Feed	Yes	No	No
Feed Bag	Yes	Yes	Yes
Liquids	Yes	No	No
Waste	Yes	No[1]	No
Racks	Yes[2]	Yes	Yes
Cages	Yes	Yes	Yes[3]
HEPA filters	No	Yes	No
Plastics	Yes[4]	Yes	Yes
Electronics	No	Yes	Yes

1. Chlorine dioxide gas has been shown to be effective on cages with bedding under significantly extended decontamination cycles.
2. HEPA filters and electronics modules must be removed prior to autoclaving.
3. VPHP has been observed to off-gas at unsafe levels for up to one week after absorbing into plastic cages.
4. Certain flexible plastics are incompatible with autoclaving.

Table 1: Decontamination Options for Common Vivarium Items

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Conclusion

As more facilities look to become LEED certified, decontamination chambers will continue to become a more viable solution for a facility's internal decontamination and sterilization. The energy and cost savings can provide a significant benefit for facilities that utilize them. Green technology is isn't just for the adventurous anymore. Technology and products are now readily available to help save energy in research laboratories and vivariums. It turns out that some of these technologies are substantially less expensive both initially and as time goes on. Decontamination chambers offer a potential solution to any facility looking to become more energy efficient, or just to save money.

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