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White Paper

THE BENEFITS OF DRY HEAT STERILIZATION TO THE LAB ANIMAL SCIENCE INDUSTRY

In recent years dry heat used for the sterilization of rodent cages has been making its mark in the Lab Animal Sciences market. Although dry heat sterilization has been utilized for many years in the pharmaceutical and medical industries, the ability for this to be a viable technology in the LAS market is relatively new. So what has changed to allow this technology to be more pertinent today?

Sterilization is a time/temperature function, as we elevate the temperature the time needed to achieve sterilization is lessened. The common polymers used for the molded rodent cages allow a higher operating temperature.

Polysulfone (PSU) is an amorphous polymer.
Amorphous polymers do not have defined melting points but ranges at which they soften (called the glass transition temperature). Glass transition temperature for PSU 370°F (188°C).

Polysulfone caging permits a higher sterilization temperature setpoint comfortably within the materials temperature tolerance. Other materials, such as high temperature polycarbonates, are sterilized at a lower temperature due to the lower Glass transition temperature associated with the material.

It is essential with the dry heat systems that the cages receive good airflow over their surface area in order to achieve optimum results thus minimizing the cycle time. The specialized airflow characteristics utilized in the modern dry heat sterilizers are designed and developed for this purpose. This method of cage sterilization provides the industry with a viable alternative to bulk autoclaves and a number of advantages in comparing the two technologies.

These benefits include:

- Less complex technology resulting in considerably less maintenance requirements.
- Lower initial investment to purchase.
- Lower operational costs.
- Lower infrastructure costs, electrical supply and exhaust duct required.
- No pit, steam or water requirements.
- Panelized or modular build construction resulting in more ease to rig into place.

STERILIZATION OF NUTRITIONAL DIET

In a recent study conducted in conjunction with a major nutritional diet manufacturer, samples of both autoclavable and non-autoclavable diets were sterilized utilizing dry heat sterilization. Each diet was housed in the caging and the typical sterilization cycle was operated. At the completion of sterilization the diet samples were sent to a 3rd party test lab for evaluation.

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Findings

Post-sterilization levels were similar to theoretical vitamin levels, so the dry heat sterilization caused little degradation of the analyzed vitamins and was considered to cause less degradation to the diet when compared to samples that had been sterilized in an autoclave.

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	Theoretical	*Non-Sterilized*	*Dry Heat Sterilized*	*Theoretical*	*Non-Sterilized*	*Dry Heat Sterilized*
Thiamin, mg/kg	17	19.2	20.6	117	139	128
Vitamin A, IU/g	15	11.6	11	30	27.2	24.9
Vitamin E, IU/kg	110	71	100	135	114	126

INSTALLATION ADVANTAGE

Bulk sterilizers are large units which often need to be located in areas that are prohibitive to moving such heavy, cumbersome equipment into position. A dry heat sterilizer is two to three times lighter than an equivalent steam system, utilizes less floor space and by design can be moved through a facility and rigged into place as modules/panels assembled at site. This results in a reduction of challenges, lower costs and fewer time delays.

The dry heat sterilizer does not need to be pit mounted. Instead, a steel plate floor in the sterilizer allows the load of animal cages to be rolled in directly from the facility floor. The dry heat sterilizer requires no drain, no steam, and no cooling of reject water as there is none.

Flexible Installation Options

A critical, logistical point to consider when installing a bulk sterilizer is the task of getting a large piece of equipment into the building and placed in the desired position. For labs interested in replacing their old equipment: navigating bulky equipment through an existing building layout may prove difficult, expensive, or impossible.

Modular design

Dry heat systems can be designed allowing the individual modules to be fitted through most corridors, service elevators, and doors. The modules can be reassembled at the location of use.

COST OF OWNERSHIP

A fundamental factor in deploying any technology is cost, including dry heat sterilization systems.

How much will it cost me today, next week, and next year to maintain and operate?

Dry heat systems can cost less to implement, operate, and maintain. In one direct comparison the life cycle costs of a bulk autoclave are five to ten times greater than a dry heat sterilizer over an average 20 year asset life. The order of magnitude may vary depending on the specific requirements and location, but the cost differential is substantial. Some of the factors:

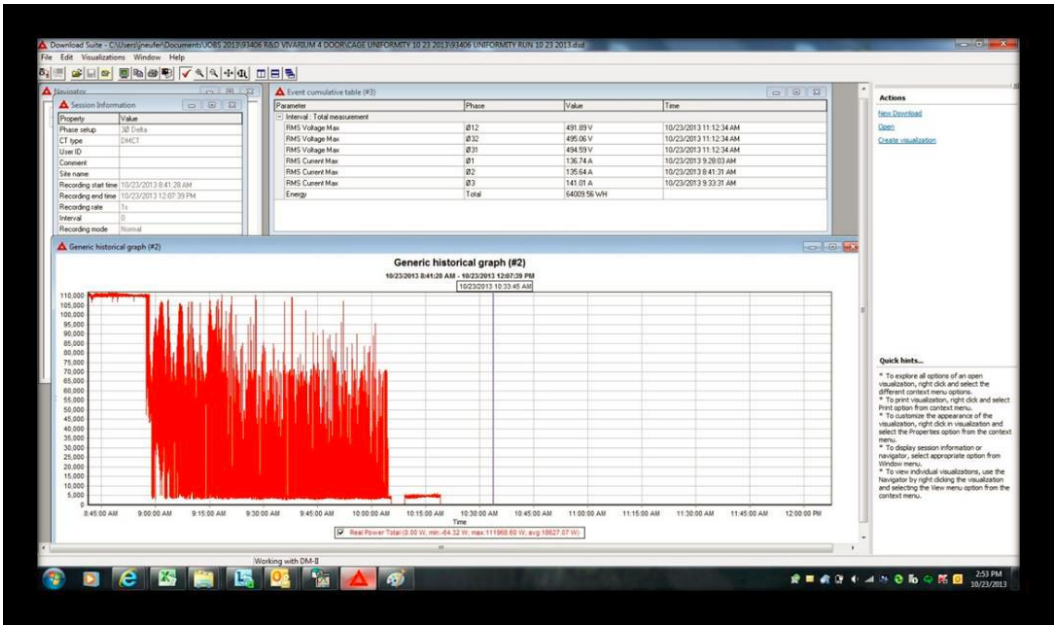
Initial Cost: The initial cost of available dry heat systems is about 40% less than the equivalent sized steam autoclaves. But that is only the beginning of the financial benefits. Rigging, installation, operation, and maintenance all provide large cost benefits with dry heat sterilizers.

Rigging: A dry heat sterilizer is two to three times lighter than an equivalent steam system. Because the dry heat sterilizer can be rigged in place as modules, there are considerably less rigging challenges and costs.

Installation: The dry heat sterilizer does not need to be pit mounted. Instead, a steel plate floor in the sterilizer allows the load of rodent cages to be rolled into the oven from plant grade.

MINIMIZED UTILITY COSTS

The dry heat sterilizer uses just one utility, electricity. In comparison to other sterilization methods the cycle operational cost can be considerably less. The graph below depicts a Gen II SteriDry system model # VST40H349.3PTSS, 350cuft of process area, loaded with two load trucks and 504 nested mouse cages plus bedding. The cycle is validated to prove 100% spore kill. The total electrical usage is 64.009KWH. Obviously electrical costs vary but based on a $0.10 per KWH this translates to $6.40 per cycle or $0.0127 per cage.



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CYCLE TIME AND CAPACITY CONSIDERATIONS

Modern dry heat sterilization systems using the new patent pending PrecisionFlo™ focused forced air convection technology are consistently decreasing the cycle time. Depending on the load configuration, sterilization is typically achieved in less than two hours, with proper cage orientation. Although the cycle may be slightly lengthier than an autoclave, the dry heat system design allows for considerably larger product load to be processed in the same overall machine footprint: with standard models offering nested cage capacities of 340, 680, or 1360.

The sterilization cycle consists of three segments: heat up, soak, and cool down. During the heat up segment, the oven and its load of cages are raised to the pre-set sterilization temperature. The cages soak for a pre-determined time period for complete sterilization, after which a forced cool down segment brings the oven and product down to a manageable temperature.

SUSTAINABILITY

Sustainability is an increasingly important consideration.

"Water is an issue of particular concern. The world's water problems and the looming water-security crisis were ranked high by the World Economic Forum (WEF) 2013 Global Risk Survey. 'In every sector, the demand for water is expected to increase, and analysis suggests that the world will face a 40% global shortfall between forecast demand and available supply by 2030,' WEF concluded."

76% of respondents named "water" as the resource most at risk, above oil, metals, minerals, others.

Source: Ernst & Young – 2013 Six Growing Trends in Corporate Sustainability: Based on a survey of executives at organizations with over $1 billion annual revenue, in 17 industry groups.

The industry has recently seen a demand for greener technologies that require less energy, less water, and less maintenance. This puts the pressure on equipment engineers to develop innovative ways to approach sterilization. While traditional steam autoclaves use water, dry heat sterilization provides an alternative to steam that uses no water, less energy and requires less maintenance.

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