

ENHANCING THE SAFETY OF THE LABORATORY WASTE HANDLING PROCESS AT CDC

Max R. Schroeder, PhD, RBP, Carin DeBenedictis, MS, Penny Thompson, BS, Paul Meechan, PhD, CBSP, RBP, Carolyn Black, PhD
Centers for Disease Control and Prevention, Atlanta, Georgia

Abstract

All biohazardous laboratory waste at the Centers for Disease Control and Prevention (CDC) must be decontaminated prior to removal for disposal. The large diversity of laboratory work performed and autoclaves used at the CDC presented a challenge to the standardization of laboratory waste management. Additionally, this process is a coordinated effort wherein the laboratory programs generate and prepare waste while the Division of Scientific Resources (DSR) operates autoclaves, collects and disposes of waste, monitors autoclave performance, and facilitates maintenance and repair of all autoclaves. Prior research identified a need to standardize the openings of waste bags (Araujo unpublished data); thus we manufactured and distributed a new device called a BagPipe. We established and implemented a standardized laboratory waste guidance, created a helpdesk, and training course. To optimize the safety and efficacy of autoclave operations, we tested several different cycles and cycle times for liquid handling and use of alternative primary containers for larger waste materials. Since the implementation of the laboratory waste guidance in August 2017, we have distributed 2299 BagPipes to CDC laboratories and successfully engaged the laboratory staff community through the helpdesk and the online training module. We found that up to one liter of liquids may be autoclaved with a pre-vacuum cycle and that larger volumes need to be run on a liquid cycle for a time that is dependent on the volume. Also, we addressed laboratory staff concerns about small volume discard pans by researching and implementing a procedure for use of a large plastic bin for bulky hard laboratory waste. This laboratory waste management process is undergoing continuous improvements focused on quality and safety of those within and outside of the Agency. The successful collaboration between DSR and the laboratory programs on laboratory waste minimizes the risks associated with management and handling of biohazardous waste.

Introduction

All potentially infectious laboratory waste must be decontaminated prior to disposal, and at the CDC autoclaving is preferred for decontamination of solid waste.

- A comprehensive risk assessment identified areas of highest risk for waste decontamination:
 - Incomplete inactivation of infectious material
 - Thermal exposure
 - Equipment damage
- Research and development of a BagPipe
 - Standardized openings of lab waste bags
 - 6 in long, 2 in diameter, cross-linked polyethylene tube
- Developed research-based policy and practice for laboratory waste



Figure 1. New (left) and used (right) BagPipes.

Methods

- Implemented standardized biohazardous waste preparation methods across all Atlanta laboratories
 - Monitored waste decontamination and processing
 - Investigated all incidences to determine root cause
- Tested liquid waste decontamination cycles and a larger waste container
 - Use of temperature and pressure data logger
 - Submersible biological indicators
 - Spill testing
- Revised standardized practices based on results

Results

Gravity Cycle does not effectively heat all materials within a container and allows for incomplete decontamination, while a Pre-Vacuum cycle facilitates rapid heating to facilitate decontamination.

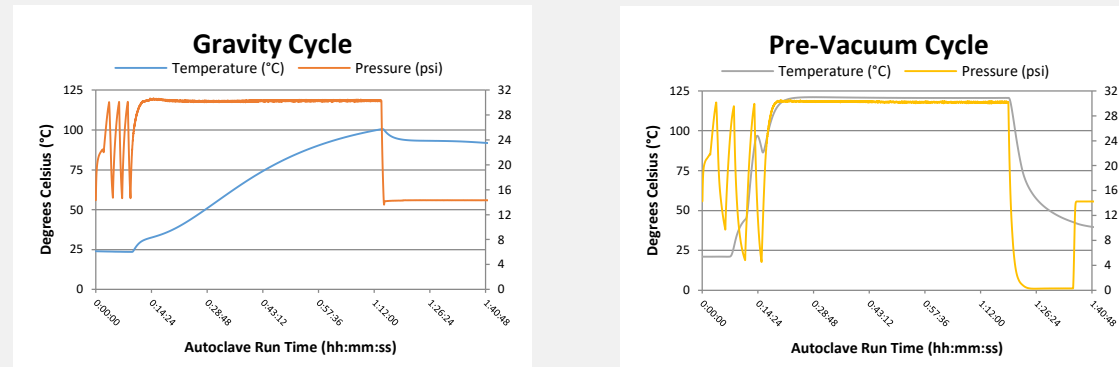


Figure 2. The 32 gallon tank containing a bag of PPE was autoclaved with a gravity cycle (left) and a pre-vacuum cycle (right) with the temperature and pressure measurements recorded by a data logger. The gravity cycle failed to reach 121°C even after the 1 hour exposure time, while the pre-vacuum cycle quickly achieved 121°C at the bottom of the bag. The gravity cycle did not fully decontaminate the bag, while the pre-vacuum successfully decontaminated the bag.

Liquid Waste Studies

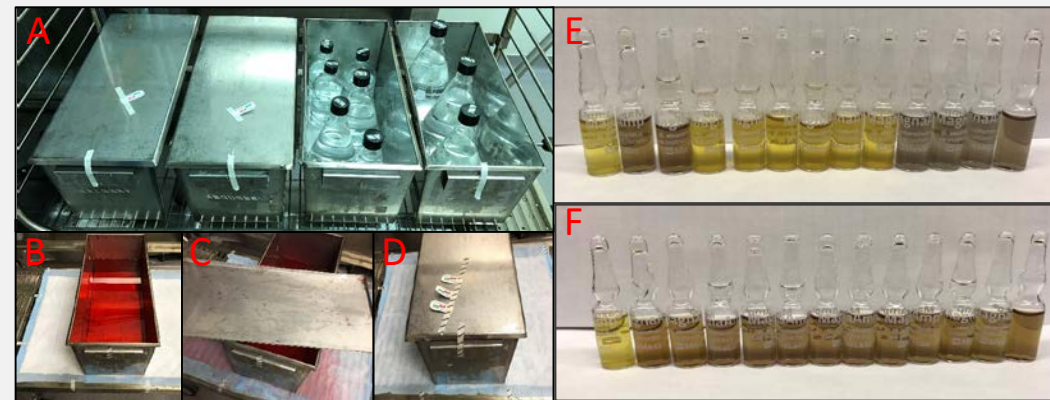


Figure 3. A variety of containers were used to study liquid decontamination (A and B). The pre-vacuum cycle caused liquids to spill (C), while the liquid cycle did not spill (D). The liquid cycle exposure time is dependent on the volume of liquid within a container: a 1 hour exposure time was not long enough to decontaminate all tested (E), while a 2 hour exposure fully decontaminated the same volumes (F).

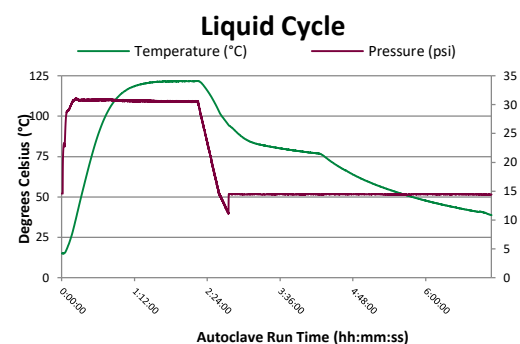


Figure 4. A liquid cycle was performed with a 2 hour exposure at 121°C to achieve decontamination of all liquids in Figure 3. With the autoclave opened and containers removed, the liquids required a 3 hour hold at room temperature before they were safe to transport.

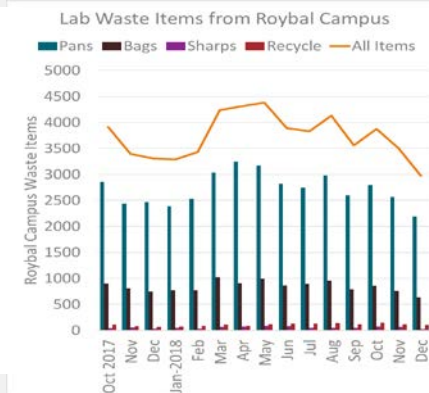


Figure 5. Waste processed from October 2017 through December 2018 included primarily solid/mixed and bagged waste.

Other Lessons Learned

Ensure bags are unsealed to allow air exchange (BagPipes) Autoclaving is not compatible with:

- Desiccant
- Ice Packs
- Excessive liquid (agar) volumes
- Dehydrated media
- Sealed glassware

Discussion

Research studies improved the biohazardous waste handling process at CDC:

- Based on the container shape and size, a gravity cycle may be ineffective in decontaminating lab waste and may require extended time to achieve desired exposures
- A pre-vacuum cycle was more effective for waste decontamination than a gravity cycle
- Liquid waste decontamination requires a custom setting based on the volume and container used
- BagPipes improved soft waste decontamination
 - BagPipes distributed throughout CDC
 - No more bag ruptures or leaks
- Improper lab waste handling causes safety concerns and facility issues



Figure 6. Examples of correct BagPipe usage (A-D) with an unobstructed opening (B) and autoclave pan options (E). From left to right the pans are 0.86 ft³ (6.5 gallon), 0.51 ft³ (3.8 gallon), and 4.3 ft³ (32 gallon).

Conclusions

- Data-driven continual improvements decrease risks for equipment damage and occupational exposures.
- The CDC optimized the safety of biohazardous waste handling and autoclave decontamination.
- Collaboration between lab workers, safety personnel, and waste handlers were the most valuable feature.
- Institutions should evaluate their waste handling practices and perform simulated waste studies to reduce the risks related to biohazardous waste processing.

Contact Info

Max Schroeder, PhD, RBP
MYJ8@CDC.gov
404-718-5520

