

Portable Sanitization Chamber

Concept Generation and Selection

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Overview

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 - Autoclave
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- Conclusion

Introduction

- W.L. Gore
- Develop a portable sanitization process that disinfects bioburden amounts past acceptable levels.
- Constraints
 - Portable
 - Safe
- Cost is under \$3,000
- Design Completion date: December 4, 2013

Autoclave Sanitization

- More penetrative power than dry air
- Above 121° C for at least 15 mins
- Above 135° C for at least 3 mins

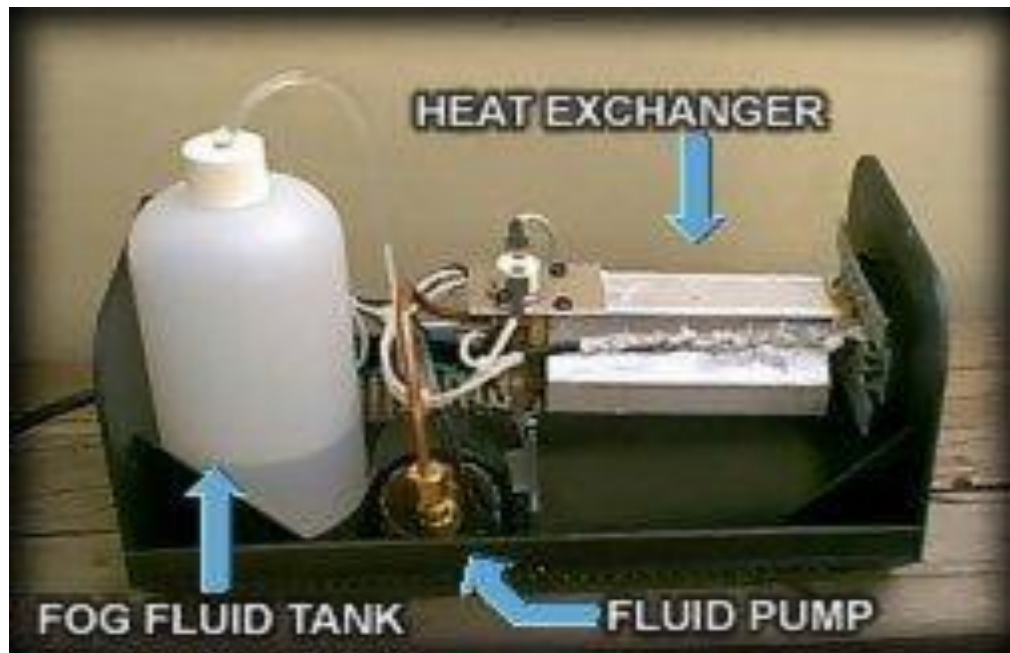
Autoclave Sanitization

- Economically inefficient
- Meet heat tolerant requirement
- Scale deposition

Chemical Processes

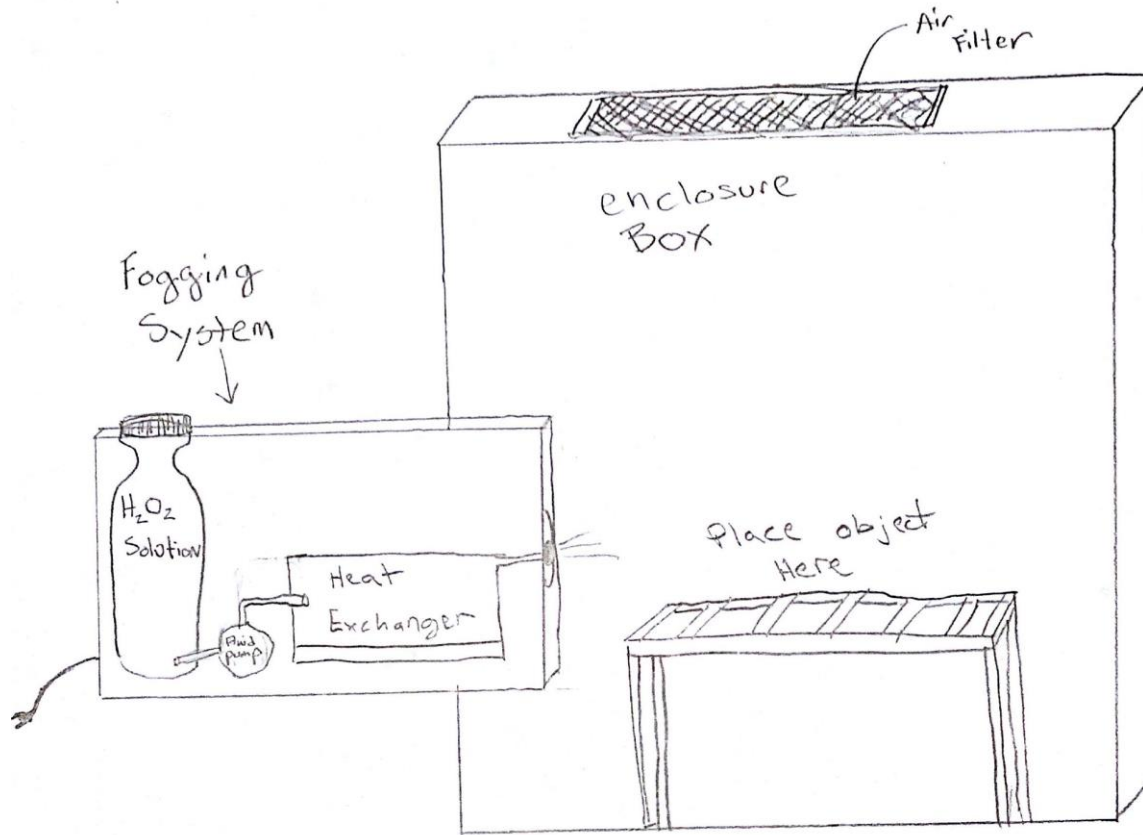
- Most chemicals can kill 99% of bacteria
- Dry fog chemical sanitization
- Hydrogen Peroxide is the safest chemical
- Entire rooms can be cleaned in 15-30 minutes

Vaporized Hydrogen Peroxide

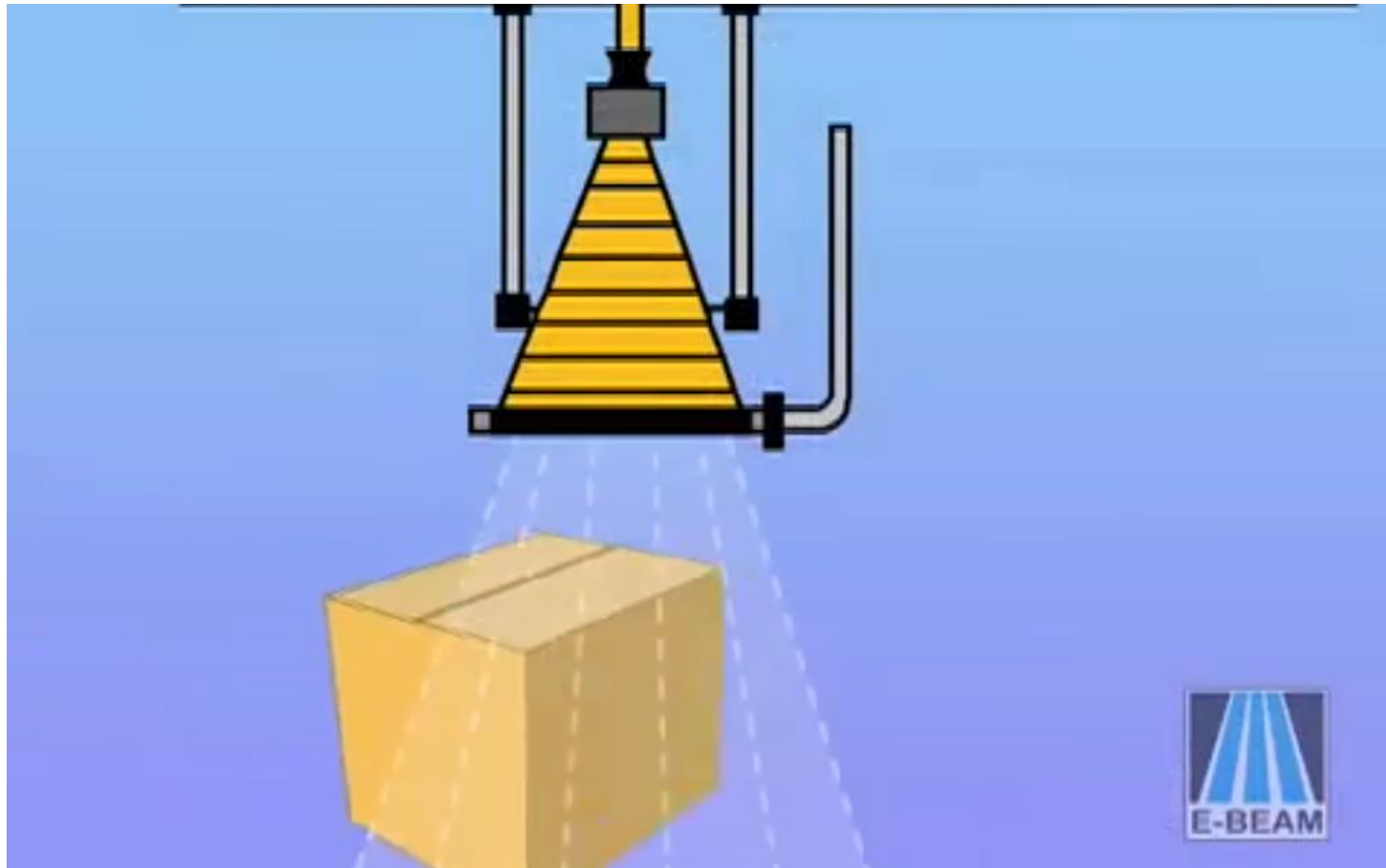


- Courtesy of <http://www.gotfog.com>

Hydrogen Peroxide Process



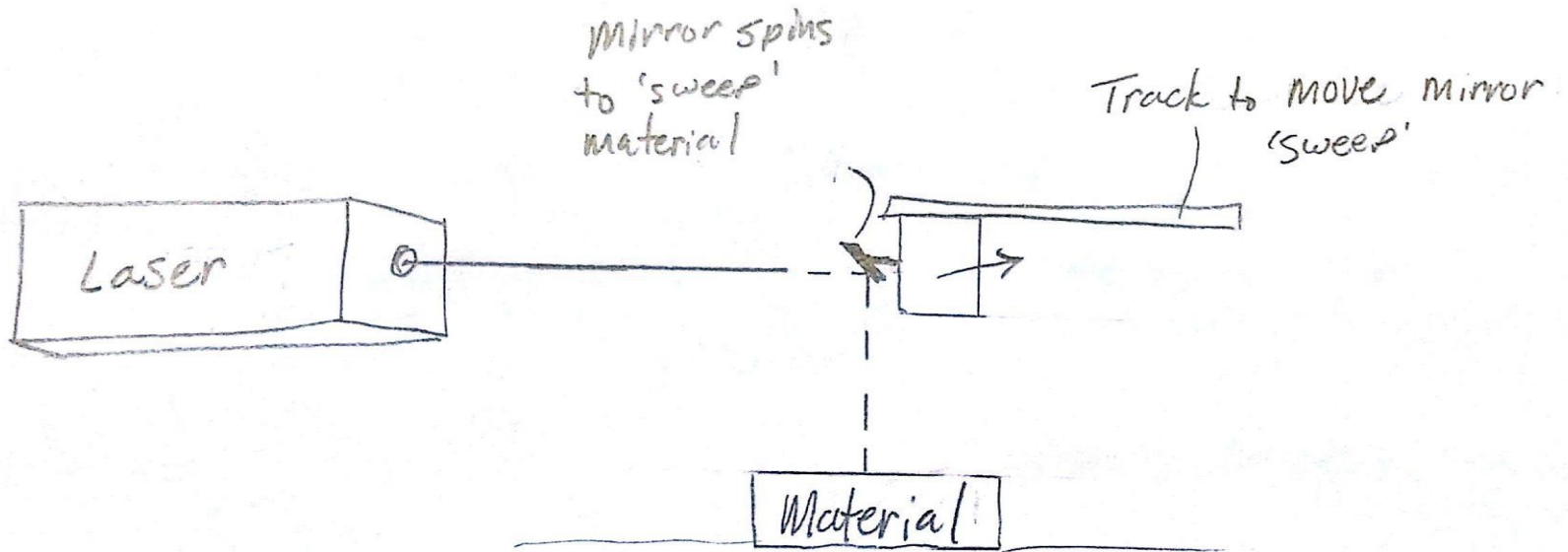
Electron Beam and Laser



Coutesy of www.ebeamservices.com

Bobby Beauchamp

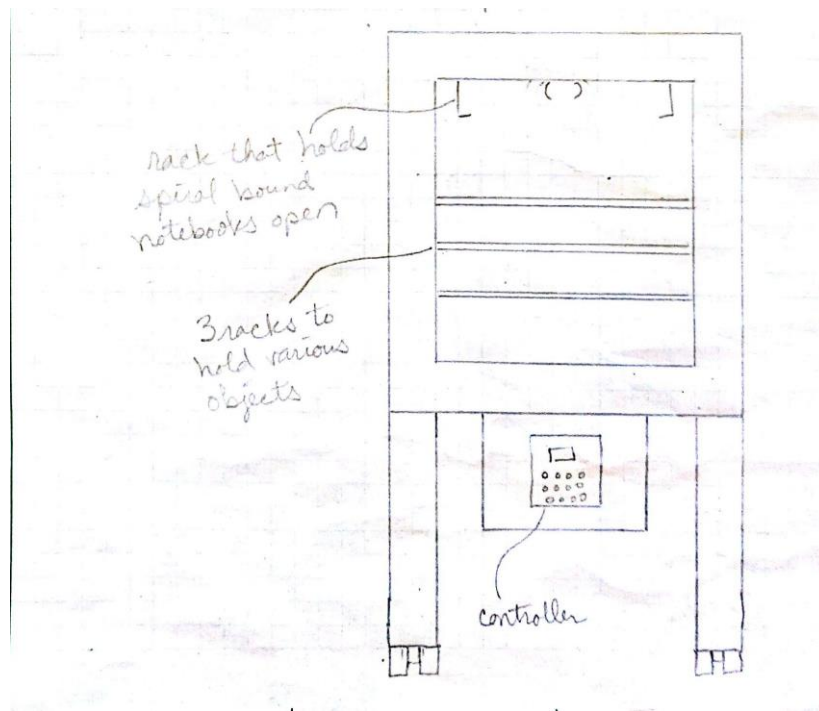
Electron Beam and Laser



Electron Beam and Laser

	Electron Beam	Laser
Pros	<ul style="list-style-type: none">- sanitizes through items- very fast- does a large variety of materials- Zero prep is needed for materials	<ul style="list-style-type: none">- relatively low power- quick- does various materials- Already used by dentists
Cons	<ul style="list-style-type: none">- May not be able to produce on a small scale- Complicated control systems- Cost- Safety to the user	<ul style="list-style-type: none">- May be cost prohibitive- Power requirements are different for various lasers/wavelengths- Doing large items may take too much time- only surface sanitized

Infrared Radiation



- Utilizes specific wavelength
- Sanitizes through heat application

Infrared Radiation

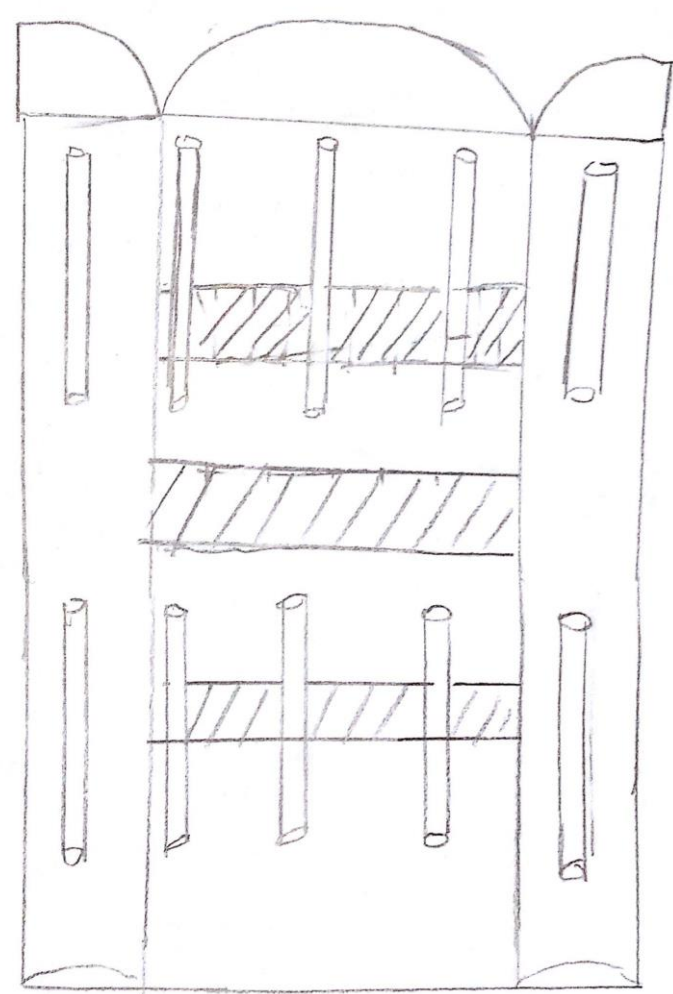
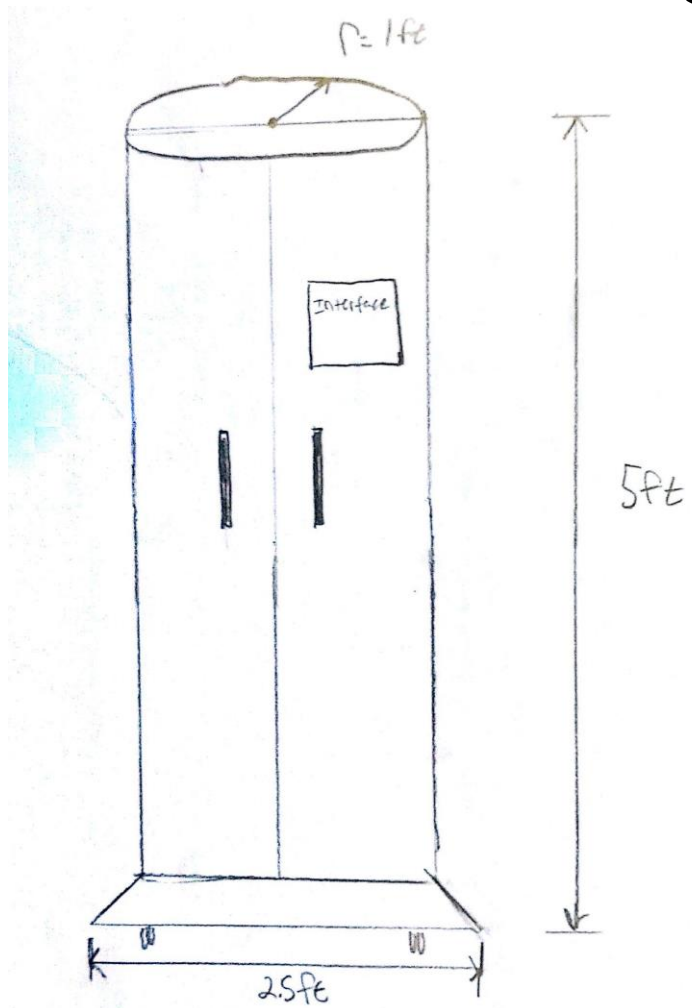
- Advantages:
 - Low cycle time
 - Compact
 - Minimum maintenance
 - Ease of use

- Disadvantages:
 - Cost to produce
 - Power required
 - Material incompatibility

Ultraviolet Light

Advantages	Disadvantages
Maximum kill potential occurs within 2-15 minutes depending on virus or microorganism	Over exposure of UV rays will cause damage to humans
Can adjust light sensitivity to produce better results	Effectiveness of UV light lessens over time
Cost effective	May damage rubber, paper and plastic over time
Sanitize all surfaces	Must clean UV light bulbs regularly

Ultraviolet Light



Decision Matrix

	Safety	Material Compatibility	Maintenance	Cycle Time	Cost	Power Required	Total
Autoclave	0	-1	1	1	1	-1	0.14
Chemical Process	0	1	0	1	1	1	0.57
Lasers	1	1	1	0	-1	1	0.62
Infrared Radiation	0	-1	1	1	0	-1	0.05
UV Light	1	1	0	0	1	1	0.67
Weights	29%	24%	14%	19%	10%	5%	

Project Plan



Conclusion

Through research and decisive reasoning we were able to narrow down our process to a chemical and UV light process.

This is so we could effectively sanitize materials that are porous and require penetrative sanitization.

References

- C.E. Moss, R.J. Ellis, W.E. Murray and W.H. Parr, *Infrared Radiation*, 2013.
- Heraeus Noblelight LLC, *Infrared Heat for Disinfection in the Food Industry*, 2013.
- PathCon Laboratories, *The Microbial Bioburden of USP 797 Compliance*, 2009.
- Sridhar Rao PN, *Sterilization and Disinfection*, 2009.
- Rutala, W., Weber, D., *Guideline for Disinfection and Sterilization in Healthcare Facilities*, 2008, Department of Health and Human Services, 2008
- Carlson, C., *The Use of UV Lights for Disinfection*. Arizona State University, From: <https://cfo.asu.edu/node/2667>
- *Ultraviolet Disinfection: Crucial Link in the Sterilization Chain*. Terra Universal Inc. From: http://www.terrauniversal.com/images/tools/catalog/uvc_germicidal_irradiation_082510135200.pdf