

STERILE PROCESSING BASIC TRAINING: SPD BOOT CAMP®

Module #:8

*Notes on the Thermal Mortification of
Microorganisms*

by

The Central Sterile Processing Initiative

Sterile Processing Basic Training: SPD Boot Camp

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Message From The Central Sterile Processing Initiative Director

Thank you for purchasing this e-course, an introductory and review survey of the basics of sterile processing, *Sterile Processing Basic Training: SPD Boot Camp*.

Thank you, enjoy the program, and I am always just an e-mail away if you have questions or need my assistance during the course of your studies.

Sincerely,
Shane Huey,
Director

www.centralsterileprocessing.net

Preface

This e-course is neither the traditional textbook nor the typical student workbook. It is, rather, a combination of the best and most relevant of information related to the basics of sterile processing education and training presented much like a series of lecture notes with multimedia elements included for a more complete and well rounded educational experience for both sterile processing "newbies" and seasoned veterans simply seeking a comprehensive review alike.

The content is structured as a classroom lecture/text with all relevant points discussed and references provided for further information and investigation.

In this text one will be presented with material contained within the industry standard texts, current field relevant articles, and as well have workspace much like contained within the likewise standard workbooks. Herein, however, the student will find no superfluous material to bog one down unnecessarily. Covered within is only that which one needs to know as a sterile processing tech at the level 1 stage—the ESSENTIALS of sterile processing, that which every tech need know—the prerequisites of the field. References will be cited throughout the course, however, to point students in the right direction should they choose (and we are trusting that they will!) to pursue additional knowledge, training, and advancement in the field of sterile processing.

The course consists of multiple individual modules (at least 15 at the time of this printing). Please read through each module from beginning to end at least once before attempting to complete the assignments and then work your way back through the text completing the required coursework specified in the assignment directions at the end of the module (see contents).

Module 8

Module Objectives

- Understand thermal microbial mortification from death phase to sterility
- Comprehend the concept of "death" with respect to microbes in terms of statistical analysis
- List some conditions and criteria for microbial mortification
- Understand and explain the process of *denaturation*
- Explain the *D value* and comprehend its role in thermal mortification of microorganisms
- Thermal *resistance* in microorganisms and the spore state

Notes on the Thermal Mortification of Microorganisms

Introduction

The primary modality of sterilization in the sterile processing department is steam sterilization, i.e., *thermal* (heat) sterilization. Before proceeding into subsequent modules on the principles of sterilization, it will be of benefit to discuss some general concepts and principles of the thermal mortification of microorganisms.

(*NOTE: This will not be a comprehensive, in-depth module due to the introductory nature of this course. For further reference, please inquire about The Central Sterile Processing Initiative's *Advanced Microbiology and Microbial Mortification Kinetics in Sterile Processing*.)

The Microbial Growth Curve

The biological growth curve (encompassing growth, development, and death) is distinguished by several distinct phases. Several of these phases of relevance are:

- 1) **Lag phase**-Initial exposure to a medium with no net reproduction and productive expansion of the culture.
- 2) **Acceleration phase**-Initial expansion via reproduction and growth
- 3) **Exponential phase**-Maximized rate of microbial reproduction and expansion.
- 4) **Stationary phase**-At a certain level, constancy of number of microbes maintained and becomes semi-homeostatic.
- 5) **Mortification phase**-Phase at which environment becomes inhospitable for microorganisms and viability not maintained. Death begins.

"Microbial death is a statistical phenomenon...applied to the cell represents an irreversible cessation of those vital processes which are essential for growth and reproduction. The death of microorganisms can be measured only by determining the diminution in the number of viable cells in a population" (Perkins, 61).

Determination of Microbial Death

Ascertaining the viability of an organism post exposure to a mortifying process is difficult and the criteria vary. Some general criteria for consideration:

- 1) Inability to continue reproduction.
- 2) Exposed to optimal culture medium to ensure non-viability.

Some Notes on Mortification Via Thermal Modalities and the Mechanism of Denaturation

With the exception of biological spores and prions, most microbes succumb at temperatures above 176 degrees F. The mode of sterilization of such microorganisms occurs via the destruction (by thermal agency) of proteins and nucleic acids, a process referred to as *denaturation*, particularly *protein coagulation*.

The enzymatic proteins of a microbe are dispersed substantially allowing for functionality in viable organisms. Via coagulation, the proteins are denatured and protein structures are altered such as to destabilize the core chemical life components of the microbe which support and sustain its viability.

The D Value

The *D value* (also known as the decimal reduction time) refers to the time required for a sterilization methodology at a given temperature to destroy 90% of a viable microbial colony.

Temporal Aspects of Thermal Death Point

Attainment of a given thermal mortification point temperature for a given microbe does not guarantee total mortification of an entire colony of same microbe. Exposure temperature alone is insufficient. Other considerations are exposure time, size of colony, colony medium, and physiological status of microbes (Perkins, 70).

Microorganismal mortification is resultant primarily of the temperature-exposure time conjunction. At effective kill temperature, each organism has a given D value. At higher exposure temperatures, the exposure time declines. At lower exposure temperatures, exposure time increases in order for mortification to obtain.

Thermal Death Time (TDT) is an optimal rendering of the above discussed relationship of temperature and exposure time. *TDT refers to the optimal effective temperature affecting mortification at the shortest possible time for a specified colony size in a specific medium.*

Thermal Resistance and the Spore State

Microbes demonstrate a host of evolved responses and resistances to a variety of agents capable, under specific circumstances, of mortification. Such agents may be heat, chemical, radiative, etc.

The spore stage of the microbial cycle of life is that of resting state. During this stage, the metabolic machinery of the cell is stepped down and it becomes dormant. At this time, the spore interior becomes reenforced along both its external and internal protoplasm (wall) creating a more effective barrier against mortifying agents.

Spore resistance is dependent upon varying conditions. E.g., density of protoplasmic proteins, chemical content and variation within the spore, number of spores in colony, etc.

Spore resistances vary commensurate with a given bacterium.

Required Readings, Recommended Readings, and Other Resources

Required Reading

Module 8

**Read each of the following articles in its entirety.*

http://en.wikipedia.org/wiki/Bacterial_growth

<http://www.mansfield.ohio-state.edu/~sabedon/biol2025.htm>

<http://en.wikipedia.org/wiki/D-value>

<http://www.mddionline.com/article/assess-or-determine-unraveling-d-value>

<http://www.molecularstation.com/wiki/Sporulation>

<http://www.medicalnewstoday.com/articles/29537.php>

Recommended Reading

Perkins, John J. *Principles and Methods of Sterilization in the Health Sciences*. Chapters 3-4.

Recommended Links

N/A

Module Assignments

Module 8 Assignments

- 1) Read the module in its entirety from cover to cover at least once.
- 2) Read the articles assigned for required reading.
- 3) Provide a brief but detailed summary (2-3 paragraphs *minimum*) of each of the required reading assignments.
- 4) Independently, find 3 additional articles online related to the module and summarize (provide web link) as above.
- 5) Complete the module quiz (posted online separately 3-5 days after posting of this module). Submit with above documents to info@centralsterileprocessing.net. In subject line, type "Module 4 Assignments." In body of e-mail, submit full name.
Module assignments must be completed prior to submission of quiz.

END MODULE 8