



**AL- MUSTAQBAL UNIVERSITY COLLEGE**  
**DEPARTMENT OF BIOMEDICAL ENGINEERING**

**Biomedical Instrumentation Lab**

**BME 514**

**Lecture 4**

**- Autoclave -**

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# Autoclave

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- The medical steam autoclave is a device that uses pressurized, high temperature steam to sterilize medical instruments.
- It is work by subjecting them to high-pressure saturated steam (in the range of 121-134°C).
- It is the most common sterilization procedure, except for those materials that cannot resist heat and moisture.



- Steam sterilizers are often referred to as steam autoclaves, or just autoclaves.
- They are an essential part of the decontamination and sterilization process performed by central sterile services departments (CSSDs) in healthcare facilities.
- This method has the advantages of rapidly producing elevated temperatures, having short sterilization times, and not leaving toxic waste in the material.



- The basic principle of steam sterilization by the action of temperature and saturated steam, to resulting in microbial death.
- Heat is known to destroy microorganisms, but this process of destruction is hastened by the addition of moisture to dry heat.
- Steam in itself is inadequate for sterilization, and therefore, pressure greater than atmospheric is necessary to increase the temperature of steam for thermal destruction of microbial life.



- Saturated steam is a surface sterilizing agent, which is the reason of exposing each item to direct steam contact at the required temperature and pressure for the specified time.
  
- There are four parameters of steam sterilization:
  - Steam
  - Pressure
  - Temperature
  - Time



- Saturated steam (steam in thermal equilibrium with water from which it is derived) acts as an effective sterilizing agent.
  
- Steam for sterilization can be
  - Wet saturated steam (containing entrained water droplets).
  
  - Dry saturated steam (no entrained water droplets).

# Principle



- Pressure serves as a means to obtain the high temperatures necessary to quickly kill microorganisms.
- The two common steam-sterilizing temperatures are 121 and 134°C.
- These temperatures must be maintained for a minimal time to kill microorganisms.
- At constant temperatures, sterilization times vary depending on the type of item.



# Theory of Operation



- An autoclave is a large pressure cooker; it operates by using steam under pressure as the sterilizing agent.
- High pressures enable steam to reach high temperatures, thus increasing its heat content and killing power.
- Autoclaves use pressurized steam to destroy microorganisms, and are the most dependable systems available for the decontamination of laboratory waste.



- Most of the heating power of steam comes from its latent heat of vaporization.
- The amount of heat required to convert boiling water to steam.
- There should be sufficient water in the autoclave to produce the steam.
- The stages of operation of autoclaves include air removal, steam admission and sterilization cycle (includes heating up, holding/exposure, and cooling stages).



- The steam is admitted at the top or the sides of the sterilizing chamber.
- As the steam is lighter than air, it forces air out through the bottom of the chamber to the drain vent.
- The device automatically locks shut when the pressure rises (to avoid steam spraying out if you open it by accident).
- This type of autoclaves is primarily used to process laboratory media, pharmaceutical products, regulated medical waste, and nonporous articles whose surfaces have direct steam contact.



- These machines vary in size, from small models that are placed on the table and used in clinics and physician's offices to large units capable of handling carts for transporting materials.
- This method of sterilization works well for many metal and glass items but is not acceptable for rubber, plastics, and equipment that would be damaged by high temperatures.
- Penetration time becomes prolonged when there is incomplete exit of air and, accordingly, sterilization times are longer.



- This type of equipment has become almost obsolete.
- However, there is currently much more sophisticated equipment available based on the same principle, which facilitates better functioning through automatic controls, vacuum pumps, and microprocessors.

# Autoclaves Consist



Autoclaves, or steam sterilizers essentially consist of the following:

1. A cylindrical or rectangular chamber, with different capacities liters rang, usually made of stainless steel to carry out the high level of pressure and heat.
2. Water heating system or steam generating system.
3. Steam outlet and inlet valves.

# Autoclaves Consist



4. Single or double doors with locking mechanism.
5. Thermometer or temperature gauge.
6. Pressure gauges.
7. Safety valve: it is a system simply contain valve with mechanical principles that work on spring push to the lever that close pipe that used for removing the steam.

# System Description



- The autoclave is an electrically heated sterilizer using steam as the sterilizing agent.
- The heater is a high wattage element for heating the sterilizer to required temperatures.
- The heater also incorporates an automatic over temperature protection circuit.
- If the heater overheats, the mains power switch gets off and allows time for the heater to cool and reset.





- The heater is bolted to the bottom of the sterilizer chamber and is accessible through an access panel on the bottom of the unit.
- The microprocessor based control unit ensures a fully automatic sterilization cycle, control, and monitoring of physical parameters.
- It also contains the necessary circuitry to convert the analog signals from the thermocouple and the pressure sensor into digital form, calibrate those signals, and send them to the main control board.



- The system has facility to store sterilization cycles in the memory of the steam sterilizer that may be having capacity to store many sterilization cycles.
- The information includes cycle stage, chamber temperature, chamber pressure, and jacket pressure along with the information about failures and interruption.

# The standard temperature and pressure of an autoclave



- Processes conducted at high temperatures for short time periods are preferred over lower temperatures for longer times.
- Some standard temperatures/pressures employed are 115 °C/10 p.s.i., 121 °C/ 15 p.s.i., and 132 °C/27 p.s.i. (psi pounds per square inch).
- The processing time is measured after the autoclave reaches normal operating conditions of 121°C (250°F) and 15 psi pressure, NOT simply from the time you push the "on" button.



- Of all the methods available for sterilization, moist heat in the form of saturated steam under pressure is the most widely used and the most dependable.
- Portable steam sterilizers are used in outpatient, dental, and rural clinics.
- These sterilizers are designed for small instruments, such as hypodermic syringes and needles and dental instruments.



- Autoclaving is ideal for sterilizing biohazardous waste, surgical dressings, glassware, and many types of microbiologic media, liquids, and many other things.
- However, certain items, such as plastics and certain medical instruments, cannot withstand autoclaving and should be sterilized with chemical or gas sterilant.

