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Equipments Employed in Large Scale Sterilization

Moist Heat Sterilization, Autoclave, Dry Heat Sterilization, Hot Air Oven, Microwave, Mechanical Sterilization, Air Filter (HEPA Filter),

Moist Heat Sterilization

Autoclave

As a result of cellular protein coagulation, the microorganisms on the object to be sterilized are killed by saturation steam under one atmosphere pressure at 121°C for 15 minutes. Using high-pressure saturated steam and varying temperatures and times, the device sterilizes equipment and supplies. Portable autoclaves and stationary autoclaves are the two main types of autoclaves. Sterilizers on a large scale are sterilized in stationary autoclaves.

Temperature (degrees)	Pressure	Time (min)
115 - 118	10	30
121 - 124	15	15
126 - 129	20	10
135 - 138	30	3

Working

Like a pressure cooker, autoclaves operate by sealing the door to create a sealed chamber, while replacing all of the air in the chamber with steam. Once the steam has been pressed to the desired sterilizing temperature and time, it is then exhausted and the goods are allowed to be removed. Here are the phase-by-phase steps of sterilization.

Purge phase - The sterilizer begins to displace the air by applying steam, and pressure and temperature increase slightly until a continuous flow purge occurs.

Exposure (sterilization) phase - At this point, the autoclave's control system seals the exhaust valve, escalating the temperature within the autoclave and increasing the pressure. Following this, the program maintains the desired temperature (dwells) for the duration of the designated time.

Exhaust phase - By venting the chamber, the pressure is released and the interior pressure is reduced to ambient, even though the contents are still relatively warm.

Dry Heat Sterilization

Hot Air Oven

An electrical device and dry heat are used for sterilization. The original machine was invented by Pasteur. Temperature can generally be set from 50 to 300 degrees Celsius using a thermostat. Different temperatures and times may require direct heating.

Temperature (degree)	Time (min)
170	60
160	120
150	150
140	180

Working

Using forced circulation, hot air circulates inside the oven chamber, allowing the hot air to cook food. By the time hot air reaches the top of the chamber, a fan inside the chamber works to circulate it back to the bottom in order to achieve gradual heating within the hot air oven. Several hours after the contents of the oven have been heated to 160°C, the articles are allowed to remain in the oven until the temperature drops to 40°C. After the sterilized materials reach this temperature, they are removed from the oven.

Applications

- In this way, it is possible to sterilize glassware items such as pestles and mortars, Petri dishes, flasks, pipettes, bottles, test tubes, etc.
- Among the materials that can be sterilized with this method include sulfacetamide, sulphadiazine, kaolin, zinc oxide, starch, etc.

- Among the many uses for fixed oils as vehicles, progesterone injections, testosterone propionate injections, and estrogen dipropionate injections are all sterilized with dry heat.
- In addition to sterilizing scalpels, scissors, spatulas, blades, and glass syringes, it also sterilizes glass syringes.
- Laboratory, research institution, industry, hospital, and R&D center chemicals, glassware are suitably temperature controlled in hot air ovens up to 250°C.
- Various applications are possible with hot air ovens, such as heating, drying, sterilizing, and baking.

Microwave

Different wavelengths and frequencies are used to describe electromagnetic radiation waves and particles. The electromagnetic spectrum covers a wide range of wavelengths and frequencies. There are generally seven broad categories of spectrum based on wavelength, energy, and frequency. It has been widely accepted that microwaves (225 MHz to 100 GHz, particularly 2,450 MHz) are a viable alternative energy source for sterilization. Heating is a byproduct of microwave ovens, and temperature probes are used to control the temperature. At 40°C, sterilization can also take place. Microwaves are used for sterilization, whereas a bactericidal solution is heated for sterilization. A solution of benzalkonium chloride (a quaternary ammonium compound) is heated to approximately 100°C and used to sterilize dental instruments. The current process applies only to instruments that are not packaged. Microwave and convection dry-heat ovens are used simultaneously to treat dry spores of *Bacillus subtilis* and *B. Niger*.

Principle

Radio waves are microwaves, and the frequency of radio waves used most commonly is approximately 2,450 megahertz (2.4 gig). Water and other nutrients absorb these waves, converting them directly into atomic motion, which is then converted into heat.

Working

An electrical outlet converts electricity into microwaves at the power outlet, which is how microwaves are generated in a microwave. Molecular water molecules will be absorbed by the microwaves, which will cause them to rotate due to the electric field from the microwave. Molecular rubbing causes them to heat up, in turn heating the molecules around them.

Mechanical Sterilization

Air Filter (HEPA Filter)

Air purifiers reduce air pollutants by removing particulate matter (HEPA), or High-Efficiency Particulate Absorbers. An example of a filter with 99.97 percent efficiency would be one that can trap particles smaller than 0.3 microns. During the pass of a HEPA filter, particles are emitted in four directions.

Direct impaction - large contaminants like dust, mold, pollen, and mold adhere to fiber in a straight line and travel directly through it.

Sieving - When an air particle moves between two fibers, it's bigger than the gaps, and thus becomes ensued.

Interception - The air is capable of rerouting around fibers, but due to inertia, particles continue on their path and remain attached to the fibers.

Diffusion - It is more likely that ultrafine particles will hit and stick to fibers because they move more erratically than larger ones

Advantage

- In addition to sterilizing thermolabile medications, such as blood products, insulin, and enzymes, the method is also suitable for sterilizing blood plasma.
- During the preparation, all types of bacteria are removed including those that are alive and those that are dead.
- The sterilization process is performed simultaneously with the clarification process.
- A parenteral solution in a small quantity can be rapidly supplied in an emergency with this method.

Disadvantage

- Sterility testing is necessary because the method is not reliable.
- With this method, it is not possible to sterilize suspensions and oily preparations.

- Filters may allow medicaments to be absorbed from a solution.
- There are no immediate indications when the media is defective.
- Aseptic techniques must be used.
- Staff must be highly trained.
- Solution-based solutions are the only kind of medicines that can be processed in this way.

Application

Parenteral solutions containing thermolabile medicines can be sterilized using this method without decomposition, such as insulin, blood serum, and other products containing protein matter, such as heat-sensitive injections and biological products.

Color coded biomedical waste bags

Waste materials are disposed of in colored-coded bags according to their type. The color-coded bags are shown in the following table.

Red disinfected container or plastic bag	Microbial waste
Black plastic bags	Discarded medicines, incineration ash
Yellow plastic bags	For human anatomical, animal, microbial waste
Blue or white plastic bags	Disposable tubing



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