

**SHASHIDHAR PANDA GOVERNMENT
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DEPARTMENT OF BOTANY

STUDY MATERIAL



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Autoclave

1.Introduction:-

An autoclave is a machine that provides a physical method of sterilization by killing bacteria, viruses, and even spores present in the material put inside of the vessel using steam under pressure.

- Autoclave sterilizes the materials by heating them up to a particular temperature for a specific period of time.
- The autoclave is also called a steam sterilizer that is commonly used in healthcare facilities and industries for various purposes.
- The autoclave is considered a more effective method of sterilization as it is based on moist heat sterilization.

2. Autoclave Parts

The simplest form of the autoclave is the pressure cooker types or laboratory bench autoclaves. The following is the detailed description of different components/ parts of an autoclave (Fig 1)

Figure 1. Autoclave Parts



Figure 1 Autoclave Parts

1. Pressure Chamber/Bucket

- The pressure chamber is the main component of a steam autoclave consisting of an inner chamber and an outer jacket.
- The inner chamber is made up of stainless steel or gunmetal, which is present inside the outer chamber made up of an iron case.
- The autoclaves used in healthcare laboratories have an outer jacket that is filled with steam to reduce the time taken to reach the sterilization temperature.
- The inner chamber is the case where the materials to be sterilized are put.
- The size of the pressure chamber ranges from 100 L to 3000 L.

2. Lid/ Door/Cover

- The next important component of an autoclave is the lid or door of the autoclave.
- The purpose of the lid is to seal off the outside atmosphere and create a sterilized condition on the inside of the autoclave.
- The lid is made airtight via the screw clamps and asbestos washer.
- The lid consists of various other components like:

I. Pressure gauge

- A pressure gauge is present on the lid of the autoclave to indicate the pressure created in the autoclave during sterilization.
- The pressure gauge is essential as it assures the safety of the autoclave and the working condition of the operation.

II. Pressure releasing unit/ Whistle

- A whistle is present on the lid of the autoclave is the same as that of the pressure cooker.
- The whistle controls the pressure inside the chamber by releasing a certain amount of vapor by lifting itself.

III. Safety valve

- A safety valve is present on the lid of autoclave, which is crucial in cases where the autoclave fails to perform its action or the pressure inside increases uncontrollably.
- The valve has a thin layer of rubber that bursts itself to release the pressure and to avoid the danger of explosion.

3. Steam generator/ Electrical heater

- An electrical steam generator or boiler is present underneath the chamber that uses an electric heating system to heat the water and generate steam in the inner and the outer chamber.
- The level of water present in the inner chamber is vital as if the water is not sufficient; there are chances of the burning of the heating system.
- Similarly, if the water is more than necessary, it might interfere with the trays and other components present inside the chamber.

4. Vacuum generator (if applicable)

- In some types of autoclaves, a separate vacuum generator is present which pulls out the air from the inside of the chamber to create a vacuum inside the chamber.
- The presence of some air pockets inside the chamber might support the growth of different microorganisms. This is why the vacuum chamber is an important component of an autoclave.

3. Working principle of Autoclave/ Procedure

In general, an autoclave is run at a temperature of 121° C for at least 30 minutes by using saturated steam under at least 15 psi of pressure. The following are the steps to be followed while running an autoclave: -

- Before beginning to use the autoclave, it should be checked for any items left from the previous cycle.
- A sufficient amount of water is then put inside the chamber.
- Now, the materials to be sterilized are placed inside the chamber.

- The lid is then closed, and the screws are tightened to ensure an airtight condition, and the electric heater is switched on.
- The safety valves are adjusted to maintain the required pressure in the chamber.
- Once the water inside the chamber boils, the air-water mixture is allowed to escape through the discharge tube to let all the air inside to be displaced. The complete displacement can be ensured once the water bubbles cease to come out from the pipe.
- The drainage pipe is then closed, and the steam inside is allowed to reach the desired levels (15 lbs in most cases).
- Once the pressure is reached, the whistle blows to remove excess pressure from the chamber.
- After the whistle, the autoclave is run for a holding period, which is 15 minutes in most cases.
- Now, the electric heater is switched off, and the autoclave is allowed to cool until the pressure gauge indicates the pressure inside has lowered down to that of the atmospheric pressure.
- The discharge pipe is then opened to allow the entry of air from the outside into the autoclave.
- Finally, the lid is opened, and the sterilized materials are taken out of the chamber.

Figure 2 Autoclave Principle or Working procedure.

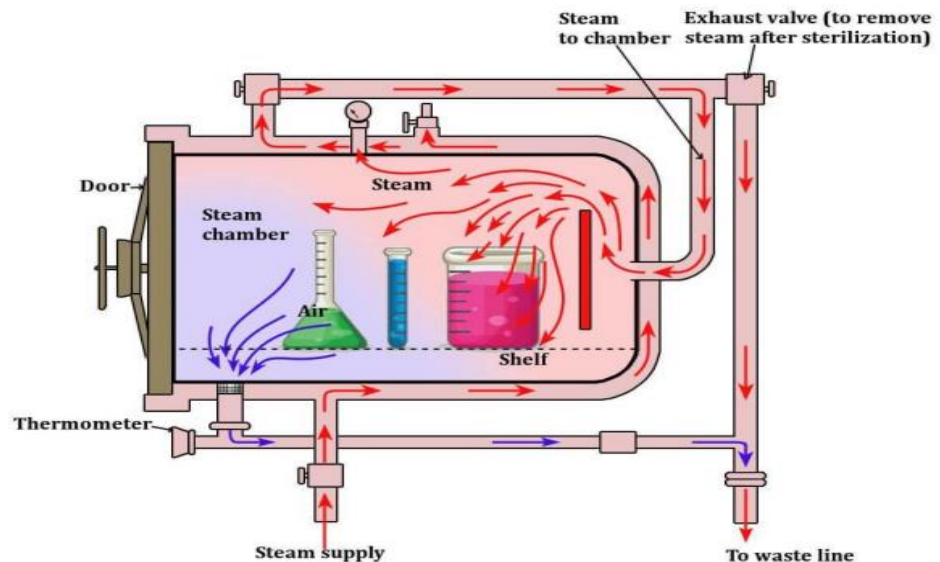


Figure 2 Autoclave Principle or Working.

4. Types of Autoclave

There are different types of autoclaves present in the market, some of which are (Fig 3)

I. Pressure cooker type/ Laboratory bench autoclaves (N-type)

- These, as domestic pressure cookers, are still in use in many parts of the world.
- The more modern type has a metal chamber with a secure metal lid that can be fastened and sealed with a rubber gasket.
- It has an air and steam discharge tap, pressure gauge, and safety valve. There is an electric immersion heater in the bottom of the chamber.

II. Gravity displacement type autoclave

- This is the common type of autoclave used in laboratories.
- In this type of autoclave, the steam is created inside the chamber via the heating unit, which then moves around the chamber for sterilization.
- This type of autoclave is comparatively cheaper than other types.

III. Positive pressure displacement type (B-type)

- In this type of autoclave, the steam is generated in a separate steam generator which is then passed into the autoclave.
- This autoclave is faster as the steam can be generated within seconds.
- This type of autoclave is an improvement over the gravity displacement type.

IV. Negative pressure displacement type (S-type)

- This is another type of autoclave which contains both the steam generator as well as a vacuum generator.
- Here, the vacuum generator pulls out all the air from inside the autoclave while the steam generator creates steam.
- The steam is then passed into the autoclave.
- This is the most recommended type of autoclave as it is very accurate and achieves a high sterility assurance level.
- This is also the most expensive type of autoclave.

Figure 3 Types of Autoclave



Figure 3 Types of Autoclave

5. Uses/Advantages:-

Autoclaves are important devices to ensure the sterilization of materials containing water as they cannot be sterilized by dry heat sterilization. Besides, autoclaves are used for various other purposes.

- They are used to decontaminate specific biological waste and sterilize media, instruments, and labware.
- Regulated medical waste that might contain bacteria, viruses, and other biological materials are recommended to be inactivated by autoclaving before disposal.
- In medical labs, autoclaves are used to sterilize medical equipment, glassware, surgical equipment, and medical wastes.
- Similarly, autoclaves are used for the sterilization of culture media, autoclavable containers, plastic tubes, and pipette tips.

6. Precautions

Although autoclaves are pretty simple to use, there are certain rules of precautions to be followed while operating an autoclave. Some of the important precautions to be followed while running an autoclave are:

- Autoclaves should not be used to sterilize water-proof or water-resistant substances like oil or powders.
- The autoclave should not be overcrowded, and the materials should be loaded in a way that ensures sufficient penetration of articles by the steam.
- The items to be autoclaved should always be placed in a secondary container.
- Only autoclavable bags are to be used to autoclave packaged waste.
- To ensure sufficient penetration, articles should be wrapped in something that allows penetration by steam, and materials like aluminium foils should not be used.
- The items placed inside the chamber should not touch the sides or top of the chamber.
- The wastes and clean items should be autoclaved separately.
- Attempts to open the lid when the autoclave is working should never be made.
- Liquid components should never be autoclaved in sealed containers.
- The liquid inside the containers should only be filled $2/3$ rd of the total volume to prevent the spilling of the liquid.
- Plastic or polyethylene trays or containers should not be used as they might melt and damage the autoclave.
- Besides, never autoclave flammable, reactive, corrosive, toxic or radioactive materials, household bleach, or paraffin-embedded tissue.
- The paper should not be placed directly inside an autoclave as it is a combustible substance. It should be autoclaved in a waste bag on a bio bag setting to prevent fire.