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LAMINAR AIR FLOW WITH REMOTE CONTROLLER

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ABSTRACT

The Laminar airflow (LAF), is a device, designed to prevent the equipment and working environment from particles. Laminar airflow units create particle-free working environments by sucking air through a filtration system and exhausting it across a work surface in a laminar air stream. A Laminar airflow is an equipment that is generally used in microbiology laboratories. It consists of a chamber with an air blower attached to its rear side that allows the flow of air with a uniform velocity in straight lines that are parallel to each other. The main purpose of a laminar flow cabinet/hood is to form a contaminant-free work environment. For this purpose, it filters and captures all types of impurity particles entering the cabinet. It makes use of a filter pad and a special filter system known as a high-efficiency particulate air filter or HEPA filter, which can remove airborne impurity particles that are up to 0.3 micrometers in size. A laminar airflow chamber is also known as a laminar flow closet or a tissue culture hood.

Keywords:

Laminar airflow; Filter pad; High-efficiency particulate air filter; Turbulent regions.

1.INTRODUCTION

1.1 Background

A laminar flow cabinet or tissue culture hood is a carefully enclosed bench designed to prevent contamination of semiconductor wafers, biological samples, or any particle sensitive materials. Air is drawn through a HEPA filter and blown in a very smooth, laminar flow towards the user. Due to the direction of air flow, the sample is protected from the user, but the user is not protected from the sample. The cabinet is usually made of stainless steel with no gaps or joints where spores might collect.[1]

Such hoods exist in both horizontal and vertical configurations, and there are many different types of cabinets with a variety of airflow patterns and acceptable uses.

Laminar flow cabinets may have a UV-C germicidal lamp to sterilize the interior and contents before usage to prevent contamination of the experiment. Germicidal lamps are usually kept on for fifteen minutes to sterilize the interior before the cabinet is used. The light must be switched off when the cabinet is being used, to limit exposure to skin and eyes as stray ultraviolet light emissions can cause cancer and cataracts.[2]

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What is Laminar Air Flow?

A laminar air flow workstation is a closed cabinet fitted with HEPA filtered air flow system. Here, laminar means unidirectional constant flow of air with almost no or minimal turbulence. The air flow velocity remains between 0.3 m/s to 0.5 m/s. The purpose of using such workstations in laboratory is to create particle and bacteria free working environment to carry out specialized work. As these units discharge air towards user, they provide no personal protection but product protection from room contaminants. LAF is short form of laminar air flow.

1.2 Objectives

A laminar airflow system aims to reduce turbulence and maintain uniformity in the flow to reduce contamination. The laminar airflow regime can be applied for down flow or crossflow operations. CFD tools can help in identifying turbulent regions and mitigating them with accurate simulations.

1.3 Definition

Laminar airflow refers to the airflow system in which the filtered air through the HEPA filter moves within a definite space at uniform velocity and direction.

2. Components / Parts of Laminar flow

A laminar flow cabinet consists of the following parts:

1. **Cabinet**

- The cabinet is made up of stainless steel with less or no gaps or joints preventing the collection of spores.
- The cabinet provides insulation to the inner environment created inside the laminar flow and protects it from the outside environment.

2. **Filter pad/ Pre-filter**

- A filter pad is present on the top of the cabinet through which the air passes into the cabinet.
- The filter pad traps dust particles and some microbes from entering the working environment within the cabinet.

3. **Fan/ Blower**

- A fan is present below the filter pad that sucks in the air and moves it around in the cabinet.
- The fan also allows the movement of air towards the HEPA filter sp that the remaining microbes become trapped while passing through the filter.
- In a vertical laminar air flow cabinet, the blower is usually present right below the filter pad. On the contrary, the position of the fan or blower in the case of a horizontal laminar air flow cabinet is right next to the filter pad.

4. **UV lamp**

- Some laminar flow hoods might have a UV germicidal lamp that sterilizes the interior of the cabinet and contents before the operation.
- The UV lamp is to be turned on 15 minutes before the operation to prevent the exposure of UV to the body surface of the user.
- The UV lamp purifies the chamber as well as all the other pieces of equipment present inside it including Petri dishes, test tubes, beakers, watch glasses, etc. The UV lamp should be turned on at least 15 minutes before the operation.

4. HEPA Filter

- Hepa filter or high-efficiency particulate air filter is a special air filter present inside the chamber that helps in the removal of all sorts of contamination particles including bacteria, fungi, and dust particles to maintain a safe and sterile environment. For this purpose, the pre-filtered air is made to pass through the HEPA filter, which acts as the secondary or final filter. The particles that are even 0.3 microns in size can be successfully eliminated with the help of a HEPA filter. To remove the impure particles, a HEPA filter generally makes use of three mechanisms as given below:

Features

- Ultraviolet lamps provide for sterilization of illuminated surfaces inside the cabinet.
- A UV lamp is not a substitute for good cleaning practices.
- Observe personnel safety precautions when using UV lamps.

Chapter 3

3.1 Procedure for working the laminar flow cabinet.

The procedure to be followed while operating a laminar flow cabinet is given below:

1. Before running the laminar flow cabinet, the cabinet should be checked to ensure that nothing susceptible to UV rays is present inside the cabinet.

2. The glass shield of the hood is then closed, and the UV light is switched on. The UV light should be kept on for about 15 minutes to ensure the surface sterilization of the working bench.

Chapter 4

4.1 Type of laminar flow cabinet

Depending on the direction of movement of air, laminar flow cabinets are divided into two types:

1. Vertical laminar flow cabinet

- In the vertical flow cabinets, the air moves from the top of the cabinet directly towards the bottom of the cabinet.

2. Horizontal laminar flow cabinet

- In the horizontal laminar flow cabinets, the surrounding air comes from behind the working bench, which is then projected by the blower towards the HEPA filters.

4.2 Use of laminar flow hood

The following are some common uses of a laminar flow cabinet in the laboratory:

1. Laminar flow cabinets are used in laboratories for contamination sensitive processes like plant tissue culture.

2. Other laboratories processes like media plate preparation and culture of organisms can be performed inside the cabinet.

4.3 Advantages of a laminar air flow

1. The laminar air flow devices are advantageous as they do not release any toxic gas into the environment, hence these are ecofriendly.
2. Laminar air flow chambers do not require frequent maintenance and repair. The only cost associated with such devices is the installation cost. Hence, they are comparatively inexpensive and economical.

4.4 Disadvantages of a laminar air flow

1. Placing objects or hands on the device disrupts the air flow, causes turbulence, and reduces the ability of the device to properly sterilize the internal environment.

2. Some types of laminar air flow devices tend to blow fumes towards the users face.

Chapter 5

5.1 Applications of a laminar air flow

A laminar air flow chamber has multiple uses in a variety of sectors including medicine, biology laboratories, chemical industries, manufacturing factories, pharmaceutical firms, and many more. Some of the prominent uses of a laminar air flow cabinet are listed below:

1. A laminar air flow cabinet is generally used in laboratories to form a sterilized environment for processes such as plant tissue culture. This is because these processes get easily affected due to the presence of impurities in the surroundings.
2. Manufacturing and operation of certain particle sensitive electron devices takes place inside the air flow chambers.

5.2 Limitation of a Laminar Air Flow

Although the laminar airflow cabinet is helpful and spacious, it has certain limitations. They are:

1. Airflow velocity can sometimes increase. A zone of turbulence is created to prevent the increase of airflow velocity, which increases the risk of introducing contaminants inside the sterile environment of the hood.
2. Operation time might increase if the hood is not turned on for 24 hours.

5.3 What are the do's and don'ts of laminar air flow

1. Wear long protective gloves, safety glasses, and lab coats while you operate a laminar workflow cabinet.

2. Don't use the UV light and airflow functions at the same time

3. Always remember to sterilize all apparatus and components inside the machine before and after use.

Chapter 6

6.1 Conclusion

Laminar airflow hoods are essential to any laboratory that does any kind of precision and careful scientific or engineering work — which is to say, virtually every self-respecting laboratory whatsoever. No lab is truly complete without it.

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