

# *Physics of Medical Devices*

*Eighth lecture*

## *Infant Incubator*

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## **The function of the incubator**

Here are 5 functions and types of incubators you need to know:

1. To assist the process of cultivating microorganisms / cell organisms, both unicellular and multicellular including bacterial cultures, tissue cultures, and yeast, as well as ensuring that the humidity and temperature conditions in the room will not hinder the incubation process of microorganisms.
2. To help produce and distribute microbial assemblages.
3. To help the animals breed process like insects in the zoology laboratory.
4. Used as a place / container for storing samples before processing in the laboratory.
5. To help accelerate the growth rate of objects / samples that are difficult to grow naturally or take a long time to grow independently.

## **Parts of the incubator**

1. Benchtop Incubator. This type is the most commonly encountered and used incubator in the laboratory. Generally, it is used to maintain and control organisms so that their temperature can be maintained and not mixed with other microorganisms that are scattered outside the incubator.
2. Incubator shaker. This type is used to cultivate microorganisms by accelerating the process of breeding / growth by transferring heat quickly and evenly throughout the room. This incubator can only be used on liquid objects / samples.
3. CO<sub>2</sub> Incubator. There are several types of bacteria that need to be investigated by increasing the concentration of CO<sub>2</sub>. A CO<sub>2</sub> incubator is needed in several laboratories that focus on research on CO<sub>2</sub>-concentrated

bacteria. It works by maintaining the humidity in the incubator so that bacteria can grow properly by utilizing a cabinet filled with water at the bottom of the appliance.

4. Portable Incubator. It has a smaller size than other incubators in the laboratory, and can be carried anywhere and everywhere.
5. Cooling Incubator. This incubator is equipped with heating and cooling controls that must always be balanced, maintained and at the right temperature

### **Control system**

The main system of infant incubator-:

#### **1- Air circulation system:- contain:**

- ❖ Fans used to distribute the air inside the glass and also distribute the temperature
- ❖ that the heater made it through the operation.
- ❖ Micro filter: - it is made of special fibers composed of three layers to pure the air.
- ❖ The micro filter must be replaced each three month.
- ❖ Filter cap
- ❖ Air convection tube:- it convect air from behind filter directly to air chamber

#### **2- Humidification system:-**

- Water tank: - it is contain distilled water down infant chamber, water must be replaced every 24 hours at least.
- Saw tooth plate: - is used to hot air passage distance increase on water tank to obtain on proper humidification.

- mechanical switch to control on dry and moist air

### **3-Heating system**

- ❖ Heater
- ❖ thermostat used to control the temperature inside the incubator so it will disconnected when the temperature reached the wanted level, when temperature decrease or increase from 37 °c or according to the situation of the baby.
- ❖ Safety thermostat used to prevent temperature from increasing above 38 °c that connect with electronic circuit shots a sound or light alarm in case increasing of temperature.

### **4- Control system:-**

- The control system uses thermistor in bridge circuit, with the set point resistance; the bridge output is amplified, giving the voltage V1, which is proportional to the difference in temperature between the thermistor and the set point resister. A 1 HZ-low frequency saw tooth generator produces voltage V2, having an amplitude equal to the maximum value of V1, then V1 and V2 are compared in a comparator circuit that produces on output voltage V3 when V1 is greater than V2
- V3 voltage controls agate pulse generator that produces pulses for the siliconcontrolled switch. While V3 is high, the silicon controlled switch allows the power line voltage to be applied to the heater of the incubator.

### **5- Infant chamber:**

it is made of resist glass or plastic. It is contained group of holes to control and regulate infant position and temperature

6- Alarm system: - incubator

has simple alarm system to alert the clinical staff if there is any dangerous of the device. The system contain a temp controller switch that carriers power to alarm when the temperature exceeds the safe limit, there is a buzzer connected in series with that is activated by a bimetallic strip.

### **Faults & repair**

The temperature high inside the glass, in order to solve this problem we should check the motor of fan, where the fan not work because of burning of motor or problem in switch of working. And then check the thermostat that control the temperature inside the glass, in this case the heater work with all its nature because there will be no control on thermostat, so it is should be change, in order to prevent burning of the child. ' If there is no reading to the temperature it's either fault in the thermostat or fault in the sensor which is responsible for reading. ' There is a leak inside the glass of incubator, so make sure that all the holes or opening found in the hot glass closed and there is no leak. ' The incubator has no problem and do not work so check the power supply. ' Fault in the increasing temperature alarm lamp.