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Comprehensive Study of Laboratory Incubator

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Abstract: *An incubator is a device used to grow and maintain different microorganisms by temperature. Incubators are also use to produce the human proteins like insulin for providing the treatment to diabetic patients it also use from treatment of other various diseases. Incubators are use in maternity hospitals in neonatal units to care for newborn babies which are may be premature or suffering from illness, breathing difficulties or other birth complications. The incubator act as a surrogate for the developing eggs to hatch baby chickens. Incubators are also use for the storage purpose mainly to store the medicinal sample by maintaining suitable condition.*

Keywords: *incubator*

I. INTRODUCTION

The incubators are device which are largely use in the laboratories or Medical center for the growth, development or production by providing and maintaining the favorable temperature to micro organisms such as bacteria, fungi, yeast or viruses and also to egg, cell or tissue culture, premature babies etc.

Basically incubators are mostly use for the growth of microbes in microbiology and laboratories and also it use in poultry farms because not all the hens are capable of breaking an egg or hatching their eggs by which chicken comes out from it, and at those time when these type of problems are arise to hen for hatching, then the incubator act as a surrogate for the developing eggs to hatch baby chickens.

Incubator is the device, which provide or create similar condition as the natural environment for development and growth of the organisms as similar as natural procedure. By maintaining proper and favorable temperature, atmospheric moisture.

The process in which incubator device is use for the developing the organism is called as incubation. Also most of time incubator is use for genetic engineering for promoting cell growth bycreating favorable condition.

An incubator is a part of essential laboratory equipment necessary for cultivating microorganisms under artificial conditions.

An incubator can be used to cultivate both unicellular and multicellular organisms.[3][4][6]

1.1 Various Types of Incubator

INCUBATORS

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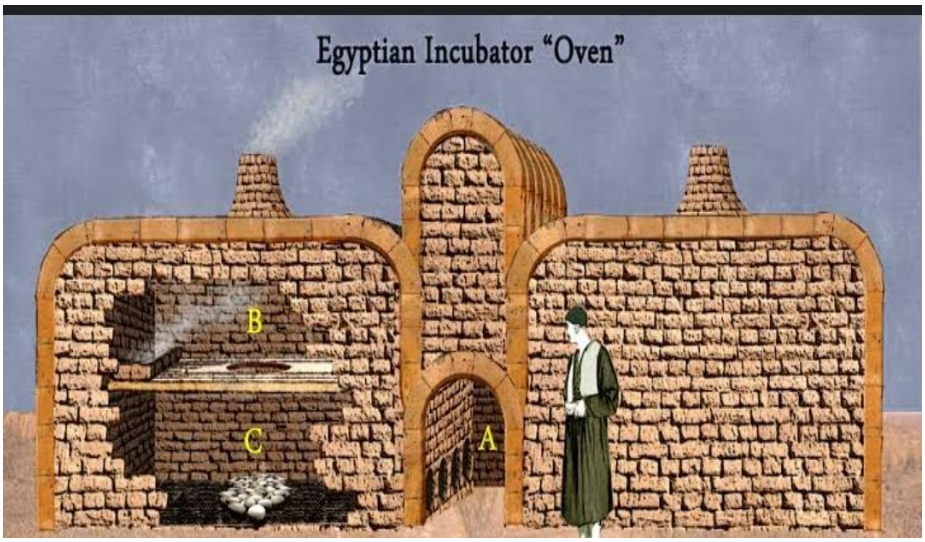
1.2 Application in the incubator

- Incubators are use in the various industries like food industry, and pharmaceutical industries. .
- Incubators are use in various laboratories like a research laboratories, science laboratories, industrial laboratories, and institute laboratories for experimental purpose.
- It is use to production of micro organisms such as bacteria, fungi, yeast or viruses.
- It is use to the developing eggs to hatch baby chickens.
- Used to maintain the growth of different microbial cultures or cell cultures, which we can use in later. Sometimes they are used to enhance the growth rate of organisms.
- It also used to store different medical samples.
- It is also mainly use for the genetic engineering
- Incubators are use in hospitals neonatal units to care for newborn babies who may be premature or suffering from illness, breathing difficulties or other birth complications.
- Incubator also use to avoids the hypothermia condition by helping the newborn babies body through maintaining a favorable temperature
- Incubators are also use to reproduce the human proteins like insulin for diabetic patients.[14]

II. HISTORY OF THE LABORATORY INCUBATOR

The first incubators



EGYPTIAN INCUBATOR

The first incubators were invented many years ago in ancient Egypt and China, which is they wereused the incubators to provide a suitable temperature to keep chicken comfortably in high temperature.

The first incubator which are invented by Egypt and china are probably made up by using rocks and soil they build a large room type structure in which there are different chambers are produce and onespecial chamber is produce for the fire they provide the heat to the egg by fires and create a favorable andsuitable condition by supplying a even and equal heat distribution for egg to hatch.

Their main aim behind the egg incubator is that when the hen was not able to hatched their eggs and various problem raised for hen, to solved those type of problems, then the incubator where invented which was acts as a surrogate for the developing eggs to hatch baby chickens as it allowed chicks to come from eggs without a hen sit on them. By which there was no requirement to hen for lay more amount of egg in shorter time duration. [3][4][24]

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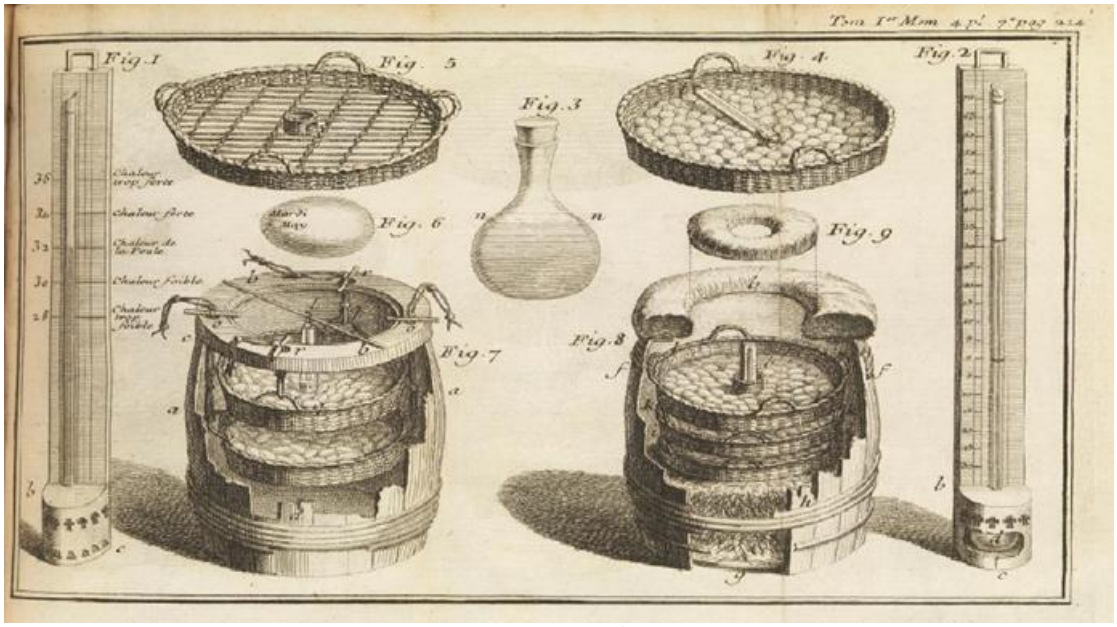
In the 17th century



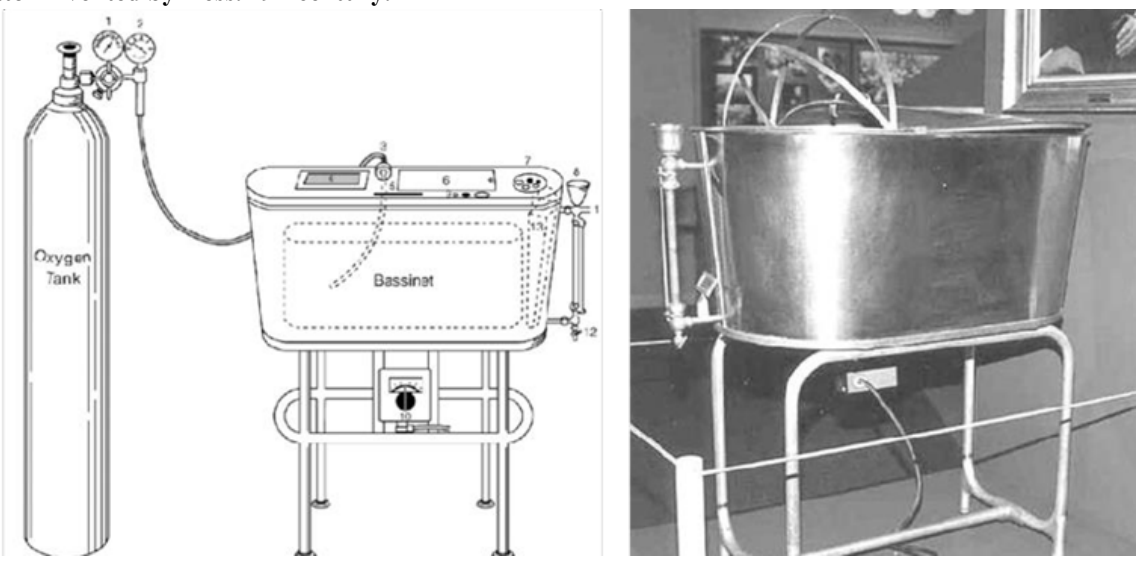
INCUBATOR FROM 17th CENTURY

The first incubator which is invented from Egypt and China was received modification or an updated in the 16th century. More proper and modified egg incubator is design when Jean Baptiste Portadrew a picture of ancient Egyptian design to create new and more modern and modified egg incubator.

In 17th century Rene-Antoine Ferchault de Reaumur took up the remaining work of discovering a modern egg incubator. Because while working on new incubator Baptiste had to discontinue his work due to having interest in learning other things.

In Incubator Which invented by the Reaumur Was made up of wood he use wooden materialin it and he also attach his thermometer which is called as Reaumur thermometer its other name is "Octogesimal division" for measuring the temperature and maintain it. And it defined o to 80 degree. He use wood stove and also use his another various inventions [3][11]

Incubator invented by Hess. 19th century.



INCUBATOR BY HESS

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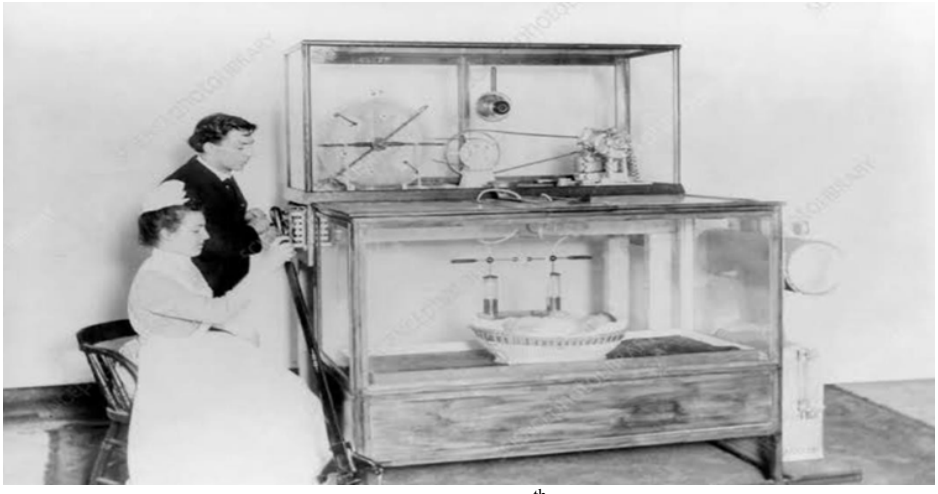
In the duration of 19th century, doctors are focused on problems related to the newborn babiesand especially towards premature babies. Many problems like illness, breathing difficulties or other birth complications and main problem of hypothermia in which baby's body required proper suitabletemperature to survive. In the solution of all these problems baby incubator in invented in 19th century

The first baby incubator was used in Paris at maternity hospital name as "Maternity of Port Royal".That was used by kerosene lamps. Than after approx after fifty to sixty year later Julius H. Hess he is an American physician who is known as father of neonatology (branch of medicine which involves the treatment and care of newborn babies.) he discovered electric baby incubators which are also use in a today's days. [5][38]

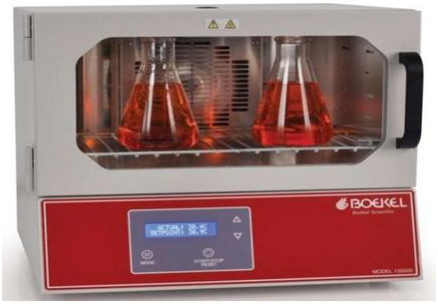
In the 20th century



INCUBATOR FROM 20th CENTURY

After baby incubator another modification, development and innovation in incubator technology came in around 1960s. On that time mainly CO_2 incubator was invented and comesto the market. On that time incubators also began to be used in genetic engineering scientist could produce a important proteins like insulin for treatment of diabetic patient with the use of incubator. On that duration there is no any option to diagnosis the microorganisms such as viruses, bacteria's which are carries by the blood inside the human body which were reasons for many problematic diseases. They are also called as pathogens. The CO_2 incubators had a ability to diagnosed or identify and study pathogen which are present inside the body fluid. After that the demand of CO_2 incubator was increased in medical filed. In its process, a samplewas collected and placed onto a sterile dish and after that put the sterile dish with sample intothe incubator. The temperature of the incubator was maintained at 37 degrees because it should match with normal human body temperature. The incubator which maintained the suitable atmospheric carbon dioxide and nitrogen levels which is important to promote cell growth.[2][,3]

21th Century (Latest)



INCUBATOR FROM 21th CENTURY

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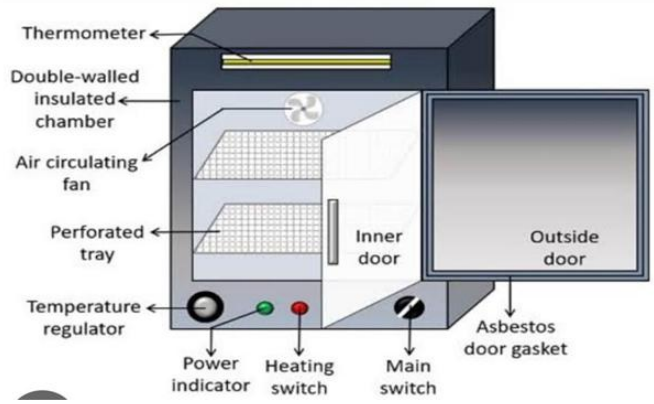
Now a day's incubator becomes most essential equipment in medical field specially.

Incubators are performs different variety of functions in a scientific laboratories and medicinal laboratories for performing different types of experiment. It is very essential experimental equipment for various medicinal colleges. Incubators mainly maintain a constant and proper temperature, by which they are use for a genetic engineering. Many incubators also control atmospheric moisture. It creates a artificial condition similar as a natural one for growth, development and production of micro organisms such as bacteria, fungi, yeast or viruses and also to egg, cell or tissue culture, premature babies etc by maintaining and providing proper amount of temperature, humidity, oxygen, and CO_2 levels. Inside the incubator air is constantly circulating by which it ensure the even distribution of temperature. [6]

III. PART OF INCUBATOR



DIFFENT PART OF INCUBATOR

LABORATORY INCUBATOR

Parts of Incubator

Cabinet

1. The cabinet is primary part of incubators body which is a double-walled cube shaped enclosed chamber. In which we put the sample for incubation process.
2. It is double-walled in which the outer most wall is made up by using stainless steel and inner wall is made up by using aluminum.
3. There is space between double-walls which is filled with glass wool to keep the cabinet totally pack in the incubator.
4. For the smooth working of cabinet it should be insulated properly for maintain proper condition inside incubator.[1]

Door

1. Its main function is to avoid the microorganisms by entering inside the cabinet.
2. To close the cabinet for maintaining the favorable temperature. [1]

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Control Panel

1. On incubator there is a control panel in outer wall of incubator. There are various swiches are located for operating the incubator.
2. The control panel also has a switch to control the temperature and some light for signals .[1]

Thermostat

1. A thermostat is used to maintain and supply the required temperature in the incubator.
2. After the desired temperature is supplies, the thermostat automatically maintains the incubator at that temperature until the temperature is changed again.[1]

Perforated shelves

1. On these shelves the culture media bound to the inner wall are some perforated shelves ontowhich the plates with the culture media are placed.
2. The perforations on the shelves are easily allow the flow of hot air evenly and heated thecabinet inside of the incubator.
3. In incubator the shelves are easily removable to clean the inside surface of the cabinet to avoid contaminations .[1]

Asbestos door gasket

1. It's very important that door of incubator should be totally air tight for creating a proper conditionfor sample to incubate. The asbestos door gasket is responsible for give a air tight seal between doorand cabinet.
2. The asbestos door avoid the external air of incubator by entering inside it which create totally hotenvironment inside the incubator.[1]

L-shaped thermometer

1. A thermometer is main part of incubator to measuring the temperature inside it and it islocated at the top part of the incubator.
2. The thermometer is clearly visible by which we can easily see the difference of temperature.
3. The one end of thermometer is outer side of the chamber and next end with the mercury bulb is protruded slightly into the chamber of the incubator.[1]

Humidity and gas control

1. The CO_2 incubators are artificially provides the CO2 gas and automatically controls the levelof gas.
2. The chamber contains the water. Then the water is vapourised to maintain the relative atmospheric moisture inside the chamber.[1]

Principle

1. An incubator is works on the principle of that, microorganisms require a particular amount of the temperature for their growth and development.
2. All incubators are based on the concept that when organisms are required proper amount of temperature, humidity, oxygen, and carbon dioxide levels, for their growth by providing them these favorable condition they divide to form more organisms.
3. In an incubator temperature is the main concept of incubation, so the thermostat maintains a constant temperature in the cabinet of incubator that can be read from the outside via the thermometer which is located at the top side of the incubator.
4. The temperature is maintained by increasing and the decreasing the heat. By these type of heating cycles temperature is supplies. During the heating cycle, the thermostat heats the incubator, and during the no-heating period, the heating is stopped, and the incubator is cooled byradiating heat to the surrounding.

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5. The asbestos door from the outside the cabinet which provides the insulation that creates an isolated condition inside the cabinet, which allows the microbial growth.
6. The conditions like atmospheric moisture, temperature, airs, gases and CO2 are also provide and maintain through various mechanism that produce condition as similar as the natural one for growth of organism.
7. In some incubators they provide CO2 for balancing the ph and atmospheric moisture that required for the growth of the organisms. [9]

IV. WORKING OF INCUBATOR

The cultures of organisms are produce, then that culture plates are keep inside the incubator atthe suitable and favorable temperature up to required period of time. For the bacterial growth the temperature is mainly maintained up to 37°C in many laboratories .[2]

The following are the steps to be followed while using an incubator:

1. While using the incubator it's very important to make sure that incubator is in normal temperature and it should be clean make sure that no remaining items are present in the incubator from the previous incubation process. If we use it without checking these conditionthan it affected on our current process of incubation.
2. Then after checking put the sample culture inside the incubator cabinet on shelves and closethe door tightly and kept it close and then switch on the incubator .Then heat is supplies inside the incubator evenly in desired amount. then temperature is raises up to its proper requirement for which culture is grows.
3. In that if the organism requires a particular amount of CO_2 gas than it should also be provided through the incubator.
4. Once all the parameters are supplies to the organisms, the petri dish cultures are placed on the perforated shelves upside down.
5. If it is essential to incubate Petri dish of cultures for some days, the plates are sealed or areplaced in plastic bags.
6. Now, the door is locked and seal tightly, and the plates are kept inside for the required timeand favorable temperature and condition before taking them out.[2]

Types of incubator

The incubators are divided into the following types:

1. Benchtop incubators
2. CO2 incubators
3. Cooled Incubators
4. Shaker incubator
5. Portable incubator

1. Benchtop incubators

1. Benchtop incubator is mostly used type of incubator which is available in most of the laboratories.
2. These incubators are mostly available in IVF lab and mainly use in IVF process that is in vitrofertilization .[2]

2. CO2 incubators

1. CO2 incubators are those incubators which use CO2 gas for incubation and it automaticallycontrols the level of CO2 in cabinet and also controls the atmospheric moisture.
2. This incubator is mainly used for the development and production of the cultivation of differentbiological or cell culture which requiring up to 5-10% of CO2 concentration.
3. Water is kept underneath the cabinet of the incubator to control the atmospheric moisture.[2]
4. By controlling the CO2 and oxygen levels in incubators, technicians are able to maintain the correctph in the growth culture.[2]

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3. Cooled Incubators

1. The cooled incubator is a device that is thermostatic which is designed to store the samples bymaintaining and providing specific temperature.
2. The main purpose of cooling incubator is to preserve the sample by maintaining the favorable condition it have heating system as well as cooling system by which sample can be store and incubate .[2]

4. Shaker incubator

1. A Shaker incubator is mainly use for the cultivation of microorganisms by using the incubationmethod.
2. Its main function is that is supplies faster and constant temperature by heating the culture samplewhich leads to accelerate the proper growth and development of microorganisms.
3. This incubator, can only be used for liquid culture media.[2]

5. Portable incubator

1. Portable incubators are lighter in weight smaller in size as compare to other incubator and are used for checking of environmental microbiology and water examination.[2]

Use of Incubator

Some of the uses of incubators are given below:

1. Incubators are used to development or production by providing and maintaining the favorable temperature to micro organisms such as bacteria, fungi, yeast or viruses and also to egg, cell or tissue culture, premature babies etc.
2. Incubators are also use for the storage purpose mainly to store the medicinal sample bymaintaining suitable condition.
3. Some incubators are used to accelerate the growth and development rate of organisms, having a prolonged growth rate in the natural environment.
4. Incubators are also use to reproduce the human proteins like insulin for providing the treatment to diabetic patients.
5. Incubators are use in various laboratories like a research laboratories, science laboratories, industrial laboratories, and institute laboratories for experimental purpose.
6. Incubators are use in hospitals neonatal units to care for newborn babies which are may be premature or suffering from illness, breathing difficulties or other birth complications.
7. It is use to the developing eggs to hatch baby chickens[4][38]

Precaution

The following precautions are to be followed while using an incubator:

1. While using the incubator, during the incubation process avoid to open a door of incubator it leadsto enter the external air and unwanted microorganisms inside in cabinet and affect on sample.
2. During the incubation process the incubator should be set at the specific degree of temperature the irregular rising and falling in temperature should be affected on the process of incubation.
3. The incubator should be properly clean to avoid the any type of contamination in incubator. Also for that the plates of incubator should be placed upside down with the lid at the bottom to avoid thecondensation of water on to the media.
4. It's very important to check that the incubator is working properly or not by checking thetemperature.
5. While using the incubator for an more duration of time, sterile water should be kept underneath theshelves to prevent the culture media from drying out by excessive heating.[9][3]

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Advantages of incubator

1. It is very easy to use the incubator. There is no risk for any harm while performing theexperiment
2. The incubator is maintaining its temperature automatically and it creates the favorable condition as per requirement in which the organism is grows or develops.
3. By using the incubator it does not harm to environment It performs the experiment safely.
4. Incubation is process which is use for producing the insulin for the diabetic patients
5. Incubator is smaller in size and some of incubatory are lighter in weight as compared with other laboratory equipment.
6. Incubators use less energy than other types of laboratory equipment, and also its less timeconsuming.
7. Some incubator also provides the CO2 gas in a proper concentration and it maintained automatically. [8]

Disadvantages

1. Incubator is having very high cost. Its mainly depend on the quality, features, size and type of theincubator.
2. By using incubator there is having the high risk of contamination, so it's essential to sterilized itafter using the equipment. And also they require constant good maintenance..
3. Incubators are quite sensitive equipment. If not handled with care, they can be easily damaged.
4. After the experiment it required some time to normalize its condition and prepared for performing the next experiments.
5. For running the incubator it required energy of electricity.[27]

Incubation Problems

There are several common incubation problems that may arise in a laboratory setting:

Contamination:

After the sample incubated the incubator should be clean and free from any microorganism to avoid and prevent it from the condition of the contamination. If the incubator becomes contaminatedthan there are many problems arise during the process of incubation. [8]

Irregular rising and falling in temperature fluctuations:

During the incubation process the incubator should be set at the specific degree of temperature the irregular rising and falling in temperature which is also called as the temperature fluctuation can causes the affect on the growth and development of the sample and affect on the process also by risinga problems.[8]

CO2 gas maintenance:

CO2 Incubators which are use CO2 as a gas for incubation process should maintain a specific and proper amount of level of CO2 in the incubator, which avoid the problems that can affect the growth and development of the samples being incubated.[8]

Atmospheric moisture issues:

Incubators should be set to a particular atmospheric moisture level which is also called as a humidity level, it avoid to affect the growth and development of the samples being incubated.[8]

Incubator use for human babyBaby Incubator

In maternity hospitals there are Neonatal Internal Care Unit (NICU) which are nursery in a hospitals that provide a proper care and treatment to sick or preterm babies. NICU we will observe lots of high-tech equipment. All of those equipments are there to help healthcare providers take care of baby and give them proper and comfortable environment. The babies which are birth with many complications they are mainly treated there. One of the most essential part of equipment in the NICU is a baby incubator. This is a bed for baby that helps provide and maintain their body temperature andprovides the ideal environment they need to grow, develop and survive.[6]

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Reason for baby incubation.

There are a lot of different reasons your baby may need to be in a baby incubator. Some of theseinclude.

Problem in respiration.

When the new born or the premature baby suffering by the trouble in breathing or have a breathing problem through his immature or undeveloped lungs in this condition the baby incubation process can be treated by helping baby to breathing though machine that pushes oxygen through baby nose and respiratory system. This breathing problem in baby is also called as a Respiratory distress syndrome (RDS) [9][6]

In low blood sugar level. Hypoglycemia.

In the condition of low blood sugar level in newborn or premature babies incubation process is use to normalized it. These type of conduction is also called as a hypoglycemia and the main reason for the low blood sugar level means hypoglycemia is poor nutrition for mother during pregnancy.[9][6]

Birth before proper time.

This is the main reason for a baby needs a baby incubator that is premature delivery. The premature babies who are born too early, before 37 weeks or before 9 months are suffering from manycomplications because of their weak body and undeveloped body. And this type of condition is mostlyhappen when a mother has a various health problems like diabetes. And because of that the premature babies have a problem like low birth weight, irregular temperature, and unstable vital signs. A baby incubator helps control and maintain their body temperature.[9][6]

Physical or emotional distress Traumatic birth.

During the birth of baby many difficulties and problems were arise by which the baby may notget a proper amount of oxygen or the baby get less supply of oxygen that reduce a flow of blood inthis condition baby incubation process is use to normalizes the condition. And it's also called as a Traumatic birth. The treatment by incubation is preventing the baby's brain by injury. [9][6]

Work of baby incubator

Baby incubators is use to create a favorable condition for a baby by providing a proper amountof temperature to his body. After the birth of newborn baby can have a problem to maintain their body temperature because there is a difference in the temperature inside the mother body when baby is unborn and outside the mother body after taking birth. Mostly those born premature baby can have more problem to regulating their body's temperature as per as surrounding. In baby incubator the temperature is automatically sets and controls as per baby's body temperature. And it also a device which keep the atmosphere in a room moist. Which avoid any harmful condition or problem for a baby skin and keep their skin safe. Just because they have very sensitive skin it's very important to taking a proper care of temperature for their skin. Also the baby incubators avoid any unwanted noise by blocking them. Basically babies have a less fat, which make them face downwards means in prone in condition of having an abnormally low body temperature which is also called as hypothermia.

BABY INCUBATOR

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It is condition in which body produce less amount of heat and loses it faster than it can produce. Which can make many health problems to a baby like breathing difficulties, low tissue oxygen and slowed development of body. Baby incubator also avoids the hypothermia condition by helping the baby's body through maintaining a favorable temperature. [12]

V. CONCLUSION

Incubator is protected by interposing material that prevents the loss of heat or the intrusion ofsound it enclosure in which temperature, humidity, and other environmental conditions can be maintained at a favorable condition for growth, hatching, or reproduction of the culture. There are three types of incubators: poultry incubators, infant incubators, and bacteriological incubators.

Incubators are device that provide proper and particular amount of temperature in which body can survive properly. Basically premature babies have a less fat, which make them face downwards meansin prone in condition of having an abnormally low body temperature which is also called as hypothermia; Baby incubator also avoids the hypothermia condition by helping the baby's body through maintaining a favorable temperature. Other main functions of incubator are reproduction of micro organisms such as bacteria, fungi, yeast or viruses and breeding of insects and hatching of egg in zoology

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