

Investigating the Limitations in the Fabrication of Locally Made Bench Incubator in Ebonyi State University, Abakaliki (Post COVID-19 Project)

Udejah VN*

Department of Medical laboratory Science, Ebonyi State University, Abakaliki

ABSTRACT

The limitations got during the fabrication of a locally made bench incubator by 2020 / 2021 biomedical electronics engineering students are reported in this write up. The bench incubator is a useful equipment used in the Medical and scientific laboratories for media culture of samples such as blood and urine. Imported bench incubator can be expensive, the need for constructive and substitution improvisation using available resources that are less expensive became necessary. This bench incubator was locally fabricated in the department of Medical laboratory science in Ebonyi State University - Abakaliki to enable the students have an understanding of Biomedical engineering and bridge the gap between theory and practicals involved in their professional practice. There were some limitations in the course of carrying out the project.

KEYWORDS

Fabrication, Biomedical electronics, Bench incubator

Corresponding Author:

Udejah VN, Department of Medical laboratory Science, Ebonyi State University, Abakaliki;
Email: vakadujah45@gmail.com

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INTRODUCTION

An incubator is equipment used in growing and maintaining microbiological cultures or cell cultures. The incubator maintains optimal temperature, humidity and other conditions such as the CO₂ and oxygen content of the atmosphere inside. Incubators are essential for much experimental work in cell biology, microbiology and molecular biology and are used to culture both bacterial and eukaryotic cells.¹ The purchase of new incubator can be very expensive, therefore the need to improvise or fabricate locally made one using available resources that are less expensive.

The incubator was locally fabricated by 400 level Group 7 students of Medical Laboratory Science, Faculty of Health Science and Technology, Ebonyi State University. Abakaliki.

Background to the Study

From aiding in hatching chicken eggs to enabling scientists to understand and develop vaccines for deadly viruses, the laboratory incubator has seen numerous applications over the years it has been in use. The incubator has also provided a foundation for medical advances and experimental work in cellular and molecular biology.

An incubator is made up of a chamber with a regulated temperature. Some incubators also regulate humidity, gas composition, or ventilation within that chamber. While many technological advances have occurred since the primitive incubators first used in ancient Egypt and China, the main purpose of the incubator has remained unchanged: to create a stable, controlled environment conducive to research, study, and cultivation.

To do this, a sample was harvested and placed on a sterile dish and put into the incubator. The air in the incubator was kept at 37 degrees Celsius, the same temperature as the human body, and the incubator maintained the atmospheric carbon dioxide and nitrogen levels necessary to promote cell growth.²⁻⁷

Operating Principle of an Incubator

- An incubator is based on the principle that microorganisms require a particular set of parameters for their growth and development.
- All incubators are based on the concept that when organisms are provided with the optimal condition of temperature, humidity, oxygen, and carbon dioxide levels, they grow and divide to form more organisms.
- In an incubator, the thermostat maintains a constant temperature that can be read from the outside *via* the thermometer.
- The temperature is maintained by utilizing the heating and non-heating cycles.
- During the heating cycle, the thermostat heats the incubator, and during the no-heating period, the heating is stopped, and the incubator is

cooled by radiating heat to the surrounding. (sources: microbesnotes.com; udeajah, 2021)

- Insulation from the outside creates an isolated condition inside the cabinet, which allows the microbes to grow effectively.
- Similarly, other parameters like humidity and airflow are also maintained through different mechanisms that create an environment similar to the natural environment of the organisms.
- Similarly, they are provided with adjustments for maintaining the concentration of CO₂ to balance the pH and humidity required for the growth of the organisms.
- Variation of the incubator like a shaking incubator is also available, which allows for the continuous movement of the culture required for cell aeration and solubility studies.

Applications of Incubator

Incubators have a wide range of applications in various areas including cell culture, pharmaceutical studies, hematological studies, and biochemical studies.

Some of the uses of incubators are given below:

1. Incubators are used to grow microbial culture or cell cultures.
2. Incubators can also be used to maintain the culture of organisms to be used later.
3. Some incubators are used to increase the growth rate of organisms, having a prolonged growth rate in the natural environment.
4. Specific incubators are used for the reproduction of microbial colonies and subsequent determination of biochemical oxygen demand.
5. These are also used for breeding of insects and hatching of eggs in zoology.
6. Incubators also provide a controlled condition for sample storage before they can be processed in the laboratories.

METHODOLOGY

The materials and methods used for the local fabrication of the incubator are given here.

Materials / Components Used

1. Metal casing
2. Heating element
3. Thermostat
4. Plug / cable
5. Indicator light
6. Wires

Parts / components of locally Made Incubator: The make-up of the locally made incubator is listed below:

i. Metal Casing: It is made of galvanized material which is heat resistant. This is used to fabricate the body of the incubator that is housing the heating element and other

electrical components such as the thermostat and indicator light etc. It can be made of stainless steel or aluminum to avoid rusting

ii. Heating Element: Converts electrical energy to heat energy, used to heat up the incubator to its required temperature.

iii. Thermostat: A thermostat is used to set the required temperature of the incubator. After the desired temperature is reached, the thermostat automatically maintains the incubator at that temperature, until the temperature is changed again.

iv. Plug: This is where the wire is connected or joined before it is plugged to the power source.

v. Indicator Light: It shows when the Incubator is "ON" or "OFF".

vi. Flex Wire: This is used for the entire connection of the various components of the incubator up to the point of its connection to the source of power, for the equipment to function.



Figure 1: Top view



Figure 2: Anterior view



Figure 3: Back view

METHODS

The procedures or steps for the actual fabrication of the bench incubator are given below, viz:

1. A Market survey was made by selected individuals from the group to ascertain the price of the materials.
2. Financial contribution was made by group members after a specified amount was accepted by all members of the group.
3. The materials were purchased by the various members of the group.
4. The height and breadth of the metal sheet were measured: 3 ft by 1.5 ft, and was coupled by a welder.
5. An opening was created underneath by the posterior side, through which the heating element was passed through.
6. The iron or metal casing was coated with a silver paint.
7. The electrical connections were made between thermostat, indicator light and heating element.
8. The cable / plug were also connected to the thermostat that goes to the heating element inside the incubator.
9. Then the plug and cable were connected to a power source to test its efficiency.

Samples that can be Grown in an Incubator Includes

1. Microbiological cultures
2. Tests
3. Culture plates and Medias.

RESULTS and DISCUSSION

The results of the fabrication of local bench incubator are given pictorially as shown. The side view, anterior, exterior, top view, interior and front elevation of the bench incubator are shown in (Figures 1 - 7) below. The circuit diagram is shown in (Figure 8).



Figure 4: Interior view



Figure 5: Side view

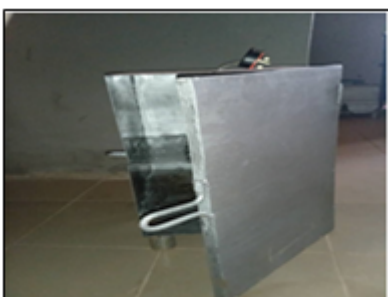


Figure 6: Front view

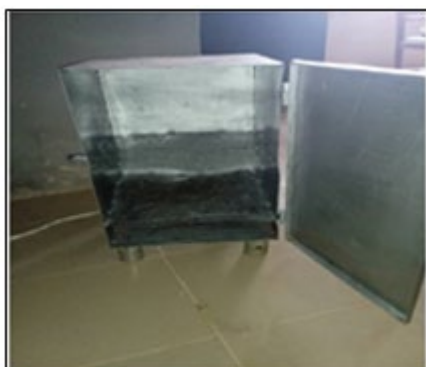


Figure 7: Anterior view

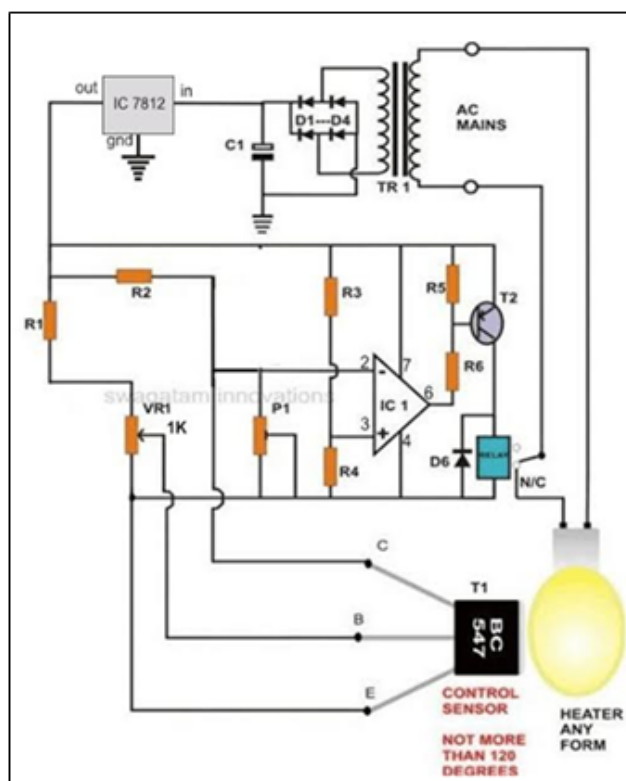


Figure 8: Circuit diagram

LIMITATIONS

Fabrication of Incubator requires the use of local materials. There are some materials that will enable the fabricated incubator deliver close to accurate result as that of the readymade or imported ones. However, there were some limitations we encountered during this fabrication

1. Due to the economy of the country we could not lay our hands on stainless material which could have been the best material to use. So we used iron casing and painted it with aluminum paint
2. We were also not able to get a temperature display that will be displaying the temperature outwards sensor could have done this but we hope future researchers will achieve such.

CONCLUSION

The fabrication of a functional bench incubator was a success. It required careful planning and cooperation among members of the group 7 (2020 / 21 session) and careful study on how to put materials and ideas together to produce a functional equipment.

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