DEVELOPMENT OF KEROSENE INCUBATOR FOR EGG HATCHERY

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Abstract

Kerosene incubator was developed to substitute the electrically operated type in rural and urban areas where power supply is not steady or where power failure is predominant. It is a simple machine which uses kerosene oil as the energy source to provide the required temperature for hatching. Most of the component parts are made from locally available raw materials which are cheap, durable, simple and efficient. The machine was designed to accommodate 86 eggs. The suitable temperature for the hatching was obtained as 37^0c-39^0c which lasted for an incubation period of 19 to 22 days. The efficiency of the machine was obtained as 80% which was found satisfactory. It was concluded that, the machine is an indispensable aspect to agriculturist for reproduction in poultry.

Advanced Oxford Learner Dictionary defined incubator as an apparatus used to hatch eggs or grow micro-organisms under controlled conditions. Two types of incubators are; forced air and still air. Forced air incubator has fans that provide internal air circulation while still air incubator has no fan for air circulation. The recommended temperature varies between the two incubators and the heating medium for incubators may be electricity, water, oil, coal or gas (Sunsbury, 1978)

The foundation of the modern poultry industry is artificial incubation in which the mechanical equipment is used to replace the broody hen for egg incubation. The art of incubation has been known for several thousand years, but it has been employed on a commercial scale only within the last 60-70 years. The Chinese developed the first incubators by using a mud barrel, heated with charcoal; the eggs were turned by hand. The Egyptians were first artisans to construct large incubators constructed with brick and heated by fires built in the same rooms in which the eggs were incubated. The first large incubators in the United States were built in 1895 by Charles A. Cyphers. It was a 20, 000 eggs capacity room type incubator for duck eggs. S.B Smith patented the first forced air incubator in 1918. The forced air system is still used in all modern day commercial incubators. Modern day hatcheries are impressive by using banks of incubators as many as one million chicks in a week can be hatched. (Sunsbury, 1978).

The most important process involved in the reproduction in poultry is incubation of eggs which could either be naturally or artificially. Man used artificial means of incubation to increase the rate of production for thousands of years. This is the large scale method of poultry farming for adequate supply of

chicks, since one cannot rely on broody hens. There are many different kinds of modern incubators which can be powered mechanically or electrically. In rural areas or where the supply of power is not steady, kerosene incubator for egg hatchery machine is used. It is a simple structure heated by kerosene oil. The eggs are held in trays which hatch several number of eggs at a time. The machine is an indigenous invention, thus, all the basic parts of the machine are made from locally available raw materials. It is equally of interest to know that the major part of this machine is wood.

The machine is very cheap, durable, simple, and efficient. Therefore it is an indispensable asset to Nigerian agriculturist for reproduction in poultry.

Methods and Materials

In this research, locally available materials such as wood, blanket, lantern, kerosene, thermometer were used in the design and construction of the incubator. The material selected are used for the project were based on certain consideration and advantages over other materials. These advantages includes; operational, production, economic and availability. Operational advantage is based on its ability to perform its desired function such as ability to withstand stress. Production advantage includes ease of cutting, welding and machining. Economic advantage has to do with cost reduction and availability of materials advantage is based on readily, affordable and locally available materials. Some of the properties of materials considered are mechanical and physical properties.

The reservoir of the lantern is filled with kerosene oil which burns to provide the temperature needed for heat generation. The lantern is fixed into lagged mild steel which conducts the heat into the vacuum where 86 eggs are set on the egg tray (as shown in figure 1). The egg tray provides sitting for the eggs. The flame of the lantern is regulated so as to achieve the required temperature in the vacuum which is controlled at 37^0c to 39^0c for the period of 19-22 days for hatching to be achieved. Thermometer and hydrometer are used to measure the temperature and humidity respectively in the incubator.

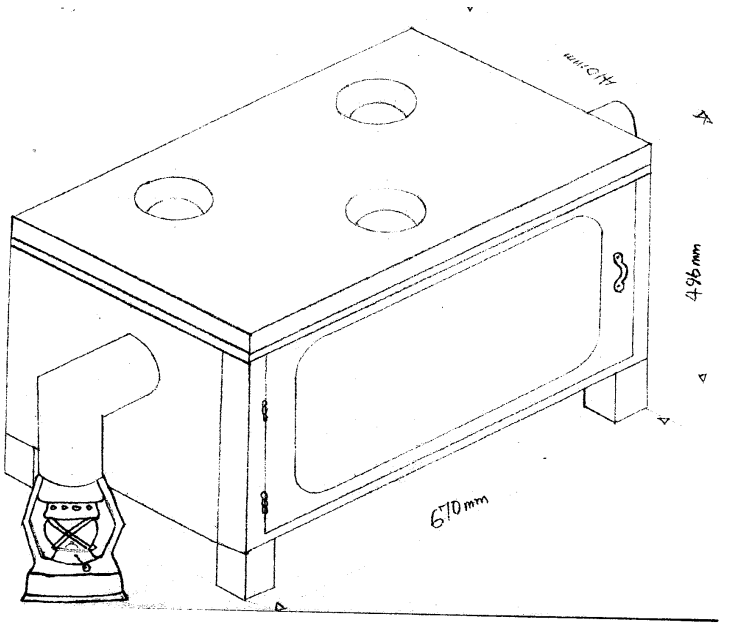

Fig 1 shows the assembling of the incubator

Heat transfer in the heat incubator was achieved through conduction and convection. In the conduction process, heat generated from the lantern is conducted through a mild steel pipe into the vacuum in the incubator. Convection process occurs when heat is being circulated by air in the incubator and also some heat loss to environment through the same process.

Various parts are cut to dimension using hacksaw and smothering with chisel, planner and emery cloth. The parts were joined together by fastening, welding and nailing. A glass fibre was used to lag the pipe externally to prevent heat loss by conduction.

Design Calculations

Design of pipe

Data: mass of the pipe =0.02kg
Over diameter of the pipe = 90mm
Thickness of the pipe = 1mm
Acceleration due to gravity = 9.8m/s
Inner diameter of the pipe = 88mm
Area of the pipe $= \frac{\pi (D^2 - d^2)}{4} = \frac{\pi (90^2 - 88^2)}{4} = 279.6mm^2$

Force = mass x acceleration due to gravity
= 0.02 x 9.8 = 0.196 N

Stress = $\frac{0.196}{} = 701N/m^2$

279.6×10^{-6}

Bending force = $\frac{bt\sigma}{2} = \frac{0.09 \times 0.001 \times 701}{2} = 0.032N$

Heat gain in the incubator

H=MCt

Where H= Heat gain

C = Specific heat capacity of mild steel pipe

= $620J/kg^k$

t = Temperature required = 38^0c

H=mct

= $0.02 \times (273 + 38) \times 620$

= $3.86\ J/kg^k$

Efficiency of the incubator

Number of eggs set = 20

Number of eggs hatched = 16

Hatching efficiency= $\frac{\text{number of eggs hatched}}{\text{Total number of eggs set}} \times 100$

= $16/20 \times 100/1 = 80\%$

Testing, Resting and Discussion

The incubator was kept in a well ventilated room for the testing. The incubator was left for five minutes for proper heat conduction into the incubator. The temperature in the incubator was measured with thermometer and the heat generated via the lantern was regulated until a temperature of 38^0c was achieved. Then, 20 fertile chicken eggs were set on the egg tray inside the incubator, although, the egg tray can accommodate 86 eggs. The eggs were turned at five hours intervals daily. In order to prevent high temperature, a water can was introduced into the incub ator to maintain the incubator's humidity and also reduce the temperature to 38^0c. On the 18^{th} day of the incubation, turning of eggs was discontinued to enhance easy hatching. The period of testing lasted for 22 days. The hatching started on the 19^{th} day until 22^{nd} day.

On the 19^{th}-20^{th} day, 10 eggs were hatched while 6 eggs hatched on 21^{st}-22^{nd} day. 4 eggs were not hatched at the end of incubation period.

Conclusion and Recommendations

The kerosene incubator for egg hatchery was designed, constructed, tested and found satisfactory. The efficiency of the kerosene incubator was calculated based on 16 eggs hatched out of 20 eggs at the temperature range of $37\text{-}39^0c$ within 19-22 days and found to be 80%. The materials are locally sourced and are available. This machine is very useful to poultry farmers both in rural and urban areas in Nigeria.

Further work is recommended on this research especially in the area of temperature regulation and turning of eggs every five hours for a period of 18 days.

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