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Electric-Less Refrigeration System

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Abstract - *Sometimes there are simple solutions to universal needs that don't require coal fired electricity, fossil fuels, or even solar panels or wind turbines. Around a one-third of the world's population have no access to electricity. So, keeping these in factors in mind we have given detail report on electric-less refrigeration. Where, Refrigeration has always been important factor of consideration we just have given an upgrade keeping all the above factors in mind that is refrigeration without electricity with the three cooling methods and the support of underground most of all we have reached a better drop in temperature than any other around 20 degree Celsius.*

Key Words: *Converging Lens, Aluminium Pipes, PVC elbow joints, Copper Coil, Acrylic Sheets, Steel Elbow Joints, Reducers, Solar Powered Fans, Copper Pipe, Thermocool box.*

1. INTRODUCTION

Refrigeration may be defined as the process of achieving and maintaining a temperature below that of the surroundings, the aim being to cool some product or space to the required temperature. One of the most important applications of refrigeration has been the preservation of perishable food products by storing them at low temperatures. Refrigeration systems are also used extensively for providing thermal comfort to human beings by means of air conditioning. Air Conditioning refers to the treatment of air so as to simultaneously control its temperature, moisture content, cleanliness, odour and circulation, as required by occupants, a process, or products in the space. The subject of refrigeration and air conditioning has evolved out of human need for food and comfort, and its history dates back to centuries

1.1 Evaporative Cooling

As the name indicates, evaporative cooling is the process of reducing the temperature of a system by evaporation of water. Human beings perspire and dissipate their metabolic heat by evaporative cooling if the ambient temperature is more than skin temperature.

Animals such as the hippopotamus and buffalo coat themselves with mud for evaporative cooling. Evaporative cooling has been used in India for centuries to obtain cold water in summer by storing the water in earthen pots. The water permeates through the pores of earthen vessel to its outer surface where it evaporates to the surrounding, absorbing its latent heat in part from the vessel, which cools the water. It is said that Patliputra University situated on the bank of river Ganges used to induce the evaporative-cooled air from the river. Suitably located chimneys in the rooms augmented the upward flow of warm air, which was replaced by cool air. Evaporative cooling by placing wet straw mats on the windows is also very common in India. The straw mat made from "khus" adds its inherent perfume also to the air. Now-a-days desert coolers are being used in hot and dry areas to provide cooling in summer

2. SCOPE

As we know to run a refrigeration system electric power is necessary. The very saddening fact about electricity is that, per IEA-Energy Access Database, out of 7 billion of population. 1.3 billion people don't have access to the electricity. Those 1.3 billion people still lives in dark.

Among the basic necessities, a man has for survival, food is the primary necessity for existence. For this very reason food preservation is of utmost importance. An estimated 25-50% of the world's food goes to waste therefore it is very necessary to find a way to improve food storage globally.

Food wastage: about 1/3 of the food produced in the world for human consumption every year; approximately 1.3 billion tones gets wasted, with this attempt to build a refrigeration system which would run without electricity, we can eliminate the food wastage to a reasonable extent. This refrigeration system could provide an economical yet efficient way of preserving food. With about 20% of world population having no access to electricity can use this refrigeration system to store and preserve their food

3. DESIGN SPECIFICATION AND WORKING

It works by passively drawing in warm ambient air through the converging nozzle, which is fed into an aluminum pipe that's been buried underground. This already starts to cool down the air before it's fed into coiled cooper pipe that's been placed above the water in the evaporation chamber. The evaporation process is helped along by a small solar-powered fan. The water

evaporating around pipe chills the air inside and this is then fed back underground before entering the refrigeration chamber. The electric-less refrigeration system uses air as refrigerant (thermal conductivity of air 0.024 w/mk).

3.1 Block Diagram

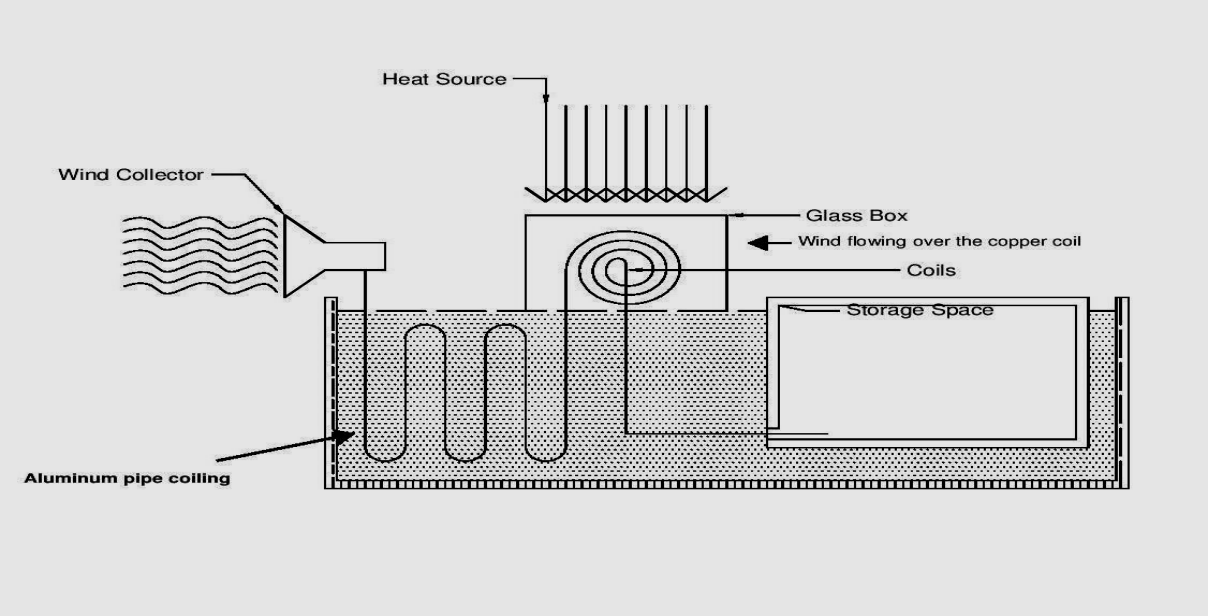

Fig 3.1 Block diagram of electicless system

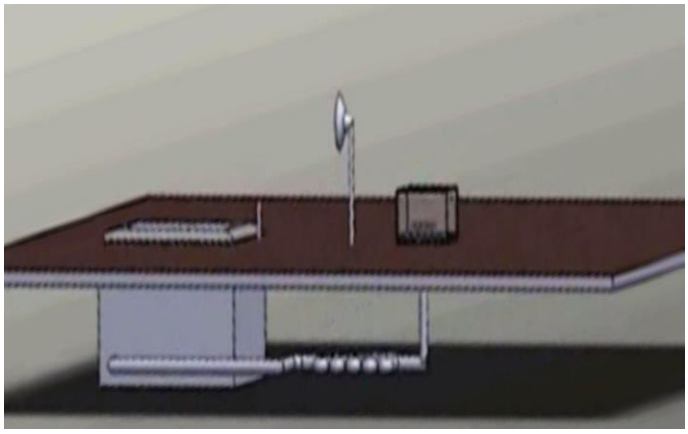

Fig 3.2 3D PRESENTATION

4. COOLING STAGES

4.1 Initial or Underground Cooling

The converging nozzle; A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enter) an enclosed chamber or pipe via orifice.

While passing through the converging nozzle, the low velocity air is accelerated to higher velocity. The nozzle guides the intake air into the underground aluminum coil. The annual temperature variation of the ground at a depth of 3m is between 15 to 25°C and the temperature remains constant at about 22°C. According to this variation of temperature with respect to depth, the temperature underground is less than the atmospheric temperature. Therefore, the is a temperature difference between the air flowing and the soil, due to this there is a heat transfer between the air flowing and the soil.

The heat from the air flowing inside the aluminum coil is transferred to the soil covering the aluminium coil. The heat transfer takes place through conduction and convection. Heat transfer through convection takes

place between the air flowing and the aluminium surface and heat transfer through conduction takes place between aluminium surface and the soil. As we know aluminium has better thermal conductivity (205 w/mk) than most of the other metals, it was striking enough to use aluminium to make a coil. As the air starts flowing inside the aluminium coil, it already starts to cool. In this stage we could achieve a temperature drop of 4-5 degrees. We could achieve higher temperature drop if we use damp or wet soil

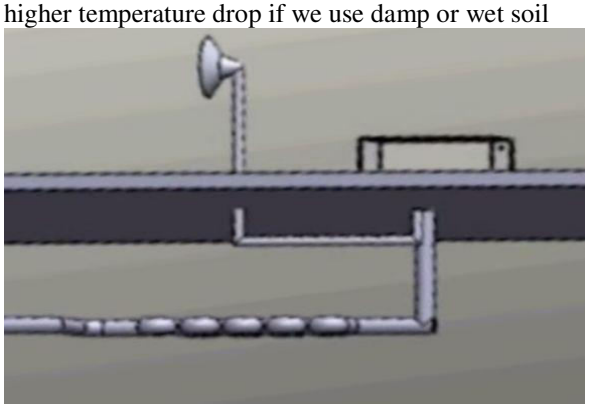

Fig 4.1 UNDERGROUND ALUMINIUM COIL (3D)

4.2 Evaporative Cooling

Evaporative cooling is a heat and mass transfer process that uses water evaporation for air cooling, in which large amount of heat is transferred from air to water, and consequently the air temperature decreases. Evaporative coolers could be classified into: 1) Direct evaporative coolers, in which the working fluids (water and air) are indirect contact; 2) Indirect evaporative coolers, where a surface/plate separates between the working fluids; (3)

Combined system of direct and indirect evaporative coolers and/or with other cooling cycles.

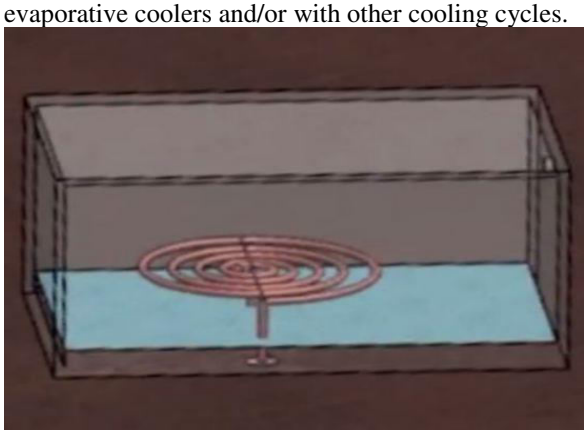

Fig 4.2 Evaporative Cooling

4.3 Storage Box

The storage box is a styro foam box (or normally called as thermocol box). The function or the reason of using this is to entrap the cool air coming out of evaporation chamber. The refrigeration takes place during the day time only and for proper food preservation the temperature must be maintained constant, for this very reason we are using thermocol ice box. This box can hold or keep the air inside it at the temperature less than 10 degrees. To have efficient flow of air throughout the process, the storage box is also kept underground

Fig 4.3 Storage box

5 RESULT AND ANALYSIS

5.1 SPECIFICATIONS

DIAMETER OF ALUMINIUM PIPE - 24 mm
LENGTH OF ALUMINIUM PIPE USED - 3.6 m
THICKNESS OF ALUMINIUM PIPE - 1.6 mm
DIAMETER OF COPPER COIL - 6 mm
LENGTH OF COPPER COIL USED - 3.8 m
THICKNESS OF COPPER COIL - 0.8 mm

5.1.1 Temperature drop due to Initial Cooling

SL NO	NOZZLE DIAMETER	ROOM TEMPERATURE	TEMPERATURE DROP
1	200 mm	30-33 degrees	5-6 degrees
2	250 mm	30-33 degrees	4-5 degrees
3	300 mm	30-33degrees	2-4 degrees

5.1.2 Temperature drop due to Evaporative Cooling

SL NO	NOZZLE DIAMETER	ROOM TEMPERATURE	TEMPERATURE DROP
1	200 mm	30- 33 degrees	18-20 degrees
2	250 mm	30-33 degrees	15-17 degrees
3	300 mm	30-33 degrees	14-17 degrees

There is no instant temperature drop in the storage box. It took around 60-90 minutes to achieve a

temperature of 8 degrees. We could achieve even more temperature drop with 100% insulation and without leakages.

6. CONCLUSION

The primary goal of this project is to identify a way to provide food preservation facility without the need of electricity. With this attempt to provide a refrigeration system which would work without electricity, we have achieved a considerable success and we are hoping that with further research on this topic would lead us to better and improved results

It was a wonderful and learning experience for us while working on this project. This project took us through the various phases of project development and gave us real insight into the world of refrigeration. The joy of working and the thrill involved while tackling the various problems and challenges gave us a feel of developers industry.

We enjoyed each and every bit of work we had put into this project. Without the support of our guide and our department this project would have not been possible.

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