

# Cooling And Heating Effects From Earth Tube Heat Exchanger

<sup>1</sup> Srikant Verma, <sup>2</sup> Sachin Singh, <sup>3</sup> Sunny Patel

<sup>4</sup> Deepak Sharma, <sup>5</sup> Akhtar Ahmed,

<sup>12345</sup>UG Student, Department of Mechanical Engineering  
Institute of Technology and Management, Gida,  
Gorakhpur, India.

<sup>6</sup> Ravi Pratap Singh

<sup>6</sup>Assistant Professor, Department of Mechanical Engineering  
Institute of Technology and Management, Gida,  
Gorakhpur, India.

**Abstract:-** Before understanding the concept of Earth tube heat exchanger .Let us first understand the concept of heat exchanger .Heat exchanger is a device used to exchange the heat between two fluid at different temperature .Earth tube heat exchanger is a new innovative technique used for cooling and heating in summer and winter respectively. Here the cooling and heating is achieved by utilizing the temperature difference of fluid present at inside and outside the earth surface. Further this method of heating and cooling is free from hazardous effects of global warming and ozone layer depletion. The performance of Earth tube heat exchanger depends upon various parameters such as length of pipe, pipe diameter, depth of burial of the pipe, air flow rate and different types of soils.

**Keyword:-**Earth tube heat exchanger ,Alternate method of heating/cooling, Blower, Temperature Sensor

## I.INTRODUCTION

The concept of earth tube heat exchanger is a new innovative technique currently being used for cooling and heating of a building or room during summer and winter respectively. The modern approach of heating and cooling is based on vapor compression cycle that utilizes refrigerants such as chlorofluorocarbon(CFCS) and Hydrofluorocarbon(HFCS) .These refrigerants are very toxic causing global warming, uncertain climate changes, acid rain and depletion of ozone layer.

Further the conventional system also consumes large amount of electricity.

These concern have motivated us to design an Earth Tube Heat Exchanger which is free from environmental pollution and require less energy consumption. It also has vast application not only on domestic usages but also on agricultural usage (say for cold storage of vegetables) and industrial usages. Though this system is not as efficient as conventional system but offers lower running cost compared to conventional system.

## II. CLASSIFICATION OF EARTH TUBE HEAT EXCHANGER

The earth tube heat exchanger is basically classified into two categories. They are:-

### A)Open loop System

### B) Closed loop System

**A) Open loop System :-**In open loop earth tube heat exchanger the surrounding air is compressed and is made to flow inside the tube buried into earth where heat is exchanged between the surrounding air and earth soil and then the air is made to pass for heating/cooling to a room or building.

**B)Closed loop System:-** In closed loop eath tube heat exchanger the surrounding air is used in a close cycle for carrying out the heating/ cooling of a room or building.

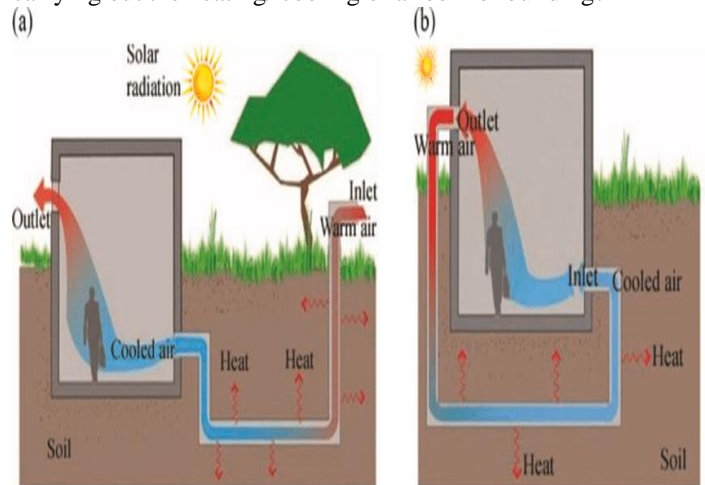


FIG 1:-OPEN LOOP SYSTEM FIG 2:-CLOSED LOOP SYSTEM

## III. LITERATURE REVIEW

N.k Bansal ,M.s Sodhi et al.[1] told that EATHE can be used an a alternate of conventional air conditioning system. He also suggested that the performance of EATHE depends upon thermal conductivity of soil ,increase in the length of tube ,decrease in pipe diameter, decrease in mass of flow rate of air and depth of tube buried inside the earth. Nilesh S. Shelar et al.[2] In his study it was found that higher velocity of air causes less temperature difference between inlet and outlet of pipe .So, velocity of air should be in between 2-5 m/s for a good performance.

Kunj M. Chauhan , et al.[3] In his research an analytical model was generated where he took a PVC pipe of length

29m having diameter of 0.15m and inlet velocity of 4m/s was able to achieve a temperature drop of 14°C which shows that this system is useful.

Serageldin et al.[4] conducted an experiment for thermal performance of EATHE in EGYPT using three different types of pipe materials i. e PVC pipe, Steel Pipe and Copper Pipe. And found that outlet air temperature in case of PVC Pipe is 19.6°C and that of steel pipe and copper pipe is 19.8°C. This suggests that outlet air temperature difference in case of PVC Pipe, Steel and Copper Pipe is of 0.2°C which is very small and can be consider as negligible.

#### IV.EXPERIMENTAL SETUP AND ITS WORKING

The earth tube heat exchanger consist of following components:-

- i) Blower
- ii) PVC Pipe
- iii) Temperature Sensor
- iv) Exhaust Fan

i) Blower:- A blower is a device that is used to pushes the ambient air by imparting energy to increase its pressure and speed into PVC pipe.

ii) PVC Pipe:-PVC Pipe is a tubular section, or hollow cylinder made of polyvinyl chloride in which the ambient air is made to flow.

iii) Temperature Sensor:- A temperature sensor is a device that detects and measures hotness and coldness and converts it into an electrical signal.

iv) Exhaust Fan:-Exhaust fan is a device used to ventilate a room or a building. This helps to bring fresh air from earth tube.

#### V. WORKING PRINCIPLE OF EARTH TUBE HEAT EXCHANGER

The earth tube heat exchanger works on the following principle:-

[5]Because of diurnal cycle of air temperature and solar radiation the temperature at 2-3 deep inside the earth surface remains constant through out the year and varies about 10-15°C from earth surface temperature.(i.e-in summer the earth surface temperature is greater than 10-15°C and than temperature at deep of 2-3m and vice-versa in winter) The temperature at deep of earth also varies according to climatic condition of the soils and its thermal conductivity.

Utilizing the above idea; In this experiment a PVC Pipe of length 10m is taken having dia of 0.10m is placed at 2m deep inside the earth in a horizontal position. A blower is used at the inlet of the pipe that pushes the ambient air by imparting energy to increase its pressure and speed inside the PVC pipe .The ambient air is made to flow across the length of pipe. And there occurs exchange of heat between the air inside the pipe and deep earth surrounding due to temperature differences.

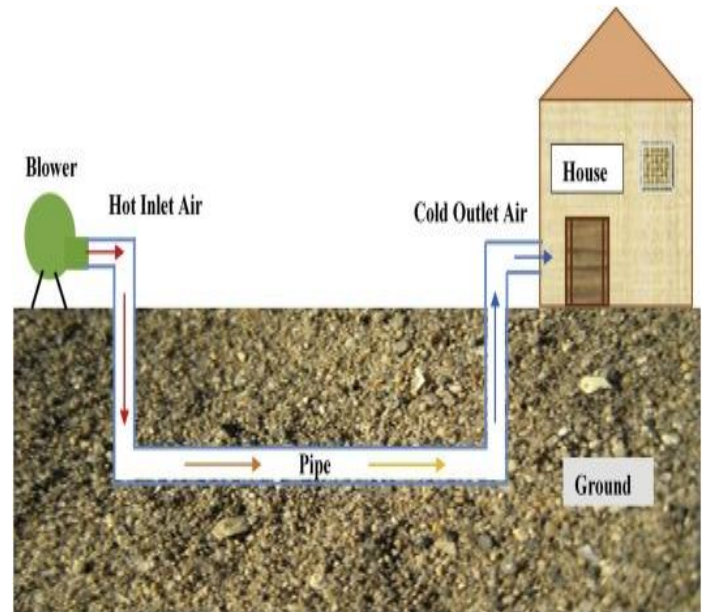


FIG:-3 EARTH TUBE HEAT EXCHANGER

#### VI.OBSERVATION

While performing the investigations following observation have been made:-

In Summer the temperature at inlet of PVC pipe measured from temperature sensor is 36°C and temperature at the outlet of pipe is measured as 25°C.

In winter the temperature at inlet of PVC Pipe measured from temperature sensor is 18°C and temperature at the outlet of pipe is measured as 28°C .

#### VII.ADVANTAGES

- The working fluid is air which is easily available ,and free from environmental pollution.
- Design and installation both are simple.
- The initial set up cost is less compared to conventional air conditioning system.
- This system does not involve any type of combustion and hence it is free from pollution and green house gas emissions.

#### VIII.RESULTS AND CONCLUSION

Earth Tube Heat Exchanger is novel alternative for air conditioning in a clean and inexpensive manner. Further this experiment give way some discoveries regarding the performance of Earth Tube Heat Exchanger that are mention below:-

- The temperature at the 2-3m deep of earth is constant through out the year and varies almost 10-15°C from the earth surface temperature. (i.e-in summer the earth surface temperature is greater than 10-15°C and than temperature at deep of 2-3m and vice-versa in winter)
- The performance of Earth Tube Heat Exchanger depends upon :-

-Length of the Pipe-Increase in the length of pipe increases the performance of Earth tube heat exchanger.

-Velocity of air inside the Pipe-Decrease in the velocity of pipe increases the performance of Earth tube heat exchanger

-Diameter of Pipe-Decrease in the diameter of pipe increases the performance of Earth tube heat exchanger.

#### IX. APPLICATIONS

- Earth tube heat exchanger can be used for air conditioning of residential areas, corporate offices.
- Earth tube heat exchanger can be used for cold storage of agricultural products.
- Earth tube heat exchanger can also be used in industries to preserve certain things.

#### X. FUTURE SCOPE

Earth tube heat exchanger has got the potential to replace the conventional system of air conditioning in future. Further it also reduces the release of harmful gases such as chlorofluorocarbon (CFCS) and hydro fluorocarbons (HFCS) into the atmosphere that causes global warming and ozone depletion.

Also this system of heating/cooling is leading a path to a no. of researcher in the field of conservation of environment.

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