JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A review on "Ground Coupled Heat Exchanger"

Mr. Nitesh Ray[1], Prateek Srivastava[2], Suraj Yadav[3], Ayush Sinha [4], Vishal Raj[5]
[1]Assistant Prof. ME Department, ITM Gorakhpur, UP. India
[2,3,4,5] Student of ME Department, ITM Gorakhpur, UP. India

Abstract: Prior to being familiar with the Earth tube heat exchanger concept. Let's first review the idea of a heat exchanger. A heat exchanger is a tool that transfers heat between two fluids of varying temperatures. An inventive new method for heating and cooling in the summer and winter is the earth tube heat exchanger. Here, the temperature differential between the fluids inside and outside the earth's surface is used to provide both heating and cooling. Additionally, there are no harmful impacts of global warming or ozone layer depletion with this way of heating and cooling. A number of factors, including pipe diameter, length, depth of burial, air flow rate, and variety of sorts of soils**.**

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

1.Introduction

Nowadays, a building or room may be heated or cooled in the summer and winter by using the novel idea of an earth tube heat exchanger Correspondingly. Refrigerants, like hydrofluorocarbon (HFCS) and chlorofluorocarbon (CFCS) are used in the vapor compression cycle, which is the foundation of the contemporary heating and cooling system. These very hazardous refrigerants are to blame for acid rain, ozone layer depletion, global warming, and unpredictable climatic shifts. Furthermore, a significant quantity of power is consumed by the typical system. These worries have inspired us to create an Earth Tube Heat Exchanger that uses less energy and doesn't pollute the environment. It is also widely used in industry and agriculture, for example, in the cold storage of vegetables, in addition to household applications. Despite having lower operating costs than a traditional system, this system is not as efficient as one.

2. Classification of earth tube heat exchanger

There are essentially two types of earth tube heat exchangers. A) Open loop system is one of them.
B) System with closed loops

A) Open loop System: In an open loop earth tube heat exchanger, the surrounding air is compressed and forced to circulate through a tube buried in the ground. This allows heat to be transferred from the earth to the surrounding air and soil, and the air is then directed to a room or building for heating or cooling purposes.
B) Closed loop system: A closed loop earth tube heat exchanger uses the surrounding air to heat and cool a space or structure in a closed loop.

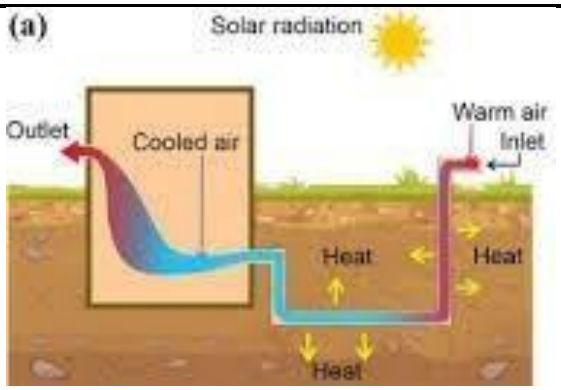

FIG 1 image source https://media.springernature.com

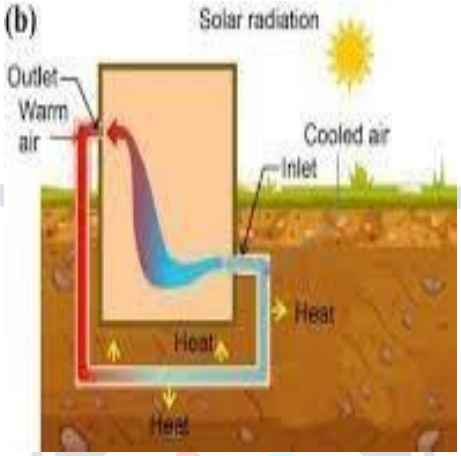

FIG 2 image source https://media.springernature.com

III. LITERATURE REVIEW

According to N.K. Bansal, M.S. Sodhi, et al. [1], EATHE can be utilized as a substitute for a traditional air conditioning system. Additionally, he proposed that EATHE's performance depends on a number of factors, including the soil's thermal conductivity, the tube's length, diameter, mass of air flow rate, and depth below ground. Shelar, Nilesh S. et al. [2] According to his research, there is less of a temperature differential between the pipe's entrance and output when air velocity is higher. Air velocity, therefore, should range from 2 to 5 m/s for optimal performance. Chauhan, Kunj M., and others [3] In order to demonstrate the utility of this system, the researcher created an analytical model in which he used a 29-meter-long PVC pipe with a 0.15-meter diameter and an inlet velocity of 4 meters per second to reduce a temperature by 140 degrees Celsius. In order to test the thermal performance of EATHE in EGYPT, Serageldin et al. [4] used three distinct pipe material types: PVC, steel, and copper. They discovered that the air temperature at the PVC pipe's exit is 19.6^0C, whereas the copper and steel pipes' outlet is 19.8^0C. This indicates that the outlet air temperature differential for copper, steel, and PVC pipes is only 0.2^0C, which is extremely little and can be regarded as insignificant.

IV. EXPERIMENTAL SETUP AND ITS WORKING

The earth tube heat exchanger consists 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 operates based on the following concepts:
[5] The temperature at 2-3 deep below the earth's surface fluctuates throughout the year because to the diurnal cycle of solar radiation and air temperature.
Roughly 10-15^{0}C above the surface of the planet. (For example, during the summer, the earth's surface temperature rises to over 10 to 150 degrees Celsius, while in the winter, it falls to between 2-3 meters.) The temperature in the earth's depths also fluctuates depending on the soil's thermal conductivity and climatic conditions. Using the aforementioned concept, the experiment involves horizontally positioning a 10-meter-long PVC pipe with a diameter of 0.10 meters at a depth of two meters below the surface of the earth. What a blower is utilized at the pipe's intake, where it imparts energy to force the surrounding air inside the PVC pipe and raises its pressure and speed. The pipe's length is designed to allow ambient air to flow through it. Additionally, because of temperature variations, heat is exchanged between the air inside the pipe and the surrounding deep soil.

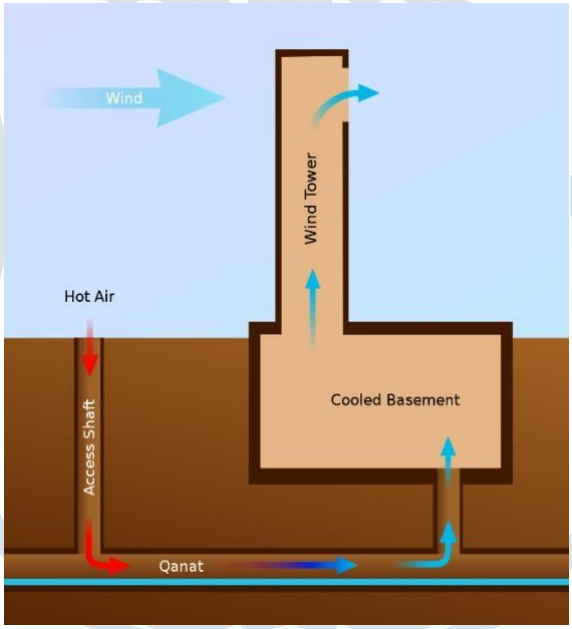

FIG 3 image source https://en.wikipedia.org/wiki/Ground-coupled_heat_exchanger

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^{0}C and temperature at the outlet of pipe is measured as 25^{0}C. In winter the temperature at inlet of PVC Pipe measured from temperature sensor is 18^{0}C and temperature at the outlet of pipe is measured as 28^{0}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 greenhouse gas emissions.

VIII.RESULTS AND CONCLUSION

An innovative, low-cost option for air conditioning is the earth tube heat exchanger. Additionally, this experiment yields some insights into the following are the Earth Tube Heat Exchanger's
performance metrics: -

- The temperature at 2-3 meters below the surface of the earth is consistently between 10 and 15^0 degrees Celsius throughout the year. (i.e., In the summer, the temperature on Earth's surface is higher than 10-15^0C, while in the winter, it is lower at 2–3 meters.

- The following factors affect an earth tube heat exchanger's performance:

-Length of the Pipe- An extension of the pipe improves the efficiency of the Earth tube heat exchanger. -Air velocity inside the pipe: A drop in pipe velocity improves Earth tube heat performance. swapper
-Diameter of Pipe: An increase in
pipe diameter improves Earth tube heat exchanger effectiveness.

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

In the future, earth tube heat exchangers may take the role of traditional air conditioning systems. Additionally, it lessens the emission of dangerous gasses such the release of hydrofluorocarbons (HFCS) and chlorofluorocarbons (CFCS) into the atmosphere, which results in ozone depletion and global warming.
Additionally, this heating and cooling technology is opening doors for many environmental conservation researchers.

XI. REFERENCES

[1] [1]N.K. Bansal et al, Evaluation of an earth–air tunnel system for cooling/heating of a hospital complex, Building and
Environment[IJATES][VOL NO 06
MAR 2013] [2] [2] Nilesh S. Shelar “A Review on Earth-Air Heat Exchanger” International Journal of Engineering Research & Technology (IJERT)(June 2018) [3] [3] Kunj M. Chauhan1 , Jaykumar G. Prajapati2 , Nikunj Giri Y. Goswami3 , Sunny N. Patel4 and
Krunal N. Patel “Design and development of an Earth Air Tube Heat
Exchanger” International Journal of
Management, Technology And Engineering (June)(2018) [4] [4] Serageldin A, Abdelrahman A K and
Cookware S, 2016 Earth-Air Heat Exchanger thermal performance in Egyptian environment: investigational results, mathematical model, and Computational Fluid Dynamics simulation. Energy Conversion and Management. [5] [5] Georgios Fluorides and Sotiris Kalogirou
“Annual Ground Temperature
Measurements at Various Depths.”