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Use of Earth-Air Heat Exchanger System for Homes and Offices

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***Abstract*: Important task of ideal air conditioning system is to provide comfort in the building. But in the last few years per capita energy consumption increased substantially. Also living standard of humans have increased with increased use of conventional energy sources. Therefore it becomes very important to search for nonconventional energy sources which prove to be clean, inexhaustible and sustainable. Thus the method of air conditioning being developed called earth air heat exchanger. Earth can be used as a heat source and heat sink is a very important subject to study and prove to be a application of renewable energy in worldwide. Hence the aim of study is to investigate the effects of various working parameters on performance of earth air heat exchanger.**

***Keywords*: Air conditioning, Earth air heat exchanger, Energy efficiency improvement, Pollution Control, Renewable energy.**

1. Introduction

Due to continuous depletion of renewable energy sources and increased greenhouse effect the requirement is to reduce use of renewable energy sources and start use of non-renewable energy sources. This requirement have captured attention of many researchers to develop systems which operates on nonconventional energy sources. Earth air heat exchanger is one of the outcome [1]. Earth air heat exchanger is a very good alternative of conventional air conditioning systems. It is economical system which can be used as heating system or cooling system. Since there are no any use of compressors, refrigerants or burners this system is completely environmental friendly. It uses only a blower to move the air so as to provide either partial or complete cooling or heating [2].

2. Environmental Impact due to conventional air conditioning systems

Conventional air conditioning system uses refrigerants which are not environmental friendly. Natural refrigerants are environmental friendly but there use is reduced now a days due to new synthetic refrigerants. Synthetic refrigerants have better thermodynamic, physical and chemical properties as compare to natural refrigerants. But these synthetic refrigerants are harmful to environment [2].

A. Greenhouse effect

Life on earth is made possible by energy from sun, which arrives mainly in the form of visible light. About 30 percent of the sunlight is scattered back into space by outer atmosphere and the balance 70 percent reaches the earth's surface, which reflects it in form of infrared radiations. The escape of slow moving infrared radiation is delayed by the greenhouse gases. A thicker blanket of greenhouse gases traps more infrared radiation and increase the earth's temperature [2]. Greenhouse gases makeup only 1 percent of the atmosphere, but they act as a blanket around the earth, or like a glass roof of a greenhouse and keep the earth 30 degree warmer than it would be otherwise. Without greenhouse gases earth would be too cold to live. Some Air conditioning systems uses HFC (hydro fluorocarbon) as a refrigerant. these refrigerants causes greenhouse effect [2].

B. Ozone layer depletion

Some air conditioning systems uses CFC or HCFC as a refrigerants. These refrigerants are responsible for depletion of ozone layer. Ozone layer in the stratosphere protects us against harmful effects of skin cancer by absorbing ultra violet radiation coming from sun. CFC refrigerants contains chlorine atom. When CFC reaches in stratosphere then in presence of sun light chlorine atom from CFC escapes out and reacts with ozone and forms different compounds. This is depletion of ozone. CFC refrigerants are more harmful as compare to HCFC. Therefore, in Montreal protocol successive reduction in use of CFC and HCFC is proposed [2].

3. Working of earth air heat exchanger

The principle behind the earth air heat exchanger is the constant temperature below the ground level. Temperature below earth surface about 2m to 2.5m depth remains almost constant. This is due to high thermal inertia of earth, therefore there is considerable difference between variation of temperature at the surface of earth and in the depth of earth [3].

Nadia saifi et. al. did research in south east Algeria, Africa. They conducted a experiment in which they have used thermometers. These thermometers are installed at various depth of ground and temperature variation in a day is recorded at various depths. They found that on the surface there is large variation in temperature whereas temperature fluctuations reduces as depth from surface increases. They found that temperature variation in a day on the surface is about 12.7°Cwhere as at a depth of about 2.5 m below temperature

variations reduce down to 2°C [4]. Earth air heat exchanger uses this principle, in Earth air heat exchanger we are using pipes. These pipes are buried in the ground at about 2.5m below ground surface. A blower is connected at one end of pipe. The blower draws air through pipes, hence temperature of air get alter. This air is then supplied to room. [4]Here it is shown how to style a subsection and sub sub-section also

4. Types of earth air heat exchanger

There are two types of earth air heat exchanger closed loop and open loop. In closed loop system air from room is recirculated. This system is more effective because same air is recirculated, but there is problem with ventilation. In open loop system air which is taken from atmosphere is not recirculated this system provides fresh air supply [1].

5. Pipe material

One of the major factors affecting the performance of EAHE is the material of so chosen pipe. Usually the pipe material is selected based on availability and cost. The materials of higher thermal conductivity have higher heat transfer rate, and therefore can reduce the buried pipe outlet temperature [5].

Aliyah et. al. studied performance of various materials for earth air heat exchanger. And they found out that polyethylene had maximum temperature reduction followed by steel, copper, polyvinyl chloride (PVC). But they found out that Material does not have any significant contribution on temperature reduction. Change in outlet temperature for various Materials is very small and hence negligible [5].

6. Air flow

As air flow rate in the pipe increases temperature of air in summer increases and in winter reduces i. e. the system becomes ineffective. This is because as air flow rate increase air has very short time in contact with pipe hence complete heat transfer doesn't take place [1].

7. Nature of soil

Thermal performance of earth air heat exchanger system is dependent on temperature and moisture distribution in the ground. Soil saturated with water provides better performance, it is therefore desirable to bury the pipe at higher depth. Smaller diameter pipes are more efficient but they causes higher pressure drop thus there is requirement of large power input. Dry soil has lesser thermal conductivity [1].

8. Site location

The earth air heat exchanger draws air through a pipe that is buried in a soil to moderate its temperature to conserve energy and achieve thermal comfort. If the system is predominantly cooling, the collector must be at permanently shaded area near a lake or river. If the system is predominately heating it should be located in a sunny area without some aquifer competing to steal away the heat. Intakes have to be located away from sources of pollutants. These include vehicle emissions, products of combustion from fire pits, lanterns, barbeques, boilers and furnaces, exhaust fumes from bath fans and dryer vents, or sources of odors, such as garbage bins, compost piles and sewer vents [6].

9. Conclusion

It can be concluded from the above study that earth air heat exchanger is very effective in reducing pollution as well as reducing energy consumption. Air flow, type of soil affects the performance of earth air heat exchanger but material of pipe doesn't affect more on performance. Lesser use of earth air heat exchanger is because lack of knowledge of how to design a efficient system, also growth of harmful microorganisms in the pipe is a important reason. Attention should be given in use of such systems to promote use of renewable and sustainable energy sources.

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