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Heat Transfer through Water in Ground Air Heat Exchanger

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***Abstract* -Ground-air heat exchangers have become one of the important topics into consideration when HVAC industry is talked about. It is capable of transferring heat without liberation of any carbon compounds because of which it has edge over other heat transfer mediums. This paper shows the study of water to air heat transfer considering the material of the pipe and the optimal design of the pipe. Earth air heat exchangers are widely used in agricultural and industrial sectors for the past few decades in other parts of the world. The vise-versa is applied in the cooler parts to preheat the air reaching the room for comfort.**

***Keywords*- ground heat exchanger, water to air heat transfer**

I. INTRODUCTION

Ground air heat exchangers which are also called earth tubes are used to exchange heat between the surrounding and the earth. The underground temperature of the earth is assumed to be constant. That is the temperature doesn't rise when the heat is liberated to the ground. Therefore, when the outside air is circulated through the pipes using blower it is used to achieve partial cooling in summers and heating in winters.

GAHX also play an important role in geothermal technology. Ground source heat pumps rely on earth tubes to transfer heat to or from the ground. GAHX are more energy-efficient than air-source heat pumps because ground temperatures are more stable than air temperatures throughout the year.

The main point for the heat transfer is the temperature difference. So in order to enhance the rate of heat transfer we need to maximize ΔT. As we know there is variable temperature difference as the surrounding temperature changes continuously. So the design of the pipes should be designed by increasing the length and choosing high conductivity material. However, pipe sizing is constrained to yield a more cost-eff ective design for users.

1. Spirally Corrugated Pipes

The flow structures of the fully developed turbulent flow in a straight pipe are quite similar to the optimal flow pattern from the optimization theory. More specifically, multiple longitudinal vortices are spontaneously generated due to turbulence without external heat transfer enhancement techniques. Furthermore, the flow structures similar to multiple longitudinal vortices also exist in the spirally corrugated pipe, although these flow structures deviate from symmetric multiple vortices. Moreover, the flow structures in the spirally corrugated pipe are much more energetic than those in the fully developed turbulent flow in a straight pipe.

2. Geothermal Heat Pump

GHP is a centralized heating or cooling system which exchange heat continuously from the ground. The ground acts as sink and source in different situations. This design takes advantage of the moderate temperatures in the ground to boost efficiency and reduce the operational costs of heating and cooling systems, and may be combined with solar heating to form a geosolar system with even greater efficiency.

II.FIGURES AND TABLES

Earth-air heat exchangers can be analyzed using several software such as ansys, FEA (finite element analysis), and others. However, numerous earth-air heat exchanger systems have been designed and constructed improperly, and failed to meet design expectations. These are widely used for air pretreatment rather than full conditioning or heating.

The setup includes the design of room, roof and the ground source. But our study deals with the underground parameters only. In other words, temperature at the inlet and outlet of the pipe is considered and whole analysis is structured to it.

Figure shows the temperature profile and its variation across the pipe. The air is circulated inside the pipe and the cold air is passed outside. In other ways, the hot fluid clearly shows the temperature variation inside the pipe

when it is in contact with the ground. It takes some time to get the uniform temperature throughout the pipe. Which is indicated in the second figure.

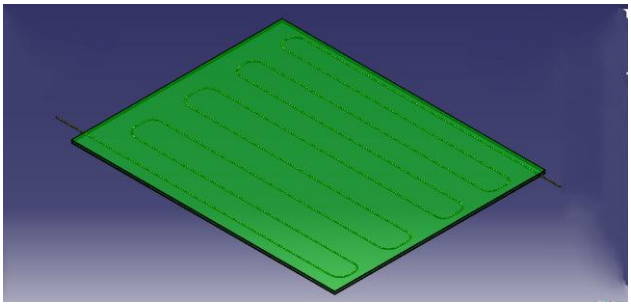

Fig.1. Sectional view of ground with pipe line

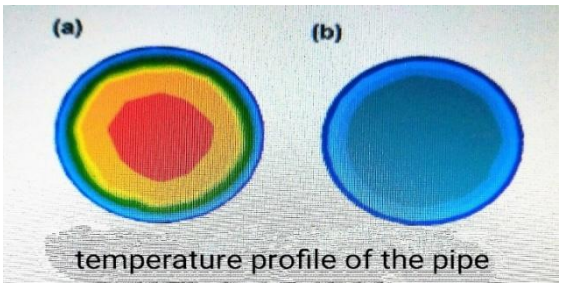

Fig.2. Temperature distribution of the pipe at different intervals

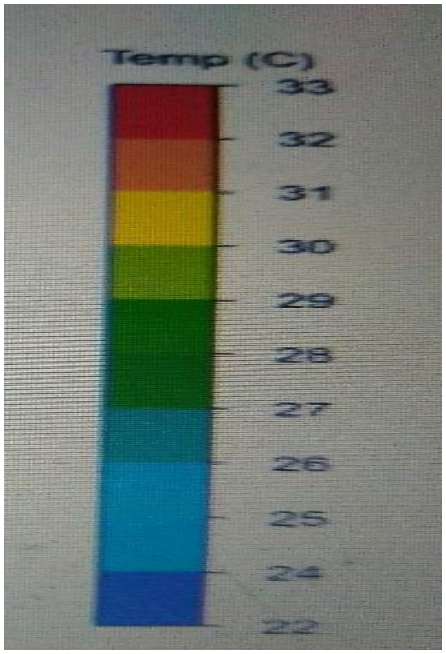

Fig. 3 Table .

2. Table

The table gives the description of the various pipes along with their properties.

Table 1 Font Sizes for Papers

Material Properties			
	PVC	PC	STEEL
density	1450	1200	8050
Thermal conductivity	0.28	0.25	16.25
Specific heat	900	900	502

III.CONCLUSION

With this analysis it was found that the time required for the heat exchange is somewhat higher as compared to other means. Also, the velocity should be low to have proper heat exchange. But theoretically it is found out that the velocity is directly proportional to heat transfer. It was also found that the pressure drop is very high in this scenario. The water was passed through the pipe in the turbulent flow. The heat transfer can be increased by proper selection of the pipe material and other parameters of flow.

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Author Profile

Swastik Kumar Agarwal
Description “Swastik Agarwal is a scholar working on energy saving. His research interests include (not limited to) heat transfer and energy utilization.”