STUDY OF THE EFFECT OF MOISTURE CONTENT ON THE THERMAL PROPERTIES OF SOIL IN THE TECHNICAL COLLEGE / NAJAF

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ABSTRACT

In the face of changing known conditions such as global warming, thermal diffusivity is a physical property represented by the thermal characteristics of the soil.

The heat transfer and temperature change in the surface layers of the soil at a depth of 2 m were investigated using a vertical heat exchanger in the sandy mixed soil in Najaf and according to location.

For one day at a temperature of 40 degrees Celsius and a flow of 0.5 liters per minute, the best thermal diffusivity was obtained, ranging 0.006251554 to 0.006625955 m^2/sec.

At a temperature of 40 degrees Celsius and a flow rate of 1 liter per minute, the best thermal performance coefficient was achieved.

***Keywords**: soil temperature, thermal diffusivity, Thermal conductivity of soil*

INTRODUCTION

The thermal diffusivity of a soil is an important soil attribute that is employed in a variety of applications such as agriculture, climatology, and engineering. It has a big impact on the soil temperature profile, which controls the earth's heat and mass transmission, and it's a key parameter in energy balance applications including land surface modeling, numerical weather forecasting, and climate prediction[1] .

In both residential and commercial buildings, ground-source heat pump (GSHP) systems are frequently utilized for space heating and cooling. A ground heat exchanger (GHE) is used to exchange heat with the earth in this manner. The vertical kind of GHE is often used in GSHP systems because it has better thermal performance than the horizontal type. The GHE's thermal performance is an important factor to consider when constructing a GSHP system. The utilization of renewable energies has recently become increasingly significant in order to reduce energy consumption in general and fuel use in particular, as solar energy may be used to generate electricity. [2].

Summer in Iraq is distinguished by high air temperature and low relative humidity because it is the longest season of the year in comparison to other countries. As a result, reducing the air temperature inside the area is a significant challenge.

Common air conditioning systems are used to remedy this problem, but these systems are not ecologically friendly and require a lot of electrical energy, therefore the researchers turned to geothermal energy as an alternate solution.

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Thermal "performance of three types of geothermal heat exchangers" using double tubes, U tubes, and multi tubes in steel substrates. With a constant running time [3].

A large number of coupled geothermal heat pump systems are employed "in residential and commercial buildings" all over the world due to the enticing benefits of high efficiency, and vertical well technology has been exploited for air conditioning applications. [4].

The response to the temperature of wells for lengthy periods of time and the heat transfer model of vertical geothermal heat exchangers for geothermal heat pump systems are explored. [5].

Thermal diffusivity, heat accumulation in the soil, thermal conductivity, and the thermal performance coefficient were all calculated using the vertical heat exchanger as a heat source. For subsurface thermal diffusivity, thermal diffusivity dependent on soil depth appears to yield adequate results.[6].

EXPERIMENTAL SET-UP

At a depth of 2 meters, a vertical heat exchanger was erected as an energy source in the soil of the Technical College of Engineering in Najaf. It is made out of a 2-meter-long wrought iron pipe with an outer diameter of 14.5 cm and an inner diameter of 14.2 cm. The heat exchanger was fed with hot water at various temperatures between 40 and 60 degrees Celsius at different flow rates between 0.5 and 2 liters per minute for 45 days. Regular thermal sensors put around the exchanger assessed ground temperature at a depth of one meter. In the laboratories of the Technical College in Najaf, soil moisture content and density were calculated., and the results were obtained.

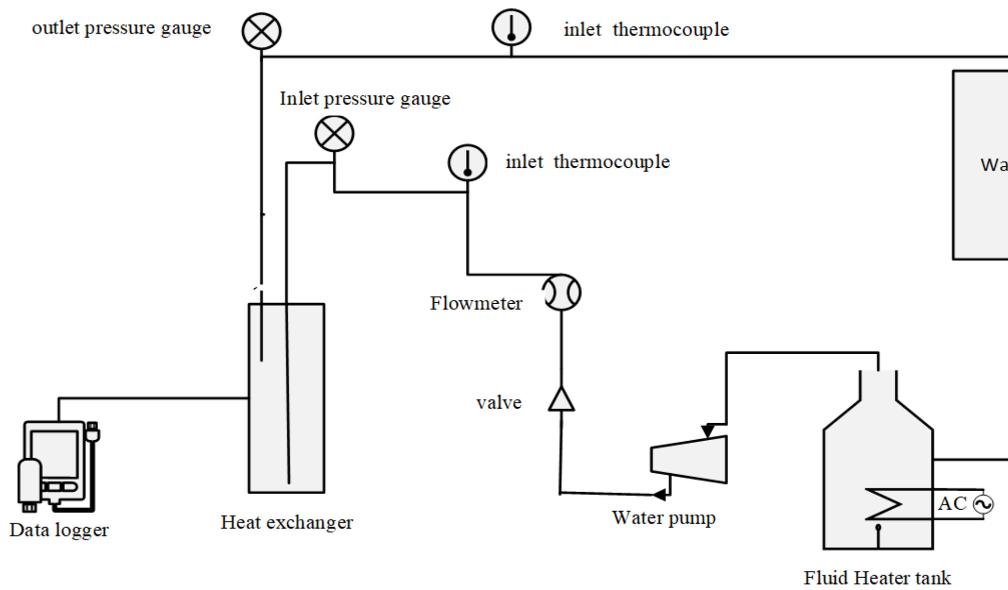

Fig (1) demonstrates the system's design

Soil Characteristics and Material Selection on the ground

The current research was conducted at Iraq's "Engineering Technical College" in Najaf. Thermal conductivity was calculated at the soil laboratory of "Engineering Technical College (Civil Technology Department)", Najaf – Iraq, where the conductivity was 1.74 W/m.K with moisture of 3%, and was based on "ASHRAE Handbook-HVAC" systems and equipment's ch. 11, Atlanta, Georgia, 2000 [7], where the soil type is light sand in accordance with thermal conductivity and moisture co-efficient.

type soil	Thermal conductivity (W/m.K)	dry density (kg/m^3)	specific heat (kj/(kg.k)	thermal diffusivity (m^2/day)
Light Sind (6%water)	0.9–2	1283	0.72	0.006625955

THERMAL DIFFUSIVITY OF WET SOIL

Thermal diffusivity is an important soil attribute that is used in a variety of fields such as agriculture, climatology, and engineering. It has a significant impact on the soil temperature profile, which regulates the earth's heat and mass movement, and is an important "parameter in energy balance applications such as land surface modeling, numerical weather forecasting, and climate prediction. [7]

COEFFICIENT OF PERFORMANCE

A heat pump's efficiency is measured by its Coefficient of Performance (COP). "When computing the COP for a heat pump, the heat output from the condenser (Q) is compared to the electricity given to the compressor" (W).

RESULTS AND DISCUSSION

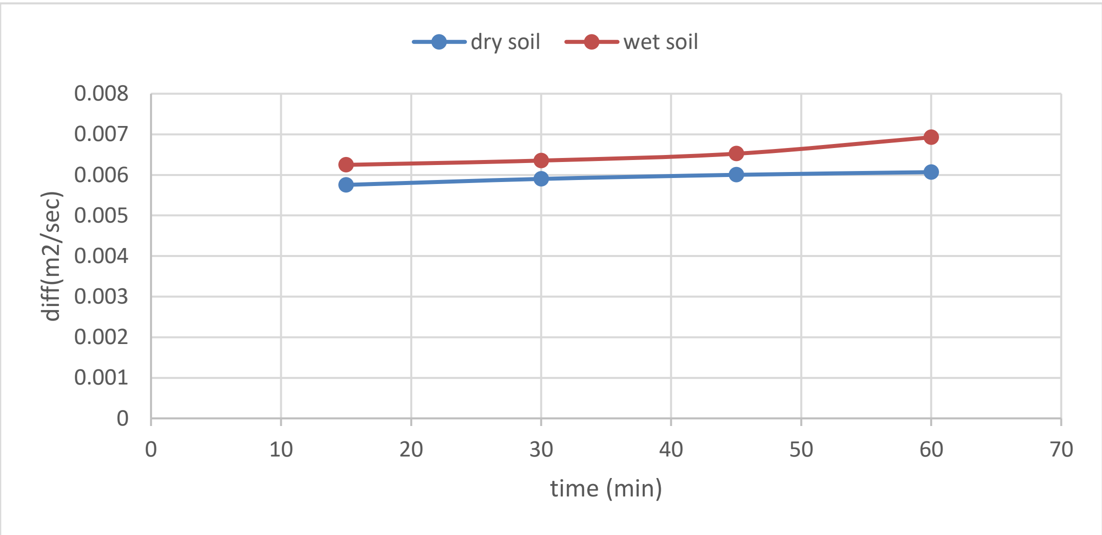

Figure (2) Thermal diffusivity of wet and dry soils

Figure (2) The thermal soil diffusivity is calculated using the results of the experiment for moist soil at inlet temperature (50) and liquid flow rate (1 liter per minute) with varying wetting rates (15, 30, 45, and 60 minutes) (0.007065127) When the thermal diffusivity of dry soil was measured at the same inlet temperature and liquid flow rate (0.006067671m^2/sec)

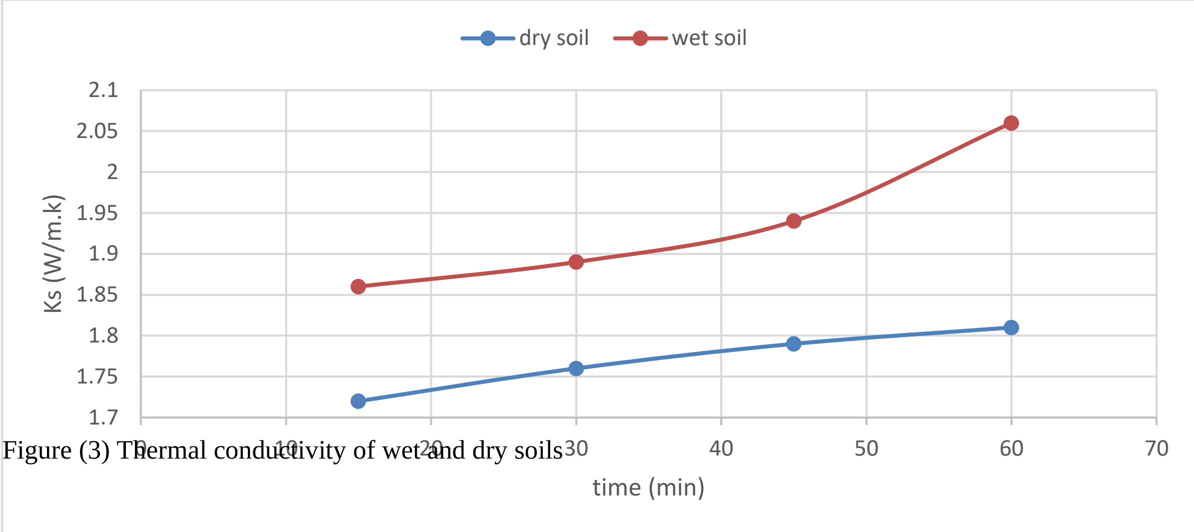

Figure (3) Thermal conductivity of wet and dry soils

Figure (3) The values of thermal conductivity at the input temperature (50°C) and liquid flow rate (1 liter per minute) with wetting rates (15, 30, 45, and 60 minutes) are shown in the experimental results for moist soil, where the best value was found. The thermal conductivity of wet soil (60 min) and its value (2.06) at inlet temperature (50 °C) and liquid flow rate (1 LPM), while the thermal conductivity values of dry soil at the same conditions were (1.17). The thermal conductivity values were (1.83, 1.87, 1.93) at different rates of soil wetness (15, 30, 45 minutes).

CONCLUSION

Because thermal conductivity is the primary driver of heat transmission in soil, estimating thermal diffusion is required to address climate change. The heat spread in the study area is in the range (0.006251554 - 0.006625955) m^2/sec

1- The best thermal diffusion was calculated at a temperature of 50 ° C and a flow of 1 liter per minute, taking into consideration the temperature of the atmosphere and the soil's outer cover "in addition to the thermal conductivity."

2- The negative and positive distributions of thermal diffusion values indicate the reduction and rise in temperature, respectively.

3- The moisture content of the soil affects thermal diffusion. The difference in thermal diffusion of the soil reduces when the soil is hydrated above the maximum.

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