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Hybrid Nanofluid Flow in a Horizontal Borehole Heat Exchanger with Twisted Tape as Turbulator

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***Abstract*— The use of ground as a heat source in geothermal heat pumps has been considered in recent years due to its high efficiency and energy savings. In this paper, the numerical simulation of the thermal performance of hybrid nanofluid flow in a horizontal geothermal heat exchanger equipped with twisted tape as turbulator is done using ANSYS Fluent CFD code. The results of numerical simulation were compared with experimental works and a good agreement was seen between the results. The results show that the horizontal geothermal heat exchanger has better heat transfer to the ground surface in the case with hybrid nanofluids than in the case with pure water.**

Keywords: Borehole Heat Exchanger, Twisted Tape, Hybrid Nanofluid, Turbulator, Heat Transfer, Thermal Performance

I. INTRODUCTION

The use of ground as a heat source in geothermal heat pump systems has been considered in recent years due to its high system coefficient of performance and reducing system energy consumption. In general, two types of geothermal heat exchangers are used in geothermal heat pumps, which are vertical exchangers, that are placed in wells with a depth of 30 to 150 meters, and horizontal heat exchangers, that are placed in a depth of one to two meters.

Vertical borehole heat exchangers have better thermal performance and require much less surface area because the ground temperature is relatively constant at lower depths, but require much more initial investment due to the drilling of deep wells. Horizontal borehole heat exchangers are located at depths of one to two meters above the ground, have lower thermal performance but require less excavation costs and, if the ground is sufficiently accessible, they are a good option.

In recent years, the use of these types of heat exchangers has increased due to the installation of new infrastructure and the elimination of excavation costs. Horizontal borehole heat exchangers have different arrangements, the most common of which are straight tube, helical tube, and slinky heat exchangers. Different researchers have examined different parameters affecting the thermal performance of these types of heat exchangers.

Wu et al. [1] used a laboratory model to compare the straight tube and helical tube types of the horizontal borehole heat exchangers. In terms of thermal performance, they found the straight tube heat exchanger better than the helical tube heat exchanger, but in terms of the amount of ground required and the economic aspect, they found the helical heat exchanger superior. Then, using numerical simulations, they studied the various parameters of the helical heat exchanger. Fujii et al. [2] simulated a helical heat exchanger with different pitches and modeled this type of heat exchanger with a rectangular tube They validated the results of numerical solution with