Modeling of Horizontal GSHP System for Greenhouse

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Abstract

Greenhouses need heating supply most of the time of a year. Their heating demands are high and economical heating systems are very important for this kind of facilities. Horizontal ground source heat pump systems are getting more interest last years for being easy to apply and low initial cost. However, they need a wide area to apply. In this study, the heating system of a greenhouse is integrated with horizontal ground heat exchangers by using the floor of the greenhouse. Experimental result of a sample slinky type ground heat exchanger was imported to the model and the model was validated with the results. The real ground heat exchanger (slinky type) is built in COMSOL Multiphysics® by using tools in the geometry tab and Heat Transfer Module and validation of the model is provided. To simplify the solutions a slinky type heat exchanger approximated with a long and thin rectangular block. The approximation is done based on to give the same results with 3D slinky solution. Furthermore more rectangular blocks allocated in the given field as different arrays to find the best performance. In 3D slinky and rectangular block temperature of pipes entered as an input. In the upper boundary of ground greenhouse's indoor set temperature is entered. After the solution is completed total heat flux magnitude is calculated. Benchmark of different allocation is this total heat flux magnitude. Then yearly analysis is done for this ground heat exchanger system for the greenhouses. It is showed that heating cost of the facility can be decreased considerably than the conventional heating system.

Figures used in the abstract

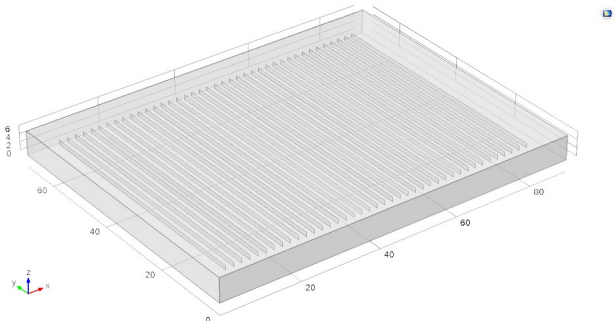

Figure 1: Horizontal GHE supported Greenhouse.