지하공기-물 직접접촉식 열교환기를 구비한 히트펌프의 성능

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Performance of Underground Air-to-Water Heat Pump with Direct Contact Heat Exchanger

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In Jeju, underground air is used for heating greenhouse and fertilizing natural CO_2 gas by suppling directly into greenhouse. But greenhouse heating method by direct supply of underground air has several problems as like low temperature below 20℃ or high relative humidity over 90%. The underground air is inadequate in heating of crops such as mangos, oranges with the growing temperature over 20℃. Also if the relative humidity of greenhouse is kept with over 90%, diseases can strike almost of the crops. And also the ventilation loss becomes larger because the air pressure of inside greenhouse by direct supply of underground air is higher. In this study the heat pump system using underground air as heat source was developed and heating performance of the system was analyzed. Heating COP of the system was 2.5～5.0 and rejecting heat into greenhouse and extracting heat from underground air in this heat pump system were 46.5～31.4 kW, 34.9～20.9 kW respectively.

Key words : underground air(지하공기), heat pump(히트펌프), COP(성능계수), greenhouse(온실)

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여과수열원 히트펌프를 이용한 온실난방기술 개발

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Development of Heating Technology for Greenhouse by Use of Ground Filtration Water Source Heat Pump

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This study was carried out in order to reduce the installation expense of heating system for greenhouse comparing to geothermal heat pump and develope the coefficient of performance (COP) for a heat pump. For getting plenty of heat flux from geothermal energy. Surface water in river channel was used for getting a lots of geothermal heat by penetrating water through underground soil layer of the river bank that make heat transmission to passing water. The range of water temperature after the process of Ground filtration is 13～18 degrees celsius which is very similar to low heat source of geothermal heat pump system and the plenty amount of heat source from that make the number of geothermal heat exchanging hole and the expense for geothermal heat exchanger construction reduced. Drainage well is also used for returning filtration water to the aquifer that keep the water good recirculation from losing geothermal heat and water resource. For the COP improvement of Heat pump, thermal storage tank with separating insulation plate according to the temperature difference make the COP of Heat pump that is similar to thermal storage tank with diffuser. Developed thermal storage tank make construction expense cheaper than customarily used one's. and that sand filter and oxidation sand (FELOX) are going to be used for improving ground filtration water quality that make heat exchanger efficiency better. All above developed component skill are going to be set on the Ground filtration water source heat pump system and applied for medium, large scale for protected greenhouse in riverside area and on-site experiment is going to do for optimizing the heating system function and overcome the problem happening in the process of on-site application afterward.

Key words : Ground filtration water source heat pump(여과수열원 히트펌프), heating technology(난방 기술), Greenhouse(온실)

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