Energy-saving low-carbon technology in greenhouse horticulture utilizing thermal energy in irrigation canals

Production | Demonstration | Item: Greenhouse horticulture | GHG emission reduction

Outline

We developed a technology for collecting and utilizing heat by installing a sheet-type heat exchanger in flowing water, such as an irrigation canal. Energy consumption and greenhouse gas (GHG) emissions from heating/cooling of agricultural greenhouses can be reduced by collecting and utilizing heat from flowing water.

Background/effect/note

Heavy fuel oil is commonly used for heating agricultural greenhouses and is one of the sources of GHG emissions. On the other hand, heat pumps have become popular for cooling in addition to heating. Recently, heat pumps have been used in order to produce high-quality crops. However, air-source heat pumps are used in most cases. Water has higher thermal conductivity and specific heat than air. The heat exchange efficiency is further improved by the flow. Thus, flowing water is the most suitable heat source for heat pumps. Laboratory experiments determined that the installation of a sheet-type heat exchanger (Figs. 1 and 2) in flowing water improved heat exchange efficiency by approximately 15 and 2.5 times when compared with that in underground and stagnant water, respectively (Fig. 3). Furthermore, construction costs can be reduced as digging boreholes is not necessary during the installation of the heat exchanger in irrigation canals. Additionally, protective materials can be attached on the heat exchanger to reduce damages caused by debris in water.

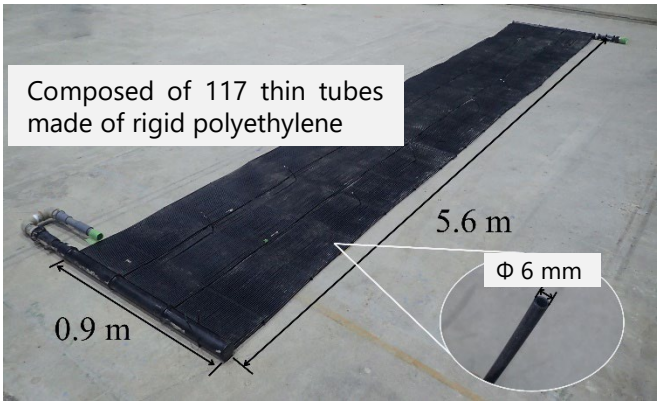

Fig. 1. Sheet-type heat exchanger

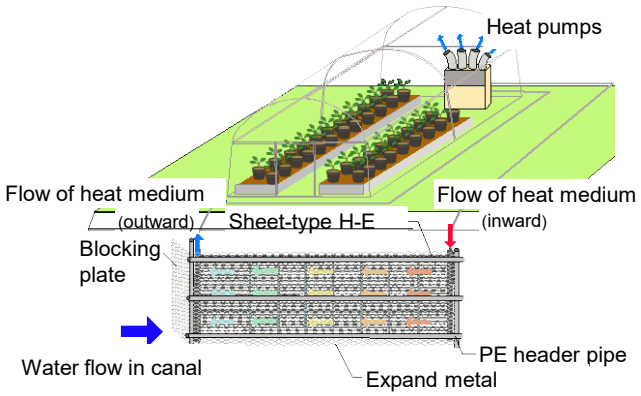

Fig. 2. Schematic view of heat utilization in greenhouse (cooling)

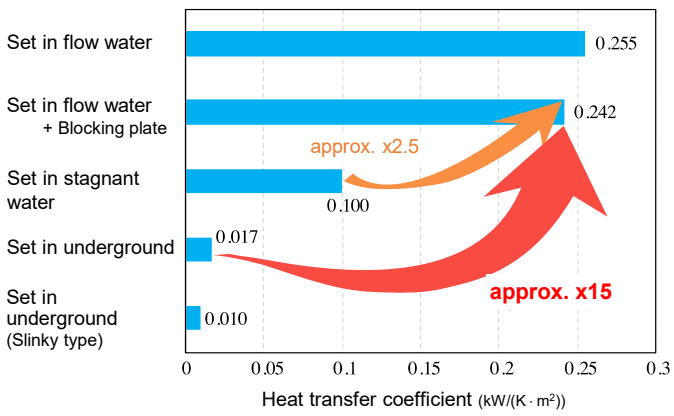

Fig. 3. Comparison of heat exchange efficiency

Technical details:

https://www.naro.go.jp/english/laboratory/nkk/press_release/sheetheatexchanger/index.html

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