Solar Water Heater Utilizing Mini-Channel Technology

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Abstract

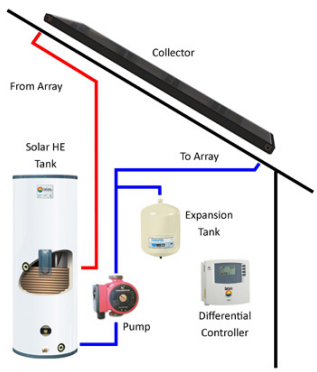
Much of the cost associated with current solar water heaters are fixed costs associated with production. This makes them a great alternative to natural-gas powered water heaters provided that the lifetime of the heater is sufficient to offset the up-front costs. Efficient design is thus a key factor in lowering these up front costs and making the heater more viable in the long-run. Proposed through this project is a design which utilizes mini-channel technology, which has seen much progress through the HVAC and automotive industry, in place of round-tube plate-fin design currently in use by solar water heaters. By increasing the heat transfer efficiency, a more compact design can be obtained. The mini-channel design can also be used in evacuated-tube solar collectors.

Motivation

- Compare performance of standard solar water heater and modified mini-channel water heater
- Construct a round-tube flat-plate and a minichannel-based solar water heater
- Install a conventional flat-plate and the mini-channel solar water heater side by side. Install temperature, solar radiation, and flow rate sensors.
- Determine experimental performance and thermal efficiency of the two systems

Typical System Installation

- SunEarth collector model EC 40
- Standard Size: 10" X 4"
- Closed loop with heat exchanger



Mini-Channels

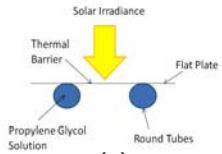
- Currently used in heat exchangers/condensers for HVAC and automotive industry
  - Large Port/Web area ratio

  - Rectangular or tubular design

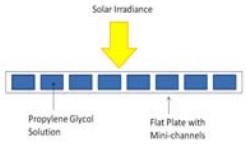
  - Large contact area of working fluid and tube-walls for small hydraulic diameter

Concept

- Thin absorber fin and limited contact with round tube carrying working fluid imply high thermal resistance, Fig. (a).
- Mini-channel provides more direct contact area between fluid and absorber allowing for better heat transfer, Fig. (b).



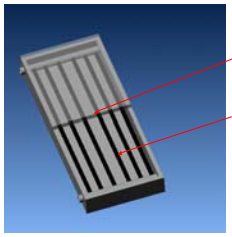
(a)



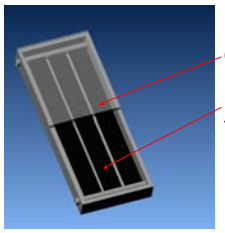
(b)

Implementation

- A standard solar water heater panel



- A mini-channel solar water heater panel



Acknowledgements

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