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A Thermosyphon Solar Water Heating System for Sub Zero Temperature Areas

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Abstract

Heating without global warming is a key challenge being faced by world community today. In this regard, harvesting solar energy to meet domestic hot water demand of cold regions is attempted as an alternative design solution. Low solar insulation, chilly winds and sub-zero temperatures have been identified as major hindrances in harnessing solar energy in cold regions. A thermosyphon driven supercritical CO_2 fluid based solar water heating system is developed for use in subzero temperature areas. The solar collector consists of parallel U-tubes inserted in fins inside the evacuated glass tubes. Special arrangements in manifolds and evacuated glass tubes were applied to make it possible to stop the reverse thermosyphon. Optimal heat transfer refrigerants were studied for this solar heating system. At ambient temperature range of 30 to 35°C range, CO_2 refrigerant easily attains 75°C with collector efficiency ranging from 80- 85%. When the hot refrigerant is passed through helical coil counter flow type heat exchanger, the inlet water temperature increases from 26 to 55°C giving off a temperature gradient of 29°C, resulting in efficient heat transfer of system. The system provides 23°C greatest temperature difference (GTD), 14°C lowest temperature difference (LTD) and 18.13°C log mean temperature difference (LMTD). This innovative solar water heater can perform adequately in subzero