Columbia Technology Ventures

Tank-less solar water heater for the U.S. and global markets

Technology #cu16060

Energy efficient and inexpensive, solar water heaters have enjoyed increasing popularity in China for both residential and industrial purposes. However, the systems used in China, based on glass vacuum solar energy collectors, require a large insulated storage tank placed on top of an array of vacuum tubes to contain the water once heated. Besides, cold water must be filled manually every night. Because of the weight and inconvenient location of the storage tanks, it is unpopular in many countries in the world.

The new solar water heater uses glass vacuum tubes as both solar radiation collectors and thermal energy storage devices. First, the vacuum tubes are perfect insulators for thermal energy storage. Therefore, after sunset, or in raining days, the thermal energy can stay for a longer period of time. Second, with a clever design, the system works like an electric tankless water heater: When hot water is needed, cold water is sent to the vacuum tubes to acquire heat from the energy storage medium inside the vacuum tubes, and then hot water with a desired temperature is delivered. Third, all the operations are performed by natural forces, without using any electrical or electronic devices. The system has an overheat prevention mechanism based on natural force. The output temperature is controlled by a mixing valve based on natural force. Therefore, the weight of the tubes is distributed over a large area, the operation is convenient, and the maintenance cost is substantially reduced, to enable its introduction to U.S. and other global markets as an alternative to electricity or gas powered water heaters for both residential and industrial use.

Increased heat capacity of aqueous aluminum sulfate enables thermal energy storage in the vacuum tubes

To increase the thermal energy storage capacity per unit volume, it takes advantage of the high heat capacity (> double that of water) of an aqueous solution of aluminum sulfate (Al$_2$(SO$_4$)$_3$). Aluminum sulfate is non-flammable, non-toxic, and inexpensive (~$160/metric ton on the international market). Sealed plastic tubes filled with a 40-47% solution of aqueous Al$_2$(SO$_4$)$_3$ placed inside the vacuum tubes through which cold water flows and is stored.
Lead Inventor:

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Applications:

• Solar water heaters for residential buildings
• Solar water heaters for industrial buildings

Advantages:

• Energy efficient
• Requires less maintenance and upkeep than a conventional water heater
• Does not require a water storage tank
• Tap water can be heated any time
• Can output hot water of desired temperature
• Using passive components without using electric sensors and electric pumps

Patent Information:

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