Thermal Energy Storage: The Efficiency of Latent Heat Energy Storage using Phase Change Materials

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Energy is essential for the existence of human life and plays a vital role in the progress of a nation. With the rapid growth in global population, there has been a tremendous burden on energy resources. The need for alternative and renewable energy is at an all-time high. One of the options is to develop new energy storage devices. A phase change material (PCM) is a substance with a high latent heat which is capable of storing and releasing large amounts of energy at a certain temperature. The thermal energy transfer occurs when a material changes in phase or state (such as liquid to solid or solid to liquid). Latent heat is retained without any change in physical or chemical properties over thousands of cycles. When combining a phase change material with direct solar energy, as in a solar water heater, energy can be stored from one period of time (such as day light hours) and used at a later date (such as night time). This is much more cost effective by reducing energy waste, and it saves on capital cost and premium fuel. For my experiment, I wanted to investigate a thermal energy storage device that would increase the efficiency of a sustainable, renewable energy source. Using a thermal storage tank, I tested various phase change materials to see if they would have an effect on thermal energy conservation. The phase change materials I tested were paraffin wax, soy wax and thermoplastic resin. Also, for a comparative control, I tested a solution with no PCM. I wanted to demonstrate how phase change materials could help keep water hot for a longer period of time in a solar water heater. To summarize my results, all thermal energy storage (TES) systems for water showed a higher temperature over time with a phase change material supplement.