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A Review on Solar Water Distillation Using Sensible and Latent Heat

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Abstract

Energy and water are the two major issues faced by human beings nowadays. Owing to increase in the energy costs and the adverse effect on the environment caused by the burning of fossil fuels, renewable energy sources are being used worldwide to contribute in meeting the energy demand. Renewable energy denotes a clean, nontoxic energy source that cannot be exhausted. The primary renewable energy sources are the sun, wind, biomass, tide, waves and geothermal energy. Harnessing the abundance of solar energy has been one of the most attractive energy alternatives. The development of an efficient and economical solar energy storage system is of major concern. Energy storage plays an important role in conserving available energy and improving its utilization. Electrical energy consumption varies during day time and night time. Solar energy is available only during the day. Hence its applications require efficient thermal energy storage so that the excess heat collected during sunshine hours may be stored for later use during the night time. The main problem while utilizing solar energy is its availability which is often intermittent, variable and unpredictable. These problems can be addressed by the storage of thermal energy. Thermal energy storage (TES) will improve the efficiency and output of solar power. A thermal energy storage system mainly consists of three parts, the storage medium, heat transfer mechanism and containment system. Thermal energy storage (TES) applications have significantly increased because of the increase in the energy prices and environmental regulations. Latent heat storage (LHS) is one of the efficient ways of storing thermal energy. Unlike the sensible heat storage (SHS) method, the latent heat storage method provides much higher storage density with a smaller temperature difference between storing and releasing heat. There are large numbers of phase change materials that melt and solidify at a wide range of temperatures. The reason behind using phase change materials is due to their advantages such as low cost, high storage density and isothermal operation. For the solar desalination process, they are used as a bridge to cross the gap between the energy source, the sun and the desalination unit.

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Keywords: Solar distillation, Thermal Energy Storage, Latent Heat, Sensible Heat and Phase Change Materials;

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1. Introduction

Energy is an essential factor for the social and economic development of the societies. Renewable energy is accepted as a key source for the future on this earth. The combined effects of the deflection of fossil fuels and the gradually emerging consciousness about environmental degradation have given the first priority to the use of renewable alternative energy resources in the 21st century. All of renewable, solar thermal energy is considered to be practically unlimited in the long term and is a very abundant resource in the world. Many conventional and non-unconventional techniques have been developed for purification of saline water. Among these water purification systems, solar distillation proves to be economical and eco-friendly technique.

Among the non conventional methods to disinfect the polluted water, the most prominent method is solar distillation. The solar distillation method is more attractive than other methods. This method require simple technology as no skilled workers needed, low maintenance and it can be used anywhere without problems.

There are two different types of solar systems; those are active type and passive type. In active type solar system extra thermal energy is supplied to the basin through an external mode to increase the evaporation rate and productivity of pure water. Passive solar systems give lower yield when comparing with active solar systems. In the present days, most of the solar stills are passive solar stills. Because, they need only sunshine to operate it, and there are no moving parts to wear and power consuming. In a passive solar still, the solar radiation is received directly by the basin or solar still water and is only source of energy for raising the water temperature, so the evaporation leading to a lower productivity of pure water.

The passive solar still of a conventional design is basically a sealed enclosure containing a shallow body of uniform temperature brine solution. This brine solution is heated by absorption of solar radiation admitted through the top transparent condensing glass cover. The convective circulation of humid air induces the temperature difference between the brine solution and the top condensing glass cover. This causes the transport of water vapor from the brine surface to the top transparent glass cover and from there it condenses into the distillate chamber.

The parameters which are affecting the solar still are; water depth in the basin, material of the basin, wind velocity, solar radiation, inclination angle of glass cover and ambient temperature. The yield of water from the solar still is depend on the temperature difference between the water in the solar still or basin and glass cover inner side temperature. The yield from solar still is directly proportional to the temperature difference of water in solar still and in side of the glass cover.

Thermal processes for the distillation of sea water are known to be among the first technologies adapted to solar energy. The idea of saline water evaporation by using solar thermal energy for getting pure water is the best technique. It is very fortunate that in times of high water demand, solar radiation is also intense. It is beneficial to exploit solar energy directly by installing solar stills because they are clean and friendly to the environment.

Numerous studies on solar stills of various designs to increase the productivity of potable water and efficiency of solar still have been carried out theoretically and experimentally. The work done by previous researchers in obtaining distilled water using solar energy is listed below: