Abstract

It is well-known that the reserve of fresh water is only 3% throughout the world. Developing and underdeveloped nations are worst affected, among different nations, because poor infrastructure, weaker economy, frequent flood and other unavoidable circumstances. Many people die during flood due to scarcity of drinking water. Hence, it is easily understood that there is huge demand of fresh or potable water throughout the world. Solar distillation is an inexpensive technology to produce distilled water which may be used in boilers or other engineering operations. Besides, minerals may be added to this water to make it potable. The present study focuses on the design and fabrication of passive solar still system with phase change materials (PCM). In order to improve the distillate, PCMs (paraffin wax, stearic acid, and lauric acid) have been stored in a copper cylinder. The effects of basin water depth on total distillate have been studied for all three cases. The maximum distillate has been obtained at 1 cm depth for all cases with three PCMs used in this study. Total distillate decreased linearly with water depth for all three PCMs.

The objective in these type of studies is to enhance the distillate output. Hence, it is important to find out means to enhance thermal conductivity of PCMs by introducing some additives. In the present study, copper oxide nanoparticle (CuO) has been dispersed in paraffin wax and stored in a copper cylinder to enhance the thermal conductivity and increase the total daily production of the solar distillation unit. Experiments have been performed for comparison between simple solar still (SSS), solar still with phase change material (SSPCM), and solar still with phase change material doped with nanoparticle (SSNPCM). The mixing of nanoparticle causes a paradigm shift of the thermo-physical properties of phase change material (PCM). Nanoparticle and copper cylinder enhance the heat transfer rate with decreased duration of sensible heating, melting and solidification of PCM. Thermal analysis reveals that the evaporative mode of heat transfer has dominated heat transfer between glass cover and water.

The maximum and average temperature for water basin and NPCM has been increased significantly for SSNPCM. The daily productivity of SSPCM and SSNPCM has been increased by 40.5 and 94.19 % as compared to SSS. Based on the heat transfer rate, thermal conductivity, and daily productivity, SSNPCM can be considered not only as a better performing system as compared to SSS and SSPCM but also as a low cost disruptive technology in resource-constrained settings where drinking water is really scarce.