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Production of potable water from Gomti River by using modified double slope solar still with external mounted reflectors

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ABSTRACT

The aim of this study is to improve the production of potable water through ultra modified double slope solar still (UMDSSS) by harvesting of direct solar energy as well as diffused radiation through transparent side walls. The setup was fabricated in combination with FRP and transparent acrylic sheets with a total basin area of 2 m^2. Reflectors angles (30°, 45°, 60°, and 75°) were optimized for climatic conditions of Lucknow (26° 50′ N, 80° 13′ E), U.P., India. On the basis of productivity, optimized reflector angle has been found as 60°. The experimental and theoretical studies were carried out in the different seasons of year 2018. The basin water depth and glass cover tilt angle have been taken as 1.0 cm and 15° respectively. Our experimental investigation shows that the cumulative distillate productivity was obtained as 9157 ml/day and 6630 ml/day during summer and winter season, respectively at 60° reflector angle. The performance evaluation has been carried out in terms of physicochemical environmental parameters, productivity, and economic analysis. On the basis of economic analysis, the payback period was found 111 days and thermal efficiency of ultramodified solar still is higher 10.4% in summer and 10.0% in winter than that modified solar still.

1. Introduction

The potable water and energy are the essential requirements which affect the civilized life on the globe. The availability of fresh potable water is a vital task for any individual nowadays & it has now become a tough task. That's why the purity of drinking water plays a significant function. Fresh and pure water is also required for agriculture and industrial applications. Due to these reasons, the groundwater has been intensively exploited (Dorre and Toor, 2018). In recent decades, freshwater scarcity is increasing and has become a worldwide crisis in secluded and arid areas due to an increase in the energy crisis, drought, desertification change in climate conditions, and global warming. This condition is more critical in arid and rural areas, especially in North Africa and the Middle East regions (Ahmed, et al., 2017). Therefore, clean water is an essential requirement for those areas. Contaminated water is the main cause of various types of health problems like bone diseases, skin problems, etc. As a result, on the other hand, if people will not be healthy, they always fight for health and consume their money to save health. Such a way economic growth will also be retarded (Wolfe and Brooks, 2003; Parveen and Singh, 2016; Rufus et al., 2016).

In the solar distillation process, the sun's energy in the form of short electromagnetic waves passes through a clear glazing surface such as a glass surface. Upon striking a darkened surface, this light changes wavelength, becoming long waves of heat, which is added to the basin water in a shallow basin below the glazing (Selvaraj and Natarajan, 2018). Desalination is known as the method of separation of salt from the sea or brackish water to produce freshwater with low brine and salt concentration (Jimenez et al., 2017). Desalination of river water, seawater, and other sources of brackish water can be used to provide fresh drinking water so that it may fulfill social needs and also minimizes any harmful effects on the environment as well as the ecosystem (Ahsan et al., 2014; Kavithaa et al., 2019). The journey of solar distillation unit has been started during the Second World War and Chile was the main leader to establish this technology for the production of drinking water, which is shown in Fig. 1.(Rajaseenivasan and Murugavel, 2013).

There are various designs of solar stills other than conventional technology. Based on the designs available in the literature. The conventional distillation plants throughout the world are energy-intensive and utilize fossil fuel directly or indirectly i.e. non-conventional energy. Solar distillation has the inherent advantage of using solar energy which is available free throughout the year due to its simplicity and economic benefits (Kushwaha et al., 2011; Kulandaivel and Karuppiah, 2014).

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