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Concentrated solar thermal cogeneration for zero liquid discharge seawater desalination in the Middle East: case study on Kuwait

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ABSTRACT

Processes have been developed for seawater desalination and for producing the required heat and power. To produce high-pressure steam and generate heat and electrical energy, solar thermal technologies can be directly applied. The design and development of water desalination technologies in the Middle East considering the particular geographic and weather conditions are the main challenges addressed in this study. Reverse osmosis in series with thermal methods is employed to prevent the environmental impact of the conventional methods, including the release of greenhouse gases and saline water rejection into seas. A design procedure is presented to calculate the equipment size and the process parameters in a concentrated solar thermal cogeneration and desalination plant with zero liquid discharge. In this case study, the available hourly solar irradiance data of Kuwait are directly input during designing. Based on the minimum and maximum values of the available solar energy, which correspond to the shortest and longest days of a year, production capacities of 400,000 and 865,000 m^3/d in winter and summer, respectively, are obtained for the desalination plant. The calculations yield a total reflector surface area of 2,670,000 m^2 and molten salt heat storage of 85,500 tons.

Keywords: Desalination; Solar thermal; Cogeneration; Solar irradiance; Design

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