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# WATER DESALINATION USING A SOLAR CONCENTRATOR WITH INTEGRATION OF EXCESS THERMAL ENERGY INTO A HEATING SYSTEM

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**Abstract:** This study presents a solar concentrator-based water desalination system integrated with a heating system. The system uses concentrated solar energy to generate the thermal energy required for the desalination process. The excess thermal energy produced during operation is recovered and utilized for heating purposes, thereby improving the overall energy efficiency of the system. This integrated approach helps reduce thermal energy losses and dependence on conventional energy sources while supporting sustainable freshwater production. The proposed system can be particularly effective in regions with high solar energy potential and limited access to freshwater resources.

**Keywords:** Solar energy, solar concentrator, water desalination, thermal energy, heating system, excess heat, energy efficiency, renewable energy sources, heat transfer.

**Аннотация:** В данной работе представлена система опреснения воды на основе солнечного концентратора, интегрированная с системой отопления. Система использует концентрированную солнечную энергию для получения тепловой энергии, необходимой для процесса опреснения. Избыточная тепловая энергия, образующаяся в процессе работы, утилизируется и используется для отопления, что позволяет повысить общую энергетическую эффективность системы. Такой интегрированный подход способствует снижению тепловых потерь и зависимости от традиционных источников энергии, а также обеспечивает устойчивое получение пресной воды. Предлагаемая система особенно эффективна для регионов с высоким потенциалом солнечной энергии и ограниченным доступом к пресной воде.

**Ключевые слова:** Солнечная энергия, солнечный концентратор, опреснение воды, тепловая энергия, система отопления, избыточное тепло, энергоэффективность, возобновляемые источники энергии, теплообмен.

**Annotatsiya:** Ushbu ishda quyosh konsentratori asosida suvni chuchutish va isitish tizimiga integratsiyalangan tizim taklif etilgan. Tizim chuchutish jarayoni uchun zarur bo‘lgan issiqlik energiyasini olishda konsentrlangan quyosh energiyasidan foydalanadi. Ish jarayonida hosil bo‘ladigan qo‘shimcha issiqlik energiyasi qayta foydalanilib, isitish tizimiga yo‘naltiriladi. Bu yondashuv tizimning umumiy energetik samaradorligini oshirish, issiqlik yo‘qotishlarini kamaytirish va an’anaviy energiya manbalariga bo‘lgan ehtiyojni qisqartirish imkonini beradi. Taklif etilayotgan tizim quyosh energiyasi salohiyati yuqori va chuchuk suv resurslari cheklangan hududlar uchun samarali yechim bo‘lishi mumkin.

**Kalit so‘zlar:** Quyosh energiyasi, quyosh konsentratori, suvni chuchutish, issiqlik energiyasi, isitish tizimi, ortiqcha issiqlik, energiya samaradorligi, qayta tiklanuvchi energiya manbalari, issiqlik almashinuvi.

**INTRODUCTION.** The increasing demand for freshwater and energy has created a need for sustainable and energy-efficient technologies. Water desalination is an important solution for providing freshwater in regions with limited water resources. However, conventional desalination methods often require significant amounts of thermal or electrical energy.

Solar energy is a promising renewable energy source that can be effectively used for thermal desalination processes. Solar concentrators can collect and concentrate solar radiation to generate

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high-temperature thermal energy required for water desalination. In addition, the excess thermal energy generated during the process can be recovered and utilized for heating purposes.

The integration of a solar desalination system with a heating system can improve overall energy utilization, reduce thermal losses, and decrease dependence on conventional energy sources. Therefore, this study focuses on the development and analysis of a water desalination system based on a solar concentrator with the integration of excess thermal energy into a heating system.

**LITERATURE REVIEW**. In recent years, the use of renewable energy sources for water desalination has attracted considerable attention due to the increasing demand for freshwater and the limited availability of conventional water resources. Water desalination is an important solution for obtaining freshwater from saline and brackish water. However, many conventional desalination technologies require significant amounts of electrical or thermal energy. Therefore, the application of renewable energy sources, particularly solar energy, is considered an environmentally friendly and sustainable alternative.

Solar energy is one of the most promising renewable sources for desalination because it is widely available and can be directly converted into thermal energy. Various studies have investigated solar stills, solar thermal collectors, and solar concentrators for desalination applications. Solar stills have a simple structure and are relatively easy to operate, while solar thermal collectors and concentrators can provide higher temperatures and greater amounts of thermal energy.

Solar concentrators are particularly effective because they concentrate solar radiation onto a relatively small receiver area, allowing higher operating temperatures to be achieved. The generated thermal energy can be used to heat saline water and provide the evaporation required for the desalination process. The efficiency of these systems depends on several factors, including solar radiation intensity, concentrator type, optical efficiency, operating temperature, receiver design, and heat-transfer characteristics.

Previous studies have also investigated methods for improving the overall efficiency of solar thermal systems through heat recovery. During the desalination process, a certain amount of thermal energy may remain unused or be lost to the surroundings. Recovering this excess heat and transferring it to a heating system can significantly improve the utilization of the collected solar energy. The recovered heat can be used for domestic water heating, space heating, or other thermal applications.

The integration of a desalination system with a heating system provides an opportunity to utilize solar thermal energy for multiple purposes simultaneously. Such an integrated system can reduce thermal losses, improve overall energy efficiency, and decrease dependence on conventional energy sources. In addition, the combined production of freshwater and useful heat can increase the practical value of solar thermal technologies.

This approach is particularly relevant for regions with high solar radiation and limited freshwater resources. The development of efficient solar concentrator-based desalination systems can contribute to sustainable water production while providing additional thermal energy for heating applications. However, factors such as variations in solar radiation, heat losses, system operating temperature, and effective heat-transfer methods must be considered to achieve optimal performance.

Therefore, further research into the integration of solar concentrator-based desalination with excess heat recovery is important for improving system efficiency and expanding the practical application of renewable energy technologies. The present study focuses on the utilization of concentrated solar energy for water desalination and the integration of excess thermal energy into a heating system.

**CONCLUSION.** The study demonstrates the potential of using a solar concentrator for water desalination with the integration of excess thermal energy into a heating system. The proposed

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approach allows solar energy to be used efficiently for both freshwater production and heating purposes. The recovery of excess heat can reduce thermal losses and improve the overall energy efficiency of the system.

The integration of desalination and heating processes can also reduce dependence on conventional energy sources and support the use of renewable energy. This technology is particularly promising for regions with high solar radiation and limited freshwater resources. Further research should focus on improving the thermal efficiency, optimizing operating conditions, and developing effective heat recovery methods to increase the productivity and reliability of the proposed system.

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