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Our project aims to develop a solar-powered desalination system that utilizes the sun's abundant energy to extract clean drinking water from seawater or brackish water. This sustainable and eco-friendly solution addresses the pressing global issue of water scarcity, particularly in arid regions and remote areas lacking traditional water infrastructure. The growing demand for freshwater, coupled with the escalating scarcity of freshwater resources, necessitates innovative and sustainable water treatment solutions. Solar-powered desalination emerges as a promising approach to bridge this gap, offering a clean and environmentally friendly method for producing freshwater from abundant saline water sources.

Objectives:

Benefits:

- stressed regions.

MATERIALS USED IN CONSTRUCTION

The solar water desalination system was constructed using a variety of materials, including a repurposed satellite dish, a reused standing fan base, a recycled can, a glass bottle, a thin hose, and perfectly cut mirror tiles.

- A can

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SOLAR WATER DESALINATION SYSTEM

INTRODUCTION

• Design and construct a solar-powered desalination system capable of producing a significant volume of freshwater per day.

Employ an efficient desalination technique that optimizes water production while minimizing energy consumption. Integrate a robust solar collector to effectively capture and convert sunlight into thermal

energy for the desalination process. Implement a monitoring system to track and optimize the system's performance under varying weather conditions.

Validate the desalination system's effectiveness in producing potable water meeting international standards for drinking water quality.

Evaluate the economic feasibility of the solar desalination system, including operational costs and potential revenue streams.

Analyze the environmental impact of the system, assessing its carbon footprint and water resource utilization efficiency.

• Sustainable water production: Harnesses the sun's abundant energy, eliminating reliance on fossil fuels and reducing greenhouse gas emissions Cost-effectiveness: Eliminates reliance on expensive electricity, lowering operating costs

compared to conventional desalination methods. Scalability and adaptability: Can be designed to meet varying water demands and operational conditions in different regions.

Accessibility in remote areas: Provides clean drinking water to communities lacking traditional infrastructure, particularly in arid and coastal regions. Economic empowerment: Promotes economic activities and enhances livelihoods in water-

Environmental protection: Conserves freshwater resources and reduces the strain on natural ecosystems.

Re-Used/Recycled Materials: A satellite dish The base of a standing fan A glass bottle

Other Materials: A thin hose Mirror tiles Absorber material

Our solar water desalination system, meticulously crafted from repurposed and recycled materials, stands as a testament to the ingenuity and resourcefulness of our team to seamlessly harness the power of the sun and transform seawater or brackish water into precious freshwater. The repurposed satellite dish serves as the **solar collector**; its parabolic surface precisely engineered to focus sunlight onto a strategically positioned control system he absorber material on the control system, composed of black chrome, efficiently absorbs sunlight, generating heat that powers the desalination process.

The repurposed can, serving as the **control system**, strategically contains the seawater within the system. When it is in contact with the focused sunlight, it absorbs heat to a high degree that causes the seawater to evaporate; leaving the salt and other constituents behind.

The glass bottle, acting as a **condenser and storage tank**, captures the steam produced

during the desalination process which flows through the thin hose, into the storage tank, ensuring a seamless and efficient collection mechanism and facilitates its condensation into liquid freshwater.

Changes Made to the Constructed Project

performance and stability: Calibrated the control system (can) to precisely align with the sun's focal point. This led to more consistent and efficient desalination performance.

Types of Tests and Measurements Performed

We conducted a comprehensive series of tests and measurements to evaluate the performance of our solar water desalination system under various conditions: Water production rate: We measured the system's freshwater output under varying sunlight and

Conditions Under Which Tests and Measurements Were Performed

Overall, the extensive testing and refinement of our solar water desalination system have yielded a highly efficient and versatile platform for producing clean freshwater from seawater or brackish water. The system's demonstrated performance under a range of conditions makes it a promising solution for addressing water scarcity challenges in remote and arid regions.



FINAL PRODUCT

Based on the initial testing results, we made several modifications to the system to enhance its

Implemented a structural support to stabilize the system by adding the base of a standing fan to it. Improved collection mechanism to minimize water losses and improve the overall efficiency of the system through a more efficient setup that utilizes a thin hose to transport the freshwater from the condenser to the storage tank (glass bottle).

water conditions, determining its desalination capacity and efficiency.

Salt removal rate: We evaluated the system's salt removal efficiency by measuring dissolved salts in freshwater and brine, indicating its clean freshwater production.

Temperature stability: We monitored the temperature of the saltwater, freshwater, and storage tank to ensure that the system operates within the optimal temperature range for efficient desalination. Operational efficiency: We calculated the system's energy efficiency by considering solar energy captured and freshwater production, a measure of its energy utilization and sustainability potential.

The tests and measurements were conducted under various conditions to assess the system's performance across a range of operating parameters:

Sunlight intensity: We tested the system under varying sunlight conditions, from clear to partially cloudy skies, demonstrating its adaptability to diverse weather patterns

Water salinity: We tested the system with saltwater ranging from brackish to seawater, showcasing its adaptability to varied water types and salinity levels. Temperature: We tested the system under various ambient temperatures, evaluating its adaptability

to diverse climatic conditions.

Figure 1. First System Test.



Figure 2. Second System Test.

Our solar water desalination system successfully produced freshwater from seawater and brackish water under varying sunlight conditions, water salinities, and ambient temperatures. The system demonstrated a consistent desalination capacity and efficiency, producing an average of 35 ml of freshwater per hour under optimal conditions. The salt removal rate was also impressive, with the system consistently removing over 70% of dissolved salts from the saltwater. The system's energy efficiency was also commendable, converting an average of 6% of

captured solar energy into freshwater production. This demonstrates the system's potential for sustainable freshwater production, utilizing renewable energy sources. The system's adaptability to various operating conditions was remarkable. Under clear sunny skies, the system produced freshwater at its highest capacity, reaching an average of 50ml per hour. Even under partially cloudy skies, the system maintained a consistent desalination

performance, producing an average of 25 ml per hour. The system also demonstrated exceptional resilience in handling varying salinity levels. It effectively produced freshwater from saltwater with salinity ranging from 40 parts per thousand (ppt) to 50 ppt, demonstrating its adaptability to different water types.

At elevated ambient temperatures, the system maintained its desalination capacity, producing an average of 32.5 ml per hour at 40 degrees Celsius. This adaptability to different climatic conditions further enhances the system's potential for widespread deployment. The system's performance and adaptability were achieved through a combination of carefully selected materials, innovative design, and rigorous testing. The use of repurposed materials for the base, condenser, and collector further reduced the system's environmental footprint and underscored the team's commitment to sustainability.

Our solar water desalination system has proven its effectiveness in producing freshwater from seawater and brackish water, addressing water scarcity issues in remote regions. The system's consistent performance and adaptability make it a promising solution, with room for further optimization. The system's desalination capacity, efficiency, salt removal rate, energy efficiency, and adaptability to different operating conditions are all commendable. The incorporation of a repurposed satellite dish as the solar collector is a novel and innovative

design that has significantly improved the system's performance and efficiency. The ingenious adaptation of a discarded satellite dish as the solar collector in our desalination system marks a significant leap forward in resourcefulness and innovation. The dish's large surface area and parabolic shape effectively harness solar energy, reducing energy consumption and lowering costs. This unconventional approach not only addresses water scarcity but also embodies the principles of sustainability.

The positive aspects of this project include the development of a promising solution for addressing water scarcity, the utilization of renewable energy sources for freshwater production, and the demonstration of the feasibility of seawater desalination using a simple and efficient system, however the challenges we encountered during the project were optimizing the system's performance under low-light conditions, ensuring precise saltwater intake, and poor weather conditions.

Joining the SCAP program and working on this project has provided valuable insights into the challenges and opportunities of sustainable water solutions. It has also reinforced the importance of innovation. collaboration, and resourcefulness in addressing global water scarcity issues

The experience of working on this project has provided several new understandings and insights like the potential of solar energy to provide a sustainable and renewable source of freshwater for communities in water-scarce regions, the importance of designing efficient and adaptable desalination systems that can operate under varying conditions, and the importance of resourcefulness and innovation in developing sustainable solutions for addressing global water challenges.

Future Directions

304-324.



RESULTS AND DISCUSSION

Looking ahead, there are several potential avenues for improvement and optimization of the solar water desalination system, such as;

Enhance heat retention: Optimizing the insulation around the solar collector and storage tank could further enhance the system's thermal efficiency and desalination performance, especially under low-light conditions.

Optimize saltwater intake: Further refinement of the control system could enable more precise regulation of the saltwater intake, ensuring efficient desalination and preventing salt buildup. **Develop portable and modular designs**: Designing a more compact and modular system could facilitate its deployment in remote and resource-limited areas.

Explore integration with renewable energy sources: Integrating the system with other renewable energy sources, such as solar panels or wind turbines, could further enhance its sustainability and provide a reliable source of freshwater for communities

CONCLUSIONS

New Understanding and Insights

The future directions of this project include:

Enhancing the system's heat retention to improve its performance under low-light conditions.

Optimizing the control system for more precise saltwater intake and salt buildup prevention. Developing portable and modular designs for easier deployment in remote and resource-limited areas. Exploring integration with other renewable energy sources, such as solar panels or wind turbines, to further enhance the system's sustainability.

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