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# Eco-Friendly Water Purification Using a Single Slope Solar Still

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***Abstract:*** ***Access to clean and safe drinking water remains a critical global challenge, particularly in remote and arid regions. This study investigates an eco-friendly approach to water purification through the use of a single-slope solar still, a sustainable and low-cost solution powered by renewable solar energy. Enhancements were introduced to improve the still's efficiency, including the integration of reflective aluminium foils to maximize solar radiation absorption and the use of blackened stainless steel balls to expand the effective evaporation surface area. Experimental results demonstrated that these modifications significantly boosted freshwater output, with the use of 10 mm steel balls achieving a 38.07% increase in productivity compared to a conventional still. The system operates with zero emissions and minimal maintenance, confirming its potential as a green, scalable solution for decentralized water purification in water-scarce environment thermal efficiencies by various rates.***

## I. INTRODUCTION

The availability of clean drinking water is an essential component of human health, economic development, and environmental sustainability. However, with increasing global population, industrialization, and climate change, freshwater resources are under immense pressure. According to the World Health Organization (WHO), billions of people worldwide lack reliable access to safe drinking water, particularly in arid regions and developing nations. In such regions, traditional water treatment infrastructures are often non-existent, underfunded, or heavily dependent on fossil fuels, contributing to both economic strain and environmental degradation.Solar distillation offers a promising, eco-friendly alternative for decentralized water purification. It harnesses renewable solar energy to separate impurities and salts from water through natural evaporation and condensation processes. Among the various solar-based purification systems, the single-slope solar still has attracted attention due to its operational simplicity, affordability, and minimal maintenance requirements. This system consists of a basin filled with impure water, covered by a sloped transparent glass or plastic sheet. Solar radiation heats the water, causing it to evaporate and condense on the cooler interior surface of the cover, where it is collected as distilled water. Despite its potential, the major limitation of conventional solar stills lies in their low thermal efficiency and limited water yield, typically less than 5 liters per square meter per day.

Therefore, nhancing the performance of these systems without compromising their simplicity and sustainability is a key area of current research. Strategies such as thermal energy storage, evaporative surface modifications, and reflective coatings have been explored to improve efficiency. This study builds upon recent experimental work and introduces an eco-conscious improvement to the single-slope solar still by incorporating reflective aluminum foils and blackened stainless steel balls. These modifications aim to optimize solar energy absorption and evaporation surface area, thereby improving freshwater output. The system remains entirely passive, cost-effective, and emissions-free, making it a strong candidate for real-world applications in water-scarce communities and disaster relief scenarios.

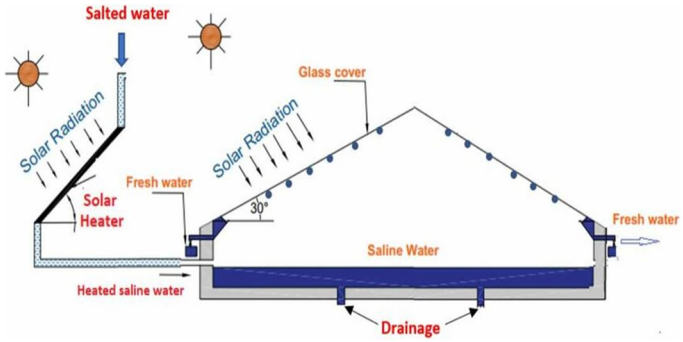



Fig. 2.1.

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*A. Materials properties*

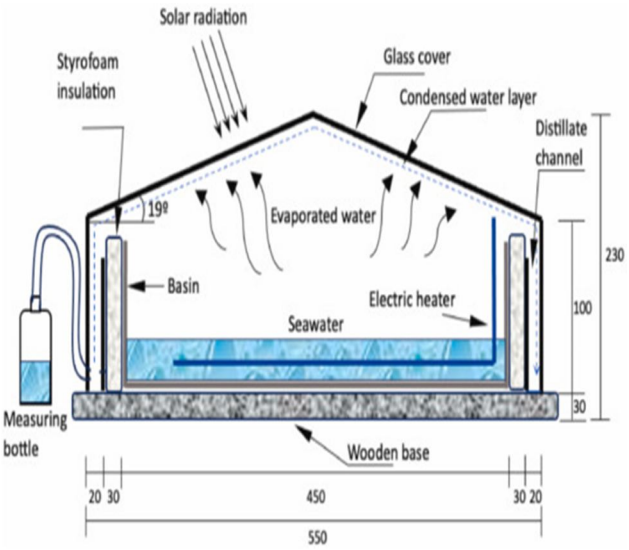
Table 2.1.Materials properties

| Sl. No | Materials | Specifications |
|---|---|---|
| 1 | Basin Tray | Galvanized Iron sheet, 1 m × 1 m × 0.1 m, black painted |
| 2 | Transparent Cover | 5 mm thick tempered glass, inclined at 35° |
| 3 | Insulation Material | Thermopolis sheet, 30 mm thick |
| 4 | Frame Structure | Wooden frame with water-resistant coating |
| 5 | Sealing Material | Silicone sealant, high temperature resistant |
| 6 | Collection Channel | U-shaped PVC pipe, 25 mm diameter |
| 7 | Absorbent Coating | Matte black paint with high solar absorptivity |
| 8 | Support Legs | Mild steel rods, 30 cm height |
| 9 | Water Input Port | Plastic funnel with valve, 1/2 inch |
| 10 | Distillate Outlet | PVC tubing, 1/2 inch diameter |

*B. Fabrication*

The fabrication of the single slope solar still was carried out using readily available, cost-effective materials to ensure ease of construction and field applicability. The basin was made from galvanized iron (GI) sheet metal, shaped into a shallow rectangular tray and coated with matte black paint to enhance solar absorption. Beneath the basin, a layer of thermocol insulation was added to reduce heat losses, and the entire unit was supported by a wooden frame treated with waterproof coating for durability. After assembly, the system was tested for leaks and structural stability, ensuring it was ready for outdoor experimentation. The final setup is a simple, efficient, and eco-friendly solution for passive water purification. The single slope solar still was fabricated using simple and locally available materials to ensure low cost and ease of construction. A galvanized iron basin was painted black to absorb solar heat and mounted over a thermocol-insulated wooden frame. A tempered glass sheet was fixed at an angle to serve as the transparent cover, allowing sunlight in and facilitating condensation. Silicone sealant was applied to ensure airtight joints. A funnel and outlet pipe were added for water input and distillate collection. The unit was assembled, sealed, and tested for leakage and performance under sunlight.

Figure2.3



## II. MATERIAL CHARACTERIZATION

The performance and durability of the single slope solar still are significantly influenced by the selection and characterization of materials used in its construction. Each component was chosen based on thermal, mechanical, and environmental suitability to ensure maximum efficiency and sustainability. Galvanized Iron (GI) Basin: The basin was constructed using GI sheet metal due to its good thermal conductivity, corrosion resistance, and ease of fabrication. The surface was coated with matte black paint to enhance solar energy absorption by increasing the absorptivity of the surface. Tempered Glass Cover: The transparent top cover is made of 5 mm thick tempered glass, which offers high transmissivity for solar radiation and mechanical strength. Its inclined placement aids efficient condensation of vapor on the inner surface.

The materials used in the construction of the solar still were selected based on their thermal, mechanical, and environmental properties. Galvanized iron was chosen for the basin due to its good thermal conductivity and corrosion resistance. The glass cover, made of tempered glass, offers high solar transmittance and mechanical strength. Thermopolis insulation was used for its low thermal conductivity, reducing heat loss. Silicone sealant was applied for its durability and resistance to high temperatures, ensuring airtight sealing. Each material contributes to the overall efficiency and longevity of the system.

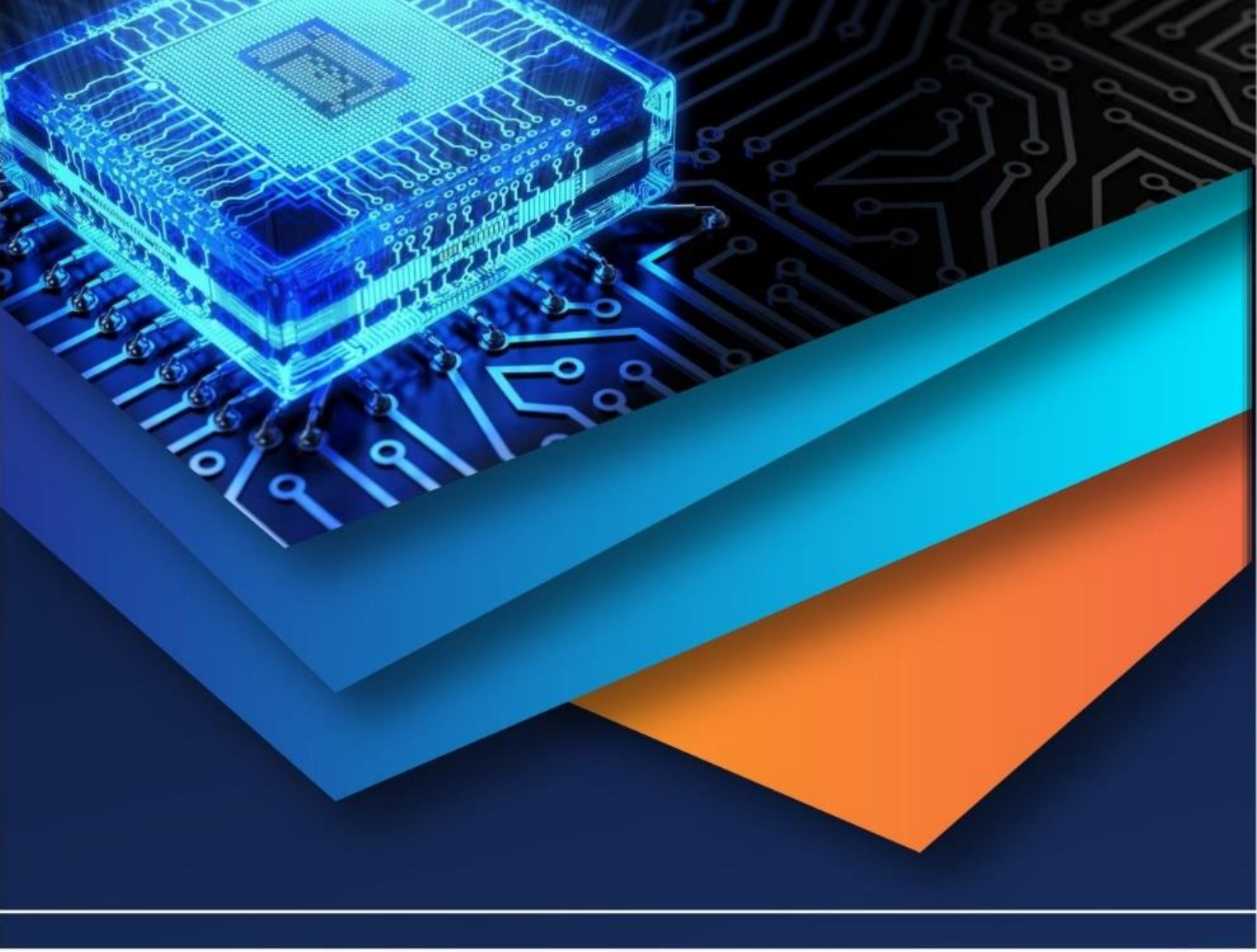
## III. CONCLUSION

The single slope solar still offers a sustainable and environmentally friendly method for water purification by harnessing solar energy. Its simple construction using locally sourced materials makes it affordable and accessible for remote and rural communities. Experimental observations confirm that the still efficiently produces distilled water with minimal energy input and no harmful emissions. While the current design performs well under average solar conditions, future improvements like enhanced insulation or integration with phase change materials could further boost its productivity. Overall, the solar still is a promising technology to help alleviate freshwater shortages in an eco-conscious manner...

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