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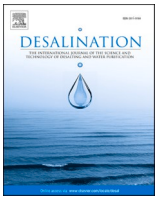

Waste-derived thermal storage solutions for sustainable solar desalination using discarded engine oil and paraffin wax: A techno-environmental feasibility evaluation

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HIGHLIGHTS

- Composite energy storage (CES) is developed with discarded engine oil and paraffin wax.
- The thermal conductivity and specific heat storage of CES are enhanced by 26.54% and 44.66% relative to pure paraffin wax.
- Basin and Water temperatures of CES-based desalination systems are improved by 14% and 11% compared to conventional systems.
- Compared to conventional systems, the distillate production of CES-based desalination systems is augmented by 52.72%.
- CES-based desalination systems reduced production costs and environmental footprint more effectively than conventional systems.

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ABSTRACT

The valorization and repurposing of waste materials for sustainable outcomes and environmental mitigation are gaining prominence. This investigation explores the feasibility of repurposing discarded automotive engine oil as a viable means of energy storage in solar thermal desalination applications. A novel approach combining discarded engine oil with Paraffin wax in equal parts by volume is proposed as a composite energy storage (CES) to enhance nocturnal production and efficiency. The experimental findings show that the composite energy storage system has 26.54 % higher thermal conductivity and 44.66 % greater specific heat energy storage capacity compared to pure paraffin wax. Comparing the Desalination System with Engine Oil-based Energy Storage (DSEES) to a Traditional Solar Desalination System (TSDS) without energy storage, considering water and absorber temperatures and distillate production, reveals compelling advantages. DSEES exhibits remarkable temperature increases of 14 % in the basin and 11 % in water, alongside a significant 52.72 % rise in distillate production rates, yielding 3.36 and 3.16 l/sq.mt compared to TSDS's 2.2 and 2.1 l/sq.mt over two testing days. Cost analysis indicates DSEES's 33.7 % lower cost per liter and 33.8 % shorter payback period relative to TSDS. Furthermore, environmental assessment highlights DSEES's 60.8 % greater net carbon credit, indicating reduced ecological impact.

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