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REVIEWER'S REPORT

Manuscript No.: **IJAR-55880**

Title: : *Development of a Mobile Solar Air Cooler with a Clay-Based Cool Water Reservoir*

Recommendation:
Accept after major revision………………

Rating	Excel.	Good	Fair	Poor
Originality		✓		
Techn. Quality			✓	
Clarity			✓	
Significance		✓		

Reviewer Name: Dr.K.ARUMUGANAINAR

Date: 24.01.2026

Detailed Reviewer's Report

Review Report

Title: *Development of a Mobile Solar Air Cooler with a Clay-Based Cool Water Reservoir*

1. Summary of the Work

The manuscript presents the **design, SolidWorks-based simulation, and experimental validation** of a **mobile solar-powered evaporative air cooler** using **porous clay** as the primary cooling medium. The system integrates:

- A **clay water reservoir** for evaporative cooling
- A **misting system**
- A **solar PV panel + battery + fan** for autonomous operation

The goal is to provide a **low-cost, energy-independent cooling solution** for hot regions with limited electricity access. The prototype reportedly achieved a **temperature reduction of ~4–5 °C** (from ~29–30 °C to ~25 °C) with **two-day autonomy**, and total system cost ≈ **98,500 FCFA**. Numerical simulations show temperature gradients and airflow patterns supporting evaporative heat transfer through porous clay.

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2. Overall Assessment

The topic is **highly relevant** to:

- Sustainable cooling
- Climate adaptation in developing regions
- Low-energy building technologies

The integration of **local clay materials + solar PV + mobility** is socially and environmentally meaningful. However, while the concept is promising, the manuscript in its current form requires **major revision** before being suitable for publication due to methodological gaps, unclear modeling assumptions, and limited experimental rigor.

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3. Strengths

3.1 Practical Relevance

The study addresses **real-world thermal comfort challenges** in hot climates with unreliable grid power. The focus on **local materials (clay)** enhances affordability and sustainability.

3.2 System Integration

Good attempt at combining:

- Porous media cooling
- Solar energy system sizing
- CFD-style thermal simulation
- Prototype fabrication

This multidisciplinary approach is commendable.

3.3 Cost Consideration

Including a **cost breakdown** is valuable for applied engineering research and demonstrates socio-economic feasibility.

3.4 Seasonal Performance Discussion

The authors correctly acknowledge **humidity limitations** of evaporative cooling, showing awareness of climatic dependency.

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4. Major Technical Concerns

4.1 Inconsistency Between Simulation and Experiment

- Simulation predicts **air ~24 °C**, but experiments stagnate at **25 °C**.
- The explanation ("T-shaped geometry") is speculative and not validated experimentally.
- No error analysis or uncertainty quantification is provided.

Authors must provide:

- Sensor accuracy
- Measurement intervals
- Repeatability of tests
- Statistical treatment of results

4.2 Insufficient Description of Thermal Modeling

The paper states **"multi-physics modelling"** in SolidWorks but does not describe:

- Boundary conditions
- Turbulence model
- Evaporation modeling approach
- Mesh size / grid independence
- Material property assumptions

Without these, the simulation cannot be reproduced or scientifically evaluated.

4.3 Cooling Load Calculation is Oversimplified

Heat load only considers:

- Lamp (16 W)
- Computer (250 W)
- Occupant (67 W)

Missing critical loads:

- Solar heat gains through walls/windows
- Infiltration
- Heat from building envelope
- Latent loads

This leads to **underestimated cooling requirement**.

4.4 Psychrometric Analysis Missing

Evaporative cooling performance depends on:

- Wet-bulb temperature
- Humidity ratio
- Enthalpy change

No psychrometric chart or humidity ratio calculations are presented, which is a major omission for evaporative cooling research.

4.5 Energy System Sizing Issues

Solar radiation value is written as **5 $Wh/m^2/day$**, which is incorrect (likely meant 5 $kWh/m^2/day$). This must be corrected.

Battery autonomy claim (2 days) lacks:

- Depth of discharge assumption
- Efficiency losses
- Actual measured energy consumption profile

4.6 Experimental Methodology Weak

- No airflow rate measurement
- No water consumption measurement validation
- No humidity change measurement in room
- No long-term durability testing

The prototype testing is **qualitative rather than rigorous**.

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5. Minor Issues

Issue	Comment
Language	Frequent grammatical errors and formatting inconsistencies
Units	Mixed SI notation (e.g., Wp, Wh, Wc)
Figures	Many figures are low resolution or not referenced properly
Table numbering	Two “Table 2” appear
Section title	“Heat balance in the cooking stove” is incorrect
References	Some DOIs malformed; reference formatting inconsistent

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6. Scientific Contribution

Novelty: Moderate

Clay evaporative cooling is known, but **mobility + PV integration** adds applied value.

Technical depth: Currently insufficient for high-impact journal; suitable for applied engineering journal after revision.

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7. Recommendations for Improvement

The authors should:

1. Add full CFD modeling details
2. Include psychrometric analysis
3. Perform multiple experimental trials
4. Measure airflow, humidity, and water consumption
5. Provide uncertainty/error analysis
6. Correct solar energy calculations
7. Improve English and formatting
8. Compare results with theoretical evaporative cooling limits

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8. Final Recommendation

Decision: MAJOR REVISION REQUIRED

The work has **strong practical potential**, but scientific rigor must be significantly improved before publication.