DESIGN AND DEVELOPMENT OF A COOLING SYSTEM FOR TWO-WHEELER SEAT PARKED UNDER SUN

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Keywords:

Phase Change Material (PCM), Two-Wheeler Seat Cooling, Passive Cooling, Thermal Regulation, Ergonomic Design.

Introduction:

Two-wheeler riders frequently face extreme seat temperatures exceeding 60°C when vehicles are parked under direct sunlight. This high heat creates significant physical discomfort and potential health risks. This project introduces an innovative cooling system utilizing Phase Change Materials (PCM) to rapidly reduce seat surface temperatures to a comfortable 30–35°C within 180 seconds of activation. By integrating latent heat storage, the system provides a sustainable, eco-friendly solution that enhances rider ergonomics and safety.

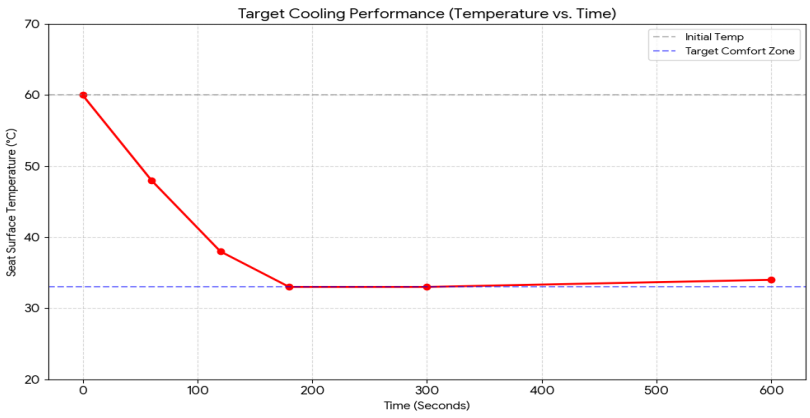

Figure 1: Target Cooling Performance (Temperature vs. Time)

Objectives:

1. Reduce seat temperature from ≥60°C to a target range of 30–35°C within ≤180 seconds of system activation
2. Limit heat gain from solar radiation (900 W/m²) using a 0.06 m² cooling area and low-absorptivity materials (α ≤ 0.5).
3. Integrate approximately 0.48 kg of PCM (latent heat ≈ 96 kJ) to ensure at least 59 minutes of passive cooling under a 27 W heat load.

4. Ensure mechanical durability with IP67 protection, 3 g vibration testing, and 10,000 load/unload cycles without PCM leakage.

Methodology:

1. Problem Study & Data Collection: Measuring real-world seat temperature rise under sunlight and recording material behavior.
2. Design Concept: Selecting suitable PCMs and breathable fabrics; finalizing the layout through CAD and thermal calculations.
3. Prototype Fabrication: Developing a modified seat with stitched PCM pouches and optimized material layering.
4. Experimental Testing: Conducting controlled thermal tests using sensors and IR readings to monitor cooling rates and temperature distribution.
5. Performance Analysis: Comparing results with standard seats and refining the design based on engineering validation.

Result and Conclusion:

The project aims to produce a functional prototype that achieves a temperature reduction of 10–15 °C compared to standard seats. With secured IP55 reliability, the system offers a feasible, eco-friendly solution that significantly improves rider ergonomics. In conclusion, this PCM-based approach effectively eradicates heat danger and guarantees safety for two-wheeler users.

References:

- [IEEE Format Citation for PCM cooling research]
- [IEEE Format Citation for Two-wheeler ergonomics]
- [IEEE Format Citation for Solar radiation and material heat gain]

Future Scope:

The future scope of this project includes:

1. Implementation of advanced conductive fillers to further reduce thermal response time.
2. Mass production optimization for universal compatibility across various motorcycle models.
3. Integration of flexible solar thin-films for completely autonomous power management.