Latent Heat Thermal Energy Storage Device for
Automobile Applications

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Abstract

Driving with a cold engine increases fuel consumption and greenhouse gas emissions in automobiles. A latent heat energy storage device has been designed, constructed and tested to investigate waste heat recovery and reduction of engine warm-up time by using phase change materials (PCMs) as a thermal energy storage (TES) medium. Two types of paraffin waxes and a 50/50 mixture of the two have been examined to characterize their thermal storage and recovery behaviors under repetitive heating and freezing cycles. The paraffin was placed in a rectangular container and hot or cold water was circulated through thin cooling plates, which were placed in the container at regular spacing. Thin aluminum fins were also placed between the cooling plates to increase heat transfer inside the paraffin. In the thermal storage and recovery experiments, temperature variations in the paraffin and at the water inlet and outlet were recorded for a period of five minutes. From the
experimental results, heat transfer was found to be more effective in the case of narrower spacing between the cooling plates without fins inserted. Fins enhanced heat transfer for both narrow and wide plate spacing, but the enhancement was more significant for the wider plate spacing. The efficiency of heat recovery was also positively correlated to the high circulating flow rate of the cold water. A 50/50 mixture of two paraffin waxes also provided better heat transfer due to the possible occurrence of natural convection in addition to conduction heat transfer. The results of the metal block heat-up simulation experiments demonstrated the potential of the latent heat Thermal Energy Storage (TES) device for use in engine warm-up during a winter season.