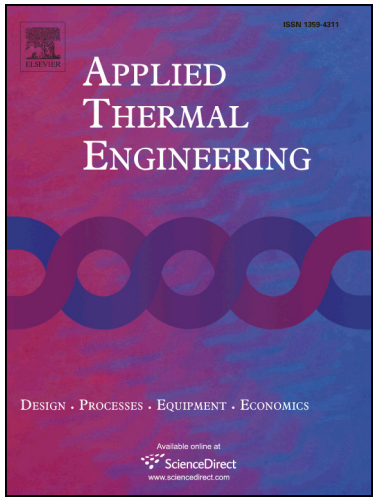

Research Paper

Exergy Analysis and Parameter Optimization of Heat Pipe Receiver with Integrated Latent Heat Thermal Energy Storage for Space Station in Charging Process

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Exergy Analysis and Parameter Optimization of Heat Pipe Receiver with Integrated Latent Heat Thermal Energy Storage for Space Station in Charging Process

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Abstract: The heat pipe (HP) receiver with integrated latent heat thermal energy storage (LHTES) is one of the key components of solar dynamic space power system (SDPSS). Therefore, thermodynamic analysis and optimization of SDPSS is significant for improving system efficiency and reducing launch cost. In this paper, a two-dimensional physical model was developed. Meanwhile, we studied further energy and exergy characters during charging process in microgravity environment. The equation of exergy efficiency was deduced by analyzing the relationship between heat flux and mass flow of HP. Through discussing the key parameters to exergy efficiency (length of evaporator (L_e), length of phase change material (PCM) (L), and length of condenser with Stirling engine (L_1)), the optimization of parameters—L_e=0.36m, L=0.41m and L_1=0.43m—were obtained by genetic algorithm when exergy efficiency reaches the maximum value of 0.97585. The results provide theoretical guidance for structure design and applications of SDPSS.

Keywords: Heat pipe, Exergy analysis, Phase change material, Solar Dynamic Space Power System