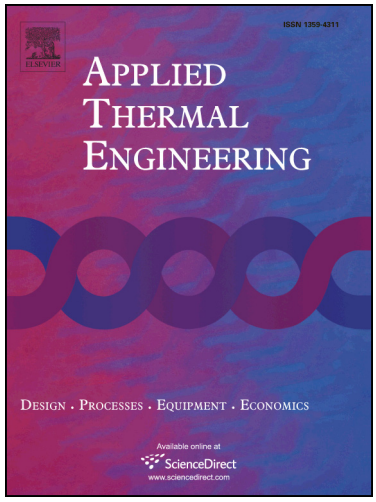

Development of advanced high porosity wicks for the high temperature heat pipes of concentrating solar power

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Highlights

- The advanced wicks that addresses durability issues while maintaining sufficient performance.
- The developed wicks have enabled to get the prerequisites for development of 80 kWth solar receiver.
- These felt metal wicks can be used in heat pipe solar receiver for dish Stirling technology.

Development of advanced high porosity wicks for the high temperature heat pipes of concentrating solar power

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Abstract

Sandia National Laboratories and Heat Pipes Laboratory of National Technical University of Ukraine «KPI» have developed several methods of improving robustness of the high-temperature heat pipe wick for their application to concentrating solar power systems with Stirling engine. In this case the wick structures must retain high heat pipe performance with robustness for long-term operation. Recent modeling indicates that wicks based on various fiber combinations could provide the robustness combined with sufficient performance. Results of the development, characterization, modeling, and testing of advanced felt metal wicks that addresses durability issues while maintaining sufficient performance are showed in the paper. The project resulted in an ongoing durability bench-scale heat pipe that simulates wick load conditions required for 80kWth throughput solar receiver, including periodic non-destructive evaluation of the wick durability. Two mock-ups of high-temperature heat pipes were made for long life and performance tests: the first sample with wick based on 12 μm fibers; and the second with hybrid wick based on 30 μm fibers and 6.5 μm fibers. The second heat pipe operation has continued unattended at 775°C vapor temperature for nearly 13,600 hours, with no observable loss of performance or change in startup characteristics.

Keywords: concentrating solar power, *S*tirling engine, high-temperature heat pipe, felt metal wick

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1. INTRODUCTION

Sodium heat pipes have been identified as a potentially effective heat transport approach for systems that require near-isothermal input to power cycles or storage, such as dish Stirling system and highly recuperated reheat-cycle supercritical CO_2 turbines [1]. Heat pipes offer high heat flux capabilities, leading to small receivers, as well as low exergetic losses through isothermal coupling