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# Optimization of Porous Medium for Solar Radiation Capture

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ABSTRACT

Fossil fuel usage is resulting in global warming. There is a need to switch to renewable energies, but existing technologies lack the efficiency for widescale adoption. Solar energy is the most abundant source of renewable energy that has the potential to replace fossil-based energy resources. However, the commercially available solar energy technologies typically have low conversion efficiencies, making them less competitive as compared to conventional fossil-based systems. Concentrated solar power (CSP) is an efficient approach to convert solar energy into high-grade thermal energy at very high efficiency. Among CSP systems, the parabolic-dish CSP system is considered as the most efficient. In a parabolic-dish CSP system, a parabolic dish directs sunlight to a single focal point where it is converted to thermal energy through absorption into the receiver. A challenge with current designs is that the surface of the thermal receiver reaches a high temperature and does not efficiently transfer the heat due to re-radiation losses. Thus, there is a need to re-design the thermal receiver to maximize the efficiency of CSP.

This project investigates the use of a metal foam with varying porosity as the thermal receiver. The porosity of the material allows incident solar radiation to absorb fully into the foam structure, thus, minimizing re-radiation losses and effectively converting it into thermal energy. To analyze the radiation capture in porous media, a computational model has been developed in ANSYS Fluent using the Discrete Ordinance method to model radiation heat transfer.

The model is validated against experimental data. This experimental setup comprises an aluminum block with a single pore that has a gradually decreasing diameter down the centre. A halogen lamp has been used to simulate solar radiation. A thermal camera was used to measure the temperature field of the aluminum block. The validated model is being used to simulate complex porous geometries to characterize the radiation heat transfer. A parametric study will be conducted to optimize the geometry of porous medium used as solar thermal receiver. Detailed simulation results will be presented and discussed at the conference.