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Wind Effect on the Performance of Solid Particle Receivers

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Summary

The solid particle receiver (SPR) is a direct absorption central receiver that uses solid particles enclosed in a cavity to absorb concentrated solar radiation. However, the existing open aperture lowers the overall efficiency by convection heat transfer. Aerowindows have the potential of increasing the efficiency of an SPR by reducing convective losses from an open receiver aperture and eliminate reflection, convection and reradiation losses from a comparable glass window. Aerodynamic windows consist of a transparent gas stream, which is injected from an air jet, across the receiver aperture to isolate its interior from the surrounding atmosphere [1, 2]. Even though, the wind conditions may still have important effect on the performance of SPRs.

In the present paper, the wind effect on the performance of an SPR is investigated numerically. The mass, momentum and energy exchange between the solid particle and air flow are simulated by the two-way coupling Euler-Lagrange method in the realizable k-ε turbulence 3D model. Solar ray tracing method is employed in calculating the solar radiation energy and the results are compared with the direct solar load method. The numerical investigation of the performance of the SPR is focusing on optimize the prototype design and finding out the best working condition for the SPR. In order to investigate the influences of the wind speed and wind blowing direction on the performance of the receiver, different wind conditions of and different air jet injection conditions are simulated numerically. The cavity thermal efficiencies are calculated and the optimal injection conditions are analyzed for different wind conditions.

References

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