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ANALYSIS OF REGENERATIVE THERMAL STORAGE GEOMETRIES FOR SOLAR GAS TURBINES

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ABSTRACT

Ceramic heat regenerators are suited to providing thermal storage for concentrating solar power stations based on a recuperated gas turbine cycle. Randomly packed beds of spheres and saddles; honeycombs and checker bricks were identified as potential regenerator inventory geometries. A parametric analysis of the heat transfer and pressure drop of each inventory type was conducted for two representative 6 hour storage systems. Due to the non isothermal nature of the sensible heat storage, the concept of a utilisation factor was introduced. This was used to determine the efficiency of each storage inventory for an allowable decrease in discharge temperature of 50^{o} C. The results demonstrate that with the correct choice of mass flux, all inventory types have a pressure drop below 1% of the compressor delivery pressure. The thermal modelling shows that checker bricks have the lowest utilisation factor and thus require a larger ceramic mass than the other inventories. Packed beds of saddles and honeycombs have the highest thermal performance but the lowest energy storage density. A packed bed of spheres is discussed as an effective inventory type that provides a good utilisation factor, acceptable pressure drop and a high energy storage density. Further investigation into the thermal-mechanical stresses in a packed bed is proposed for the development of this technology.