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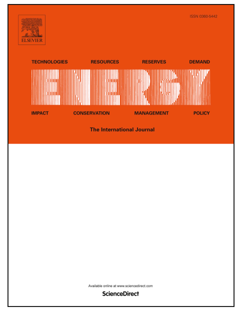

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TRANSIENT ANALYSIS AND OPTIMIZATION OF A RECUPERATIVE sCO_2 BRAYTON CYCLE ASSISTED BY HEAT AND MASS STORAGE SYSTEMS

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Abstract

This article discusses the transient behavior of a supercritical CO_2 recuperative Brayton cycle, which, in addition to standard components, includes heat and mass storage systems. The cycle's time dependent behavior is promoted by enforcing a temperature profile on the heat source, which mimics that of a hybrid power plant using an idealized solar radiation flux on top of a baseline energy input. The finite volume codes developed allow the spatial and temporal discretization of key components of the cycle. The simulations show that the thermal inertial effects are critical and capable of drastically changing the cycles' power delivery. More specifically, the analysis shows that the overall system might need several days to reach a periodic representative operational pattern, suggesting that the commonly used steady state and quasi-steady state hypotheses must be carefully considered if the cycle is assisted by a heat storage. Also, the results indicate that there is a compromise between the dimensions of the heat storage and its medium's thermophysical properties. Finally, the calculations show that, given a proper control strategy for the heat storage's charging and discharging, its use can significantly extend the cycle's power output delivery allowing a better fitting to the demand profile.

Keywords: recuperative Brayton cycle, supercritical carbon dioxide, transient model, solid heat storage, control system.

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