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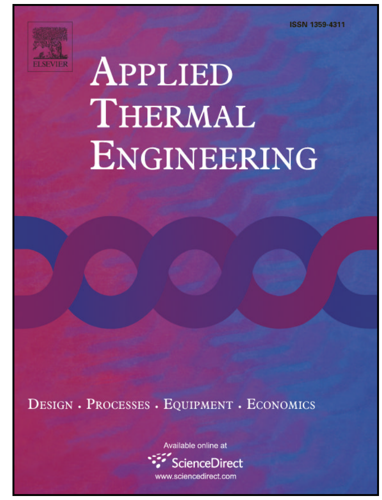

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Exergy recovery from solar heated particles to supercritical CO_2

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Abstract

In this work, the technical feasibility of a fluidized and a fixed bed heat exchanger in a concentrating solar power (CSP) tower for heat recovery applications is analysed using Two-Fluid Model simulations. The heat recovery process analysed in this work corresponds to the discharge of sensible heat from solid particles. In the cases studied, the fluidizing agent of the bed is carbon dioxide (CO_2) in supercritical conditions and the particles, which constitute the bed material, are sensible heat storage material. CO_2 is gaining attention in its application as a working fluid in thermodynamic cycles for power generation, especially in transcritical and supercritical conditions due to its high density and excellent heat transfer characteristics. Currently, research is focused on exploring the CO_2 capabilities when used in combination with CSP technologies, together with systems that allow the storage and recovery of the solar thermal energy.

Fixed or fluidized beds work as a direct contact heat exchanger between the particles and the working fluid that percolates through the bed material. Several bed configurations are presented to derive the optimal configuration of the bed that enhances the efficiency from both the energetic and the exergetic points of view. The results indicate that a fixed bed heat exchanger produces a maximum increase of availability in the CO_2 flow during longer times than a fluidized bed heat exchanger. Therefore, to maximise the exergy recovery from solar heated particles to supercritical CO_2 a fixed bed heat exchanger is more suitable than a fluidized bed heat exchanger.

Keywords: Supercritical carbon dioxide; fluidized bed; fixed bed; heat exchanger; concentrating solar power.

1. Introduction

In the last decades, the use of solar energy as a renewable alternative to fossil fuels for power generation has received great impulse. Solar energy is an ubiquitous, clean, and readily accessible renewable energy source. Concentrating Solar Power (CSP) technologies are an important alternative for providing clean and renewable electricity in the present and in the future. CSP can be integrated with large thermal storage

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