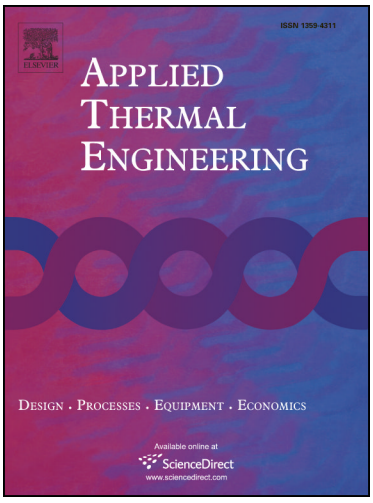

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Thermodynamic analyses of the solar-driven Kalina cycle having a variable concentration ratio

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- The middle-temperature solar-driven Kalina cycle was investigated
- The parabolic trough collector has a variable concentration ratio
- Kalina cycle basically operates at design points with varying solar irradiance
- Cycle can efficiently utilize a border range of direct normal irradiance to power
- Operation method for off-design conditions improves the annual efficiency

Abstract

Solar thermal power generation is currently an attractive solar electricity technology. Currently, we face an important issue of lower annual solar-to-power efficiency (approximately 10.0%) using parabolic trough technology because the direct normal irradiance instantly varies, and the solar thermal power cycle always derivates from the designed operation. Here, we investigate a middle-temperature solar-driven Kalina cycle that uses a parabolic trough collector with a variable concentration ratio. From lower to higher direct normal irradiance, both the aperture area of collector and the flow process of the Kalina cycle can be changed. As a result, a much border direct normal irradiance of 100-1000 W/m^2 achieves a solar-to-power efficiency of 4~20%, resulting in an annual solar-to-power efficiency of approximately 14%. Furthermore, the interactions are analyzed among direct normal irradiance, the aperture area of the collector, and the flow process of the thermal cycle. An operation method for off-design conditions is proposed to greatly improve the annual solar-to-power efficiency, offering a pathway to efficiently utilize a border range of direct

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