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Guest Editorial

Special Section: Energy Sustainability 2021 Conference

The 15th ASME Energy Sustainability Conference was jointly organized by the Solar Energy Division (SED) and the Advanced Energy Systems Division (AESD). The conference was focused on identifying innovative technologies, research and design advances, and solutions toward a path of renewable and sustainable energy, including utility-level systems integration. The Solar Energy Division organized tracks on "Concentrating Solar Power," "Solar Chemistry," "Photovoltaics," "Solar Desalination and Industrial Process Heat," "Wind Energy," and co-organized tracks on "Sustainable Buildings and Cities," and "Energy Storage" with the AESD. The Solar Energy Division organizers of the conference were Nesrin Ozalp, the General Chair, and Justin Lapp, the Technical Program Chair. This Special Section issue was arranged by the Solar Energy Division as a compilation of selected high-quality papers. The topics of the papers span a wide range of topics in solar energy.

The paper by Ma et al. presents a particle-based TES system with promising cost and performance characteristics to meet the future growing energy storage needs. The results of a techno-economic analysis based on preliminary component designs and performance indicate that particle TES integrated with an air–Brayton combined cycle power system has a path to achieve the targeted levelized cost of storage of 5¢/kWh-cycle at a round-trip efficiency of 50% when taking low-cost energy-specific components and leveraging basic assets from existing thermal power plants.

González-Portillo et al.'s paper provides a parametric and probabilistic analysis of levelized cost of electricity (LCOE) for a particle-based CSP system. The results of their research show that the LCOE could be below $0.06/kWh with a probability of between 80% and 90%, where the costs of the primary heat exchanger, particles, and lifts have the largest contribution to the variance of the LCOE.

The paper by Hicdurmaz et al. explains an experimental and numerical work to describe particle flow characteristics inside a Centrifugal Particle Solar Receiver (CentRec). Their results show that the rotational speed of slower than 62 rpm move particles freely especially for mass flowrates that are larger than 0.48 kg/s whereas rotation of the receiver faster than 67 rpm halts particle motion.

Dai and Haussner's study presents a transient volume averaged fixed-bed model of a thermochemical redox reactor utilizing macroporous ceria. Their results show that under non-isothermal operation conditions for macroporous ceria redox fixed-bed cycling, non-uniform porous structure with higher porosity boundaries, and a dense core benefit fuel production, and porosity-dependent cycle duration modulation can be used to increase performance

The work of Gladen and Bajwa explains a new composite material by impregnating a framework of crystalline nanocellulose (CNC) with calcium chloride (CaCl2) for use as an energy storage medium. Their results show that the CNC:CaCl2 combination is a promising composite material with the potential for improved hydration characteristics and stability than pure CaCl2.

Last, but not least, Hamilton et al. present a new, full-featured, PYTHON-based application programmable interface (API) for the software package SolarPILOT to generate solar field layouts and characterize the optical performance of concentrating solar power (CSP) tower systems. The paper demonstrates that the new API enables PYTHON users to perform detailed CSP tower analysis utilizing either the Hermite expansion technique (analytical) or the SolTrace ray-tracing engine.

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