Optimization of CO₂-based Cycles

Scientific Achievement:

CO₂-based cycles can be can be used in both Brayton and Rankine cycles, unlike conventional working fluids that can be used in one or the other. Low-side pressure and expansion ratio are found to be the key parameters in optimizing the cycle efficiency for a given source temperature.

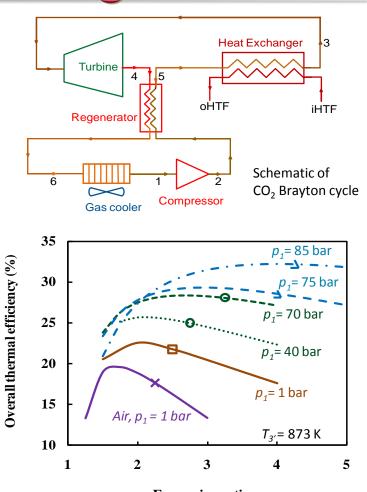
Significance and Impact:

Supercritical CO₂ cycles offer higher thermal efficiencies with significantly smaller footprint compared to any other power cycle, making it the frontrunner for CSP. Even with 70% turbine and compressor efficiencies, supercritical CO₂ cycles yield overall cycle efficiencies of 35% at 600 °C source temperature.

Research Details:

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- Developed a thermodynamic model to predict efficiency, mass flow rate for a specified power output.
- The model optimizes the pressure ratio and volumetric flow rates taking into account the various irreversibilities associated with heat exchange in the heater, regenerator, and gas cooler. Frictional losses in the turbine and compressor have also been considered.



A joint India-U.S. research consortium

funded under the Joint Clean Energy Research & Development Center (JCERDC)

Expansion ratio Thermal efficiency variation with expansion ratio

Publication: Pardeep Garg, Pramod Kumar, Kandadai Srinivasan, "Supercritical carbon dioxide Brayton cycle for concentrated solar power," J. Supercritical Fluids **76**, 54–60 (2013). <u>DOI: 10.1016/j.supflu201301010</u>

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