Enabling high heat transfer heat exchangers through binary particles (09375)

Mixtures of small and large particles enhance heat exchanger performance.

1. Impact

Particle mixtures of two distinct particle sizes can drastically improve the packed bed thermal conductivity for little to no cost. This increase in effective packed bed thermal conductivity will also yield increases in heat exchanger performance.

2. Project Goal

Demonstrate a 10% improvement in heat exchanger heat transfer using a binary particle mixture in SNLs particle-to-sCO_2 heat exchanger testbed.

3. Method(s)

- Measure effective thermal conductivity with off-the-shelf transient and modified photothermal radiometry for a range of particle mixtures.
- Develop comprehensive thermal conductivity and heat exchanger modeling.
- Demonstrate improvements of selected mixture in SNL particle-sCO_2 heat exchanger testbed

4. Outcome(s)

Thermal conductivity modeling indicates improvement of over 20% for a binary mixture with regimes over 10% for improved heat exchanger performance.

5. Conclusion/Risks

Focused work going forward will address work on measurements at high temperatures and de-risking impact to other CSP subsystems.

6. Team

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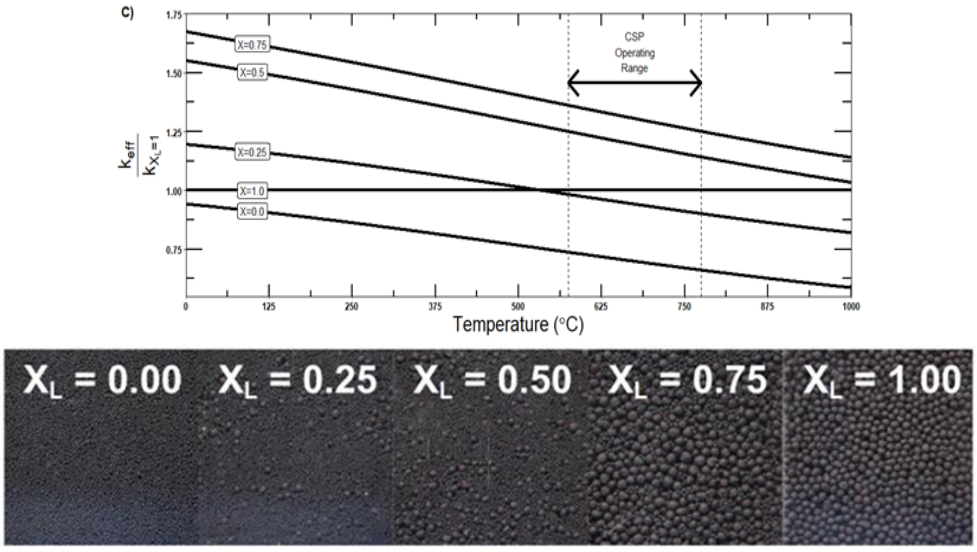

Figure 1. Modeled improvement in effective packed bed thermal conductivity for different temperatures and particle size ratios (top) and mixtures of CARBO particles at different size ratios (bottom).