Efficient Thermal Energy Storage with Radial Flow in Packed Beds 09384

Radial flow based thermal energy storage offers higher efficiency compared to traditional axial flow

1. Impact

Packed bed thermal energy storage systems currently use flow from one end to the other (axial), which leads to thermal inefficiencies and higher pressure drop. A new radial flow configuration is proposed where fluid flows from the bed's center towards the wall through a perforated pipe. In a lower temperature laboratory setting with initial radial flow prototypes, charging efficiency increased to 80% vs. 75% for axial flow.

2. Project Goal

Design guidelines will be made publicly available so systems with other fluids and packing materials can access the benefits of radial flow. Design efforts will lead to exergetic efficiency above 95%.

3. Method(s)

First, we will design the required hole patterns to enable flow to evenly move in the radial direction. Several piping designs will then be tested experimentally over a range of flow rates. All designs and experimental results will be compared to numerical models. Models and heuristic design guidelines will be made available.

4. Outcome(s)

Six designs have been created to assess various hole pattern configurations, including modifications to the experimental flanges of the vessel. These designs have been tested with CFD models. Designs are currently being 3D printed for testing at low temperature before machining into materials that can withstand higher temperatures.

5. Conclusion/Risks

Even flow requires a variation in the hole sizes. Several segments of the same size can be used along the length of the pipe, with more resistance (smaller holes) toward the end so fluid can evenly enter and exit the packed bed. Temperature gradients in the radial pipe should be minimized.

6. Team

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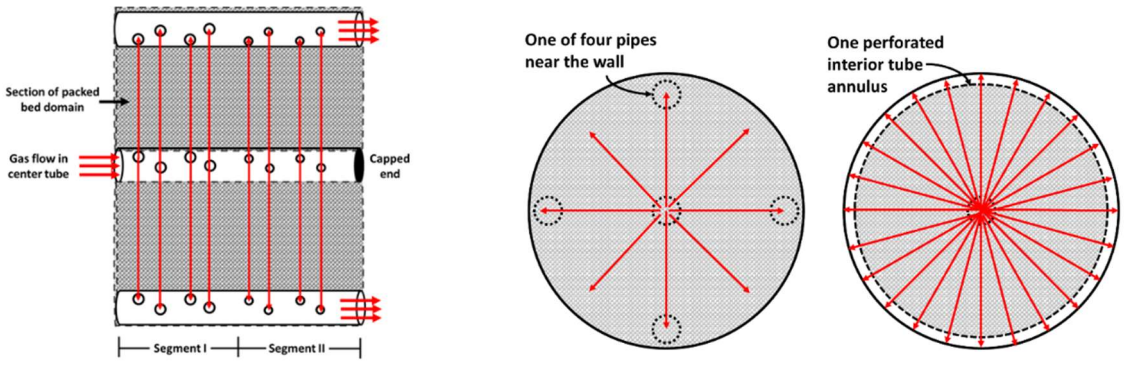

Figure 1. Left – A center pipe allows radial flow through the packing to receiving tubes. Segments I and II indicate various hole sizes can be used to ensure even flow. Right – Cross section of two piping concepts for radial flow.