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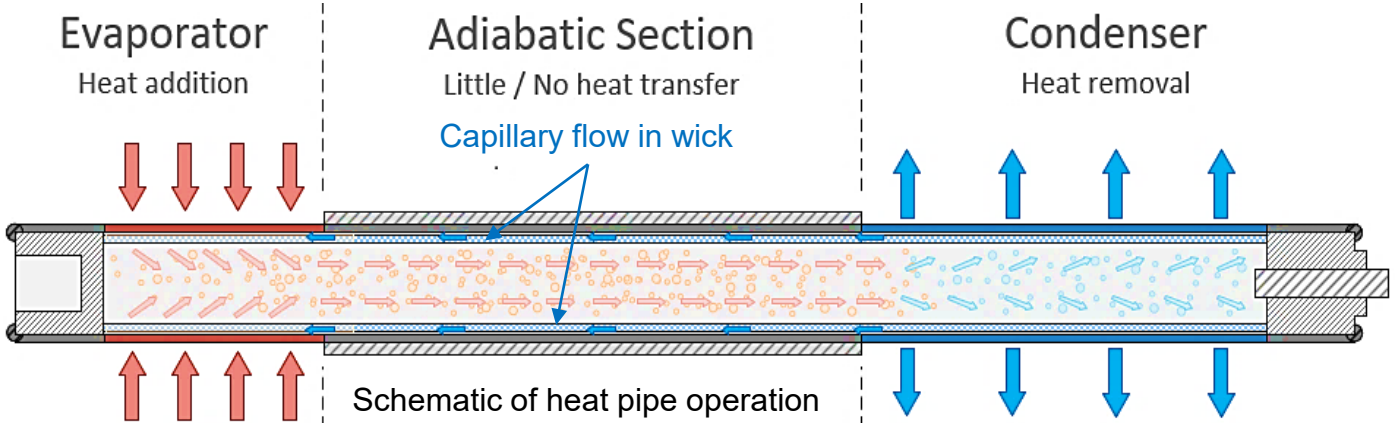
Project: Sodium Heat Pipes for Microreactors
Advisor(s): Mark Anderson & Greg Nellis
Sponsor: DOE, Westinghouse Electric Co.

SCIL

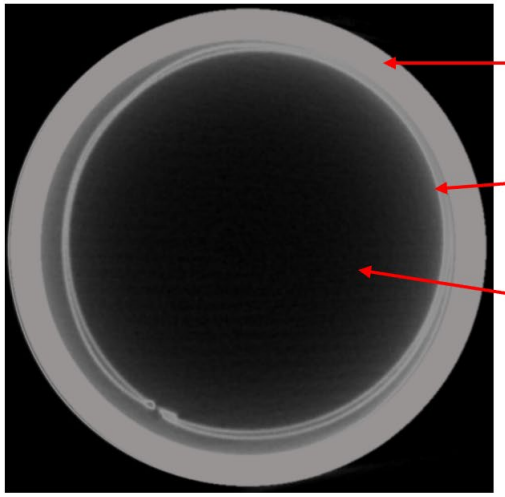
THL Thermal Hydraulics Laboratory

Background

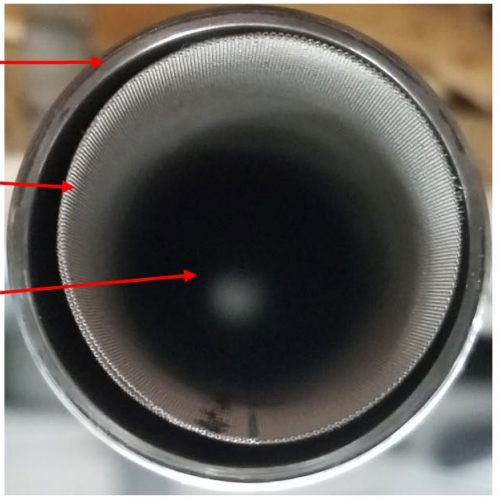
- *Microreactors*: small scale nuclear reactors for off-grid applications
- Many microreactor concepts utilize *sodium heat pipes* for heat transfer from reactor core to power cycle
- Heat pipes transfer heat by vaporizing and condensing a working fluid within sealed container
- Sodium metal is often used as a working fluid for high-temperature applications
- Heat pipes incorporate a *wick*, a porous structure that returns liquid condensate to the evaporator by capillary action
- Heat pipes allow for passive, compact heat removal from the reactor core with no moving parts



Schematic of heat pipe operation

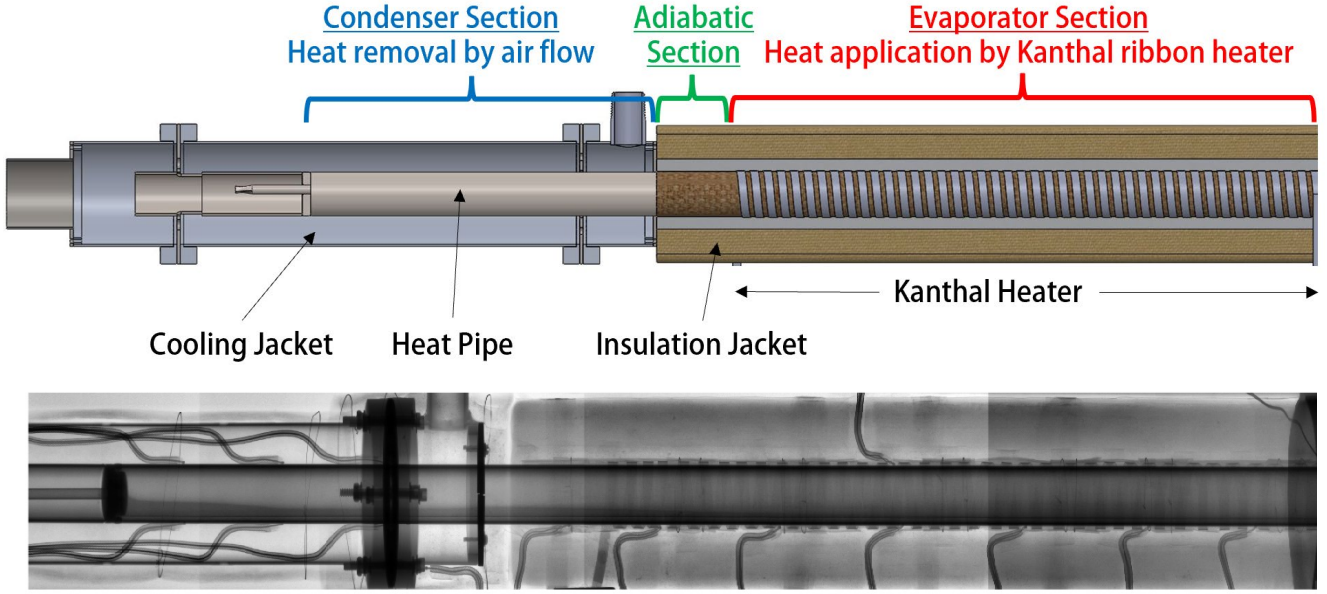


X-ray CT scan showing heat pipe cross section

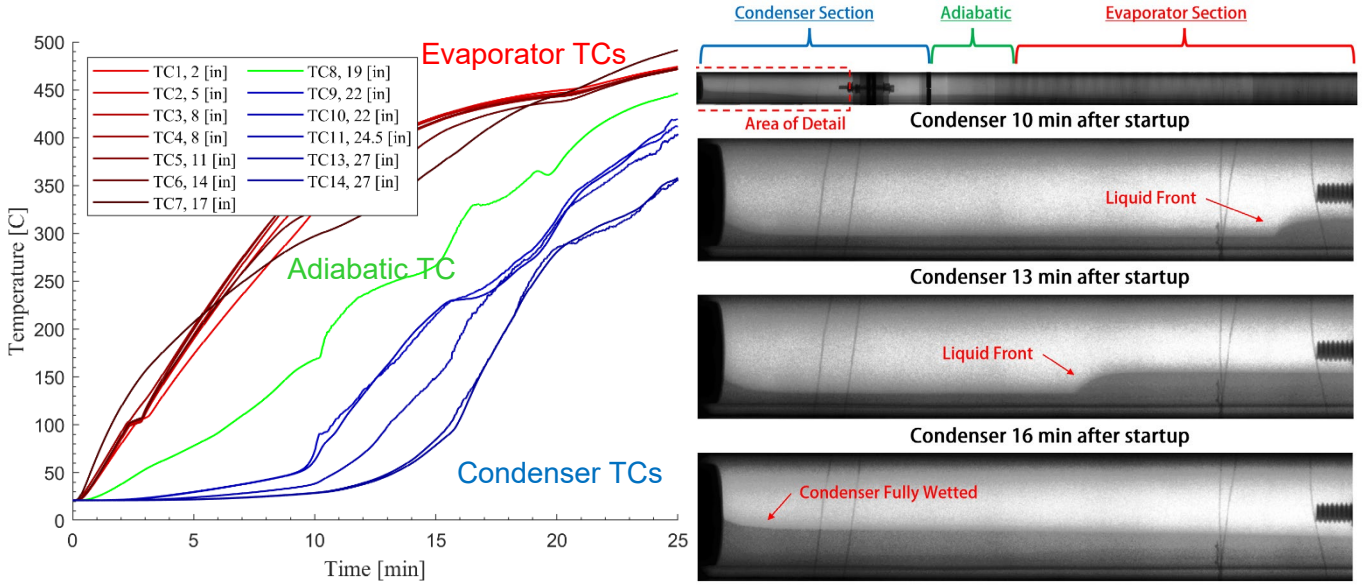

Wick inserted into heat pipe during fabrication

Project Goals

- Build and test sodium heat pipes
- Investigate temperature distribution of heat pipe for various conditions:
  - Steady-state
  - Transient startup
  - Transient shutdown
  - Dryout event in evaporator
- Use Fiber Optic Temperature Sensors (FOTS) to get high spatial resolution axial temperature profiles
- Capture internal flow phenomena using time-resolved X-ray imaging
- Investigate the effect of important design parameters on heat pipe performance:
  - Wick composition and geometry
  - Sodium fill volume



Composite X-ray image of heat pipe under 500W steady-state operation



Temperature profiles and X-ray images of heat pipe startup