

TC 08.05 RESEARCH REPORT – JUN 2009 / LOUISVILLE

ACTIVE PROJECTS

1316-RP: Experimental Evaluation of the Heat Transfer Impacts of Tube Pitch on a Highly Enhanced Surface Tube Bundle. PI: Steve Eckels, Kansas State Univ. PMS: Petur Thors (chair), Ben Dingel, Satheesh Kulankara, Axel Kriegsmann. Status: active (start date: Jan-2006. original target completion date: Jul-2008. current projected completion date: Jul-2010.)

Evraam Gorgy is the student working on this project as a PhD candidate.

Re-construction of the bundle test chamber is now complete. The system has been checked for leaks with some seals needing tightening. A set of smooth tubes were inserted and preliminary tests were run with R123. Tube rolling was successful and water headers functioned as intended. However, the elastomer used for the endplates, outlet ports, and windows failed. The gaskets and o-rings have been replaced. Testing will begin with a bundle of enhanced tubes at P/D = 1.167 in R134a.

A one-year no-cost extension was requested and granted at the main committee meeting.

1345-TRP: Waterside Fouling Performance of Brazed-Plate Type Condensers in Cooling Tower Applications. PI: Lorenzo Cremaschi, Oklahoma State Univ. PMS: Jim Bogart (chair), Art Fovargue, Axel Kriegsmann, Ken Schultz, Xudong Wang (ARTI cofunding). Status: active (start date: May-2008. original target completion date: Oct-2010).

The PMS held a conference with the PI on 15-Jun to discuss problems OSU was having with creating the high fouling potential water. Attempting to create this water from “scratch” by mixing chemicals into reverse osmosis water proved difficult – a precipitate usually formed as the end point was approached.

Another avenue that appears to be more robust is to take water from the OSU cooling tower. This gives LSI values in the ~2.2 range (medium high). However, the chloride and sulfate concentrations are higher than targeted. Bill Pearson has recommended using a corrosion inhibitor to counter this. The PMS voted to follow Bill’s recommendation – to use the OSU cooling tower water with inhibitor.

Just prior to the TC 8.5 main meeting, I had a conversation with Lorenzo and Bill Pearson. Apparently, we are still a bit naïve about water chemistry for fouling. If I heard things correctly, achieving the target water chemistries will be difficult in a closed system. Lorenzo is thinking he might need an open system with mini-cooling tower and make-up water. The PMS will discuss this further. I also made contact with the TC 3.6 (Water Treatment) research chair, Sarah Ferrari (Evapco), for additional input.

The system has been run with “clean” water to investigate operating characteristics. The 105°F and 120°F saturation temperatures have been reached. They are still working on achieving the target superheats. System operation appears to be stable (at least thermally).

Zahid asked about opening the heat exchangers after testing to look for fouling. Is it everywhere or up in the de-superheating section or elsewhere? Lorenzo noted that this is not in the work statement, but the request could be accommodated.

The project is tracking about 1-1½ months behind schedule.

1394-RFP: Study of Carbon Dioxide Condensation in a Chevron Angle Plate Geometry Exchanger.

PI: Amir Jokar, Washington State University – Vancouver. PMS: Zahid Ayub (chair), Joe Huber, Jim Bogart. Status: active (start date: Sep-2007. original target completion date: Aug-2009. current projected completion date: Aug-2010.)

All data has been collected. The next step is to do the analysis. The Nu vs Re data points look quite good. Attempts are being made to account for the superheat and subcooling sections of the heat exchanger; these tended to be <5% of the total heat transfer. The balance of resistances between the fluid and refrigerant sides was roughly 50/50.

A paper has been published on the fluid-side heat transfer characteristics of the heat exchanger:

“Dynamene/Water Correlations to be Used for Condensation of CO₂ in Brazed Plate Heat Exchangers”, by N Hayes and A Jokar
ASHRAE Transactions, Volume 115, Part 2

FUTURE RESEARCH TOPICS

1556-TRP: Characterization of Liquid Refrigerant Flow Emerging from a Flooded Evaporator Tube Bundle. author: Jon Hartfield

TC 8.5 voted by email ballot to cosponsor this work statement Apr09. TC 1.3 submitted the work statement to MORTS by the 15-May deadline. The project was approved by RAC at the Jun meeting (per Mike Vaughn’s Activities Report) and could go out for bid in the fall.

Fouling of Tube-in-Tube Type Condensers

This is the only remaining topic on TC 8.5’s research priority list. HTRI has expressed interest in doing this project. AHRI has indicated cofunding might also be available for this project. Need RTAR and then WS. Continues to be on the shelf until 1354-RP shows prospects for satisfactory results.

Research Project Ideas

- Resubmission of the fouling in enhanced tubes WS remains a possible project because 1205-RP was not successful. As above, we are waiting until good/useful data starts coming from 1345-RP (fouling in BPHE condensers) before submitting RTAR/WS for fouling in enhanced tubes again along with the fouling in tube-in-tube heat exchangers. A new WS should account for the fact that low fouling potential water did not produce any measurable fouling effect. Also consider adding a modeling aspect – how should fouling be described (ie, is “ $\beta_2 \cdot FF$ ” the correct/best description)?
- “Enhancement of Internal Flow Heat Transfer Coefficient with Micro-Encapsulated Phase Change Material”. Some question about the value of this (hasn’t this been done before?), but also some support. Jamal expressed interest in developing an RTAR to me prior to the meeting. There is still some question about best place for this topic: TC 8.5 or TC 1.3.
- “Characteristics of new low GWP refrigerants in heat transfer equipment”. Samuel Yana Motta and Jon Hartfield agreed to begin drafting an RTAR.
- “Nanofluids for HVAC”. Still on the list, but not quite sure what the best path forward is just yet.

SUMMARY OF RESEARCH CHAIR BREAKFAST

Next deadline for RTAR/WS submission is 15-Sep. Research liaisons need to be involved in development of RTARs/WSs. Going forward, the Standard Research Agreement will require the use of dual units in reports (not just in published papers). Research liaisons should also be present at PES meetings; scores the proposals, but does not vote. Performance evaluation forms are now to be submitted for each active project at each ASHRAE meeting; this is to ensure that the TC is MONITORING the project. RAC meetings are open, TC participation is welcome to help in evaluation of RTARs/WSs.

This was Ron Bailey's last meeting as research liaison for Section 8. The incoming research liaison is Rick Hermans (McQuay).

The Research Strategic Plan 2010-2015 continues to be developed. The number of goals has been reduced down to 10 at this point and is likely to be consolidated further. There continues to be potential for "Design Guides" to eat into the research budget.

Slides from the breakfast presentation in pdf format accompany these notes.