Paper Number: ICR0177

Title of Paper: Nucleate Boiling Heat Transfer Coefficients of Pure Halogenated Refrigerants

Presenter: D. Jung, Y. Ko, K. Ahn, Inha University, Korea

Session: B1-13

Person Contributing Discussion or Question: Koyama Shigeru, Kyushau University

Comment or Question: In general, average heat transfer coefficient is employed to estimate the total heat flow rate or average wall temperature. I wonder that average heat transfer coefficient you defined is meaningless. Could you explain the physical meaning of the average heat transfer coefficient you defined in eq. (3)?

Presenter's Reply: I think that it is a matter of definition. And also I believe that your suggested method would not give too much difference. But I will try to find the difference.

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Presenter: D. Jung, Y. Ko, K. Ahn, Inha University, Korea

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Person Contributing Discussion or Question: Gorenflo, D., Univ. Paderborn, Germany, e-mail: digo@wkt.uni-paderborn de

Comment or Question: To investigate the influence of thermophysical properties of fluids on pool boiling heat transfer, the variation of reduced pressure P_s/P_{crit} with the same fluid is a valuable means to do so because errors can be avoided that may arise from varying impurities with different fluids. Therefore: Did you check how your new correlation represents the many existing recent data on horizontal tubes for experiments with variation of reduced pressure?

Presenter's Reply: I will try to take data at other temperatures with the same fluids.

Paper Number: ICR0044

Title of Paper: Two-Phase Pressure Drops in Horizontal Tubes: New Results for R-410a and R-134a Compred to R-22

Presenter: J. M. Quiben and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

Session: B1-13

Person Contributing Discussion or Question: Piotr Domanski, NIST

Comment or Question: I like your approach of using the flow pattern map in the pressure drop calculation scheme. Could you estimate the accuracy of the flow pattern map?

Presenter's Reply: We now have a flow pattern database of over 2000 observations for 10 fluids with quite good agreement. Since flow pattern identification is subjective, it is difficult to pinpoint the actual accuracy. I estimate that there is an error band of about " 20-25 kg/m^2 s on the mass velocities in the flow pattern map.

Paper Number: Two papers ICR0044 and ICR0045

Title of Paper: (1) Flow Boiling in Horizontal Tubes: New Results for R-410a and R-134a Compared to R-22

(2) Two-Phase Pressure Drops in Horizontal Tubes: New Results for R-410a and R-134a Compared to R-22

Presenter: (1) L. Wojtan and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland (2) J. M. Quiben and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

Session: B1-13

Person Contributing Discussion or Question: David A. Wightman, Dawightman@xdxusa.com, XDX 3176 N. Kennicott Ln., Arlington Hgts., IL 60004

Comment or Question: Wonderfully well presented and documented research. Flow map and predictions, and discussion with comparison to various equations are significant. Openness related to subjectivity and margin of error were appreciable and refreshing. Powerpoint presentations by e-mail are requested.

Presenter's Reply: Thank you for your kind comments and support. Contact me by e-mail about the powerpoint file.

Paper Number: ICR0044

Title of Paper: Flow Boiling Heat Transfer Coefficients ot Pure Halogenated Refrigerants

Presenter: L. Wojtan and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

Session: B1-13

Person Contributing Discussion or Question: Wellsandt, Sven, PhD student, Chalmers Univ. of Technology, SE-41296 G4teborg, Sweden

Comment or Question: What is the size of the heat transfer coefficient on water side? Or more precisely, what Re numbers do you run on the water side?

Presenter's Reply: We do not require the water-side heat transfer coefficient to obtain our tube-side boiling coefficient. On the other hand, we use our liquid-liquid tests to determine the minimum water-side Re number that gives good energy balances and then always operate above this point.

Paper Number: ICR0044

Title of Paper: Flow Boiling Heat Transfer Coefficients ot Pure Halogenated Refrigerants

Presenter: L. Wojtan and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

Session: B1-13

Person Contributing Discussion or Question: Dongsoo Jung, Dept. of Mechanical Eng., Imha Univ., Incheon, KOREA

Comment or Question: Describe how you obtained heat transfer coefficients.

Presenter's Reply: We applied Newton's law of cooling: $h = q/(T_w - T_{sat})$. T_w was obtained with four wall thermocouples and corrected to ID surface with Fourier's law. T_{sat} was determined from the local saturation pressure. The heat

flux q was determined from the enthalpy profile of the hot water at the location of the well thermocouples.

Paper Number: ICR0044

Title of Paper: Flow Boiling in Horizontal Tubes: New Results for R-410a for R-134a Compared to R-22

Presenter: L. Wojtan and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

Session: B1-13

Person Contributing Discussion or Question: P. Bjorn, Royal Institute of Technology, Stockholm, Sweden

Comment or Question: What is the range of validity concerning diameter for the CTF correlation? Is the production as good as you have shown also for other diameters?

Presenter's Reply: In our database of flow pattern observations and heat transfer measurements, so far we have tested from 8-15 mm internal diameters with good success, so far involving 10 fluids. The validity for smaller diameters is not yet known for our map and heat transfer model and should be tested in the future.

Paper Number: ICR0044

Title of Paper: Flow Boiling in Horizontal Tubes: New Results for R-410a for R-134a Compared to R-22

Presenter: L. Wojtan and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

Session: B1-13

Person Contributing Discussion or Question: Kazachi G, Hill Phoenix, 8166 Industrial Blvd., Covington, Ga. 30014

Comment or Question: The uncertainty of the test results is quite impressive. What is the major contributor to the reported uncertainty? What can be currently considered the major barrier for improving the uncertainty even further? What

can we consider a practical limit and what can we consider a theoretical limit for uncertainty improvement?

Presenter's Reply: The primary error comes from calculating the local heat flux from the temperature profile. We use 5 local axial measurements (26 thermocouples) to do this, perhaps going to 8 to 10 would give some more improvement. Measuring two-phase heat transfer coefficients better than "5% is quite a challenge for the future.

Paper Number: ICR0045

Title of Paper: Two-Phase Pressure Drops in Horizontal Tubes: New Results for R-410a and R-134a Compared to R-22

Presenter: J. M. Quiben and J. R. Thome, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

Session: B1-13

Person Contributing Discussion or Question:

Comment or Question: Do you ever estimate the mean deviations from the comparisons between the three methods mentioned in your paper and your total)p data? Do you have a stabilized length at the upstream of the adiabatic pressure drop measurement section?

Presenter's Reply: We are still in the middle of the project and have not done a complete statistical comparison of existing methods to our data yet. The sight glass is located between the eveporator test section and adiabatic test section. A straight length after the adiabatic test section and then a downward curve in the piping is used to avoid upstream effects.

Paper Number: ISO0254

Title of Paper: Diffusion Effects on Multicomponent Condensation

Presenter: T. Karlsson and L. Vamling, Chalmers University of Technology, Sweden

Session: B1-13

Person Contributing Discussion or Question: Aurachen, Hein, Inst of Euergictechnik, TU Berlin, KT1 March Str. 18, 10587 Berlin, Germany

Comment or Question: The mass transfer resistance might be reduced by a mixing effect due to the condensate falling down from the upper tube and by the case that the film is not completely laminar. Did you evaluate your results by experiments?

Presenter's Reply: Experiments have been carried out on a full-scale condenser where a reduction of up to 70% in heat transfer has been recorded* (see reference in paper). Work has been carried out to identify the reason and so far mass transfer resistance in the condensate has been the only factor influential enough to explain the reduction. No detailed experiments have been done yet to evaluate the mixing effects due to mechanical impacts.

*when using a mixture instead of a pure refrigerant.