Oil return and Retention in Unitary Split System Gas Lines

Vatsal Shah, PhD, (M.E.)
PI: Dr. Eckhard Groll, Dr. James Braun
vshah@purdue.edu

Project Description

- With the increasing development of variable speed systems as well as future use of newer HFO refrigerants in HVAC systems, there is a need in the industry for upgrading the line sizing recommendations, which consider the effect of oil retention.
- Oil retention measurements are needed for range of conditions to develop rules for proper oil return.

Discussion

- "With Oil Circulation Ratio at 5% and refrigerant mass flow rate at 14 g/s, the oil retention volume ratio was as high as 32%, which means 32% of the total oil charged in the compressor sump was outside the compressor."

  Source: Lee, J. P.; Hwang, Y.; and Radermacher, R., "An Experimental Investigation Of Oil Retention Characteristics In CO2 Air-Conditioning Systems" (2002). IRACC

- "Above Jacob's limit, where the film reversal begins, oil retention in vertical suction line can still be large"

  Source: Ankit Sethi & Pega Hrnjak (2014) Oil retention and pressure drop of R1234yf and R134a with POE ISO 32 in suction lines, HVAC&R Research

Approach

- Measuring oil retention within a vapor compression cycle is challenging due to various factors such as phase change of different fluids, miscibility between the oil and refrigerant, and varying flow regimes.
- A test setup is being built that can create wide range of the conditions in a horizontal and vertical test sections, which will then be used to measure oil retention using gravimetric method.
- A quicker measurement method is also being developed using capacitive sensor to measure void fraction of refrigerant vapor and liquid oil, from which oil retention can be calculated.

Results

- Oil retention data will be available of a wide range of parameters, which include refrigerant-lubricant combination, orientation and size of pipe, different refrigerant mass flow rates, different oil circulation ratios and different operating temperatures.
- This data will be helpful for the HVAC designers to correctly choose the pipe size that consider the effects of oil retention, specially for situations with low mass flow rates seen in variable speed systems for part load condition.

Oil retention is an important parameter for line sizing