ASHRAE RESEARCH: THE EFFECT OF OIL ON HEAT TRANSFER

Sources:

ASHRAE Study RP-751
ASHRAE Transactions 1986, Vol 92, Part 2
1986 ASHRAE Handbook I-P Edition
1998 ASHRAE Handbook I-P Edition
2005 ASHRAE Newsletter
2010 ASHRAE Handbook I-P Edition
2013 COMISSIONED RESEARCH

ASHRAE Study RP-751, "Effects of Oil on Boiling of Replacement Refrigerants Flowing Normal to a Tube Bundle-Part I: R-123, Robert A. Tatara, Ph.D., Parviz Payvar, Ph.D.,P.E.

"This enhanced tube shows a marked decrease in heat transfer with the addition of even a small amount of oil throughout various heat loadings. Even at 1% to 2% oil, the heat transfer coefficient is reduced by one-third from its no-oil baseline. At substantial oil content (5%-15%), a 40% to 50% reduction is noted."

ASHRAE Study RP-751, "Effects of Oil on Boiling of Replacement Refrigerants Flowing Normal to a Tube Bundle-Part II: R-134, Robert A. Tatara, Ph.D., Parviz Payvar, Ph.D.,P.E.

"This enhanced tube shows a marked decrease in heat transfer with the addition of even a small amount of oil throughout various heat loadings. Even at 1% (by weight) oil, the heat transfer coefficient is reduced by 25% from its no-oil baseline. At higher oil content, a 30% reduction has been typically measured."

ASHRAE Transactions 1986, Vol 92, Part 2, "The Effect of Oil Contamination on the Nucleate Pool-Boiling Performance of R-114 From A Porous-Coated Surface", A.S. Wanniarachchi, Ph.D., P.J. Marto, Ph. D., J.T. Reilly

*"The presence of up to 3% oil caused a 35% reduction in the heat-transfer coefficient of the porous-coated surface at all heat fluxes. With 6% or more oil, the boiling performance of the this surface declined drastically at heat fluxes in excess of 9500 Btu/hr *ft^2."*

1998 ASHRAE Handbook I-P Edition, Refrigeration Systems and Applications, Chapter 2.9-2.11, "Oil Management in Refrigerant Lines" AND 7.11, "Effects of Partial Miscibility in Refrigerant Systems"

2005 ASHRAE Newsletter, "Air Conditioning and Refrigeration Systems Oil Fouling"

Effects On Heat Transfer
Oil fouling of the heat transfer surfaces of air conditioning and refrigeration systems, will cause a loss of about 7%efficiency the first year, 5% the second year, and 2% per year the following years. This loss will continue to accumulate until equilibrium is reached between flow force and adhesion. At this point the oil boundary layer formed has achieved its maximum thickness, producing maximum loss of efficiency. Usually, the efficiency degradation will peak somewhere between 20% and 30 %. Published ASHRAE information confirms these observations. According to ASHRAE, performance is degraded by as much as 30% due to the build-up of lubricants on internal surfaces. Higher percentages up to 40% have been observed in systems 20 years old or older.

2010 ASHRAE Handbook I-P Edition, Refrigeration Systems and Applications, Chapter 12.2- 12.3, "Refrigeration Lubricant Requirements"

2013 COMISSIONED RESEARCH

Lorenzo Cremaschi, Ph.D., associate professor, School of Mechanical and Aerospace Engineering, Oklahoma State University
Cremaschi's project, "Smart Nano-lubricants for HVAC&R Systems," focuses on nanoparticles with purposely-different conductivity, size and shape. The research will advance the understanding of the interactions of the nanoparticles with refrigerant and lubricant flow boiling at the nano- and micro-scale levels, for which no previous studies exist.
"This research opens a new frontier for nanotechnology applied to air conditioning and refrigeration systems," he said. "Driven by higher energy efficiency targets, there is critical need of major heat transfer enhancements in heat exchangers and nano-lubricants, which are defined as nanoparticles suspended in high-viscosity suspensions, have the potential to address such need in a cost-neutral manner for both new and retrofitting residential air conditioning applications."