

**Refrigerants Track Program
Chicago AHR Expo**

Seminar #1 –Next Generation of Lower or Low GWP Next Generation HVAC&R Equipment

Session Chair: Chris Seeton

New lower and low GWP next generation refrigerants are being offered in equipment today in the market place. This seminar will focus on the type of new equipment being offered with lower GWP refrigerants and will also include retrofitting of equipment with high GWP HFC's with lower GWP refrigerants. Seminar topics will include discussions on new equipment in the area of chillers, unitary, commercial refrigeration, portable HVAC&R equipment and retrofitting of existing R404A commercial refrigeration with lower GWP refrigerants

Topic 1: Next Generation Low GWP Refrigerants for Chillers

Presenter: Steve Kujak - Trane

Abstract: Regulatory actions are leading to the development and investigation of a new class of refrigerants, unsaturated chlorinated and fluorinated hydrocarbons, with lower GWPs. This presentation provides an overview of the next generation refrigerants (NGR) available and presents the state of understanding and development of these alternatives by their environmental, safety, and design tradeoffs for chiller products. Tradeoffs between GWP, flammability, and specific capacity have been made and these trade-offs have resulted in the need for changes to equipment designs. Some lower GWP refrigerants are beginning to be introduced in many market segments.

Topic 2: Low GWP Systems for Commercial Refrigeration.

Presenter: KC Kolstad - Target

Abstract: The commercial refrigeration sector has been one of the most active looking at new lower GWP refrigerants, both retrofit and new systems designs, because of mounting regulatory pressure on R404A and many older systems still using R-22. This seminar will discuss the process, equipment changes and others issues involved in R404A or R22 systems conversions, i.e. retrofits, to R449A. In addition, the retailer will discuss their experiences with new lower GWP systems, like CO₂ cascade, CO₂ transcritical and R290 equipment.

Topic 3: Key Learnings from Conversions of Commercial Refrigeration Systems to Low GWP Alternatives

Presenter: Chuck Allgood, Ph.D., Andrew Pansulla, Member, Chemours, Wilmington, DE

Abstract: The search for replacements for HCFC and HFC based refrigerants such as R-22 and R-404A, being phased out globally due to stratospheric ozone depletion and global warming potential issues, has led to the development of low GWP HFO blend alternatives, such as R-449A. This presentation includes the retrofit procedure for HFO refrigerants in low and medium temperature commercial refrigeration systems that were originally designed for HCFC and HFC refrigerants. Also, data obtained during actual system conversions, including compatibility with seals/lubricants as well as operational and energy performance is reported.

Seminar #2 - Some Low GWP Next Generation Refrigerant will be Flammable: What does it mean to be Flammable?:

Session Chair: Steve Eckels

This seminar would focus on the fundamentals of flammability, issue in handling flammable refrigerants and ASHRAE and industry funded research into flammable refrigerants. We could fit is product and standard changes needed to handle flammable refrigerants in this area as well.

Topic 1: Flammable Refrigerant Basics

Presenter: Steve Kujak

Abstract: Increasing concerns about the impact of refrigerants on the environment and on climate change are driving new regulatory policies to restrict and lower the global warming potential (GWP) impact of fluorocarbon refrigerants used in the HVAC&R industry. In response, the industry is developing and examining a new class of lower GWP refrigerants. As this transition moves forward, many questions exist about changing refrigerants options and requirements to use them safely. This presentation will highlight some important considerations, particularly flammability, that engineers, designers, and building owners should keep in mind regarding next-generation refrigerants.

Topic 2: Developing Guidelines for Flammable Refrigerant Use

Presenter: Matt Guernsey, Navigant

Abstract: Several countries outside the U.S. are adopting flammable refrigerants as low-global warming potential (GWP) alternatives to hydrofluorocarbons (HFCs); however, their specific requirements for safe handling and use are generally unknown to the US HVAC&R industry. ASHRAE 1807-TP sought to provide industry with insights on the best, consistent handling practices that can be used in the US to enable the safe use of flammable refrigerants. The project investigated currently available requirements and best practices in other countries related to the safe handling, storing and transporting of flammable refrigerants and HVAC&R equipment containing flammable refrigerants, as well as for the installation, servicing, maintenance, decommissioning and dismantling of HVAC&R equipment containing flammable refrigerants. Leveraging this knowledge of requirements and best practices in other countries, as well as knowledge of current US practices and gaps in key safety standards, the project developed recommendations for the use of A2, A2L and A3 refrigerants. Where suitable, the recommendations included characterization of testing opportunities that could confirm the proposed requirements.

Topic 3: AHRI Flammable Refrigerant Research

Presenter: Xudong Wang, AHRI

Abstract: The presentation will provide an overview of the recent AHRI research activities on flammable refrigerants. The activities cover A2L refrigerants leak and ignition testing, A2Ls hot surface ignition temperature testing, examining the potential ignition sources and a summary of the current sensor technologies for A2L refrigerants.

Topic 4: Investigation of Flammable Refrigerant Charge Safety using Numerical Release Studies

Presenter: Omar Abdelaziz, ORNL

Abstract: This presentation will provide a summary of several numerical refrigerant release studies under various scenarios in order to develop safe guidelines on refrigerant charge. The activity focuses on using R-32 as the refrigerant. First we will discuss the validation and verification of the Computational Fluid Dynamics model, the different scenarios studied, and then present relevant results.

Seminar #3 - Lubricants Changes for Low GWP Next Generation Equipment:

Session Chair: Ed Hessell

This seminar would focus the lubricant changes and challenges needed for next generation refrigerants and replacement for R123, R134a, R404A and R410A.

Topic 1: Lubrication Considerations for Lower GWP R-410A Alternatives

Presenter: Julie Majurin CPI Fluid Engineering

The industry has made significant progress in developing, evaluating, and beginning to implement lower GWP refrigerant alternatives as interim or long-term HCFC and HFC replacements. These efforts are enabled through empirical assessments of existing or optimized lubricants with the new fluids, and in some cases development of new lubricant formulations to meet the reliability and efficiency requirements of the application. As standards organizations, government bodies, and other stakeholders continue to work on the revision of relevant safety standards and building codes for the safe use of flammable refrigerants, R-410A alternatives remain a subject of uncertainty. This presentation will cover lubrication considerations for multiple R-410A alternatives as they relate to factors such as oil return (miscibility), bearing life (working viscosity and solubility), and compressor discharge temperature (chemical stability) relative to baseline R-410A performance.

Topic #2 Understanding Lubricant Requirements for Next Generation Low Global Warming Potential Refrigerants

Presenter: Ed Hessell and Roberto Urrego – Lanxess Solutions

Lubricants are important components of almost all air conditioning and refrigeration systems. Their primary function is to lubricate the compressor, provide sealing of clearances between low and high pressure sides of the compressor and remove frictional heat. The lubricant and refrigerant are in contact at all times in the refrigeration cycle and so it is imperative to understand the properties of these mixtures and how this correlates to equipment performance, reliability and service life.

This presentation will cover some fundamental data on the solution properties of polyol ester lubricants in combination with select low global warming potential refrigerants such as R-32, R-1234ze, R-290 as well as HFC/HFO mixtures. The data provides insight into potential lubrication issues associated with the commercialization of next generation refrigerants but also suggests opportunities where the proper optimization of the refrigerant/lubricant pair can improve system performance.

Topic #3: Lubricant Changes for Low GWP Next Generation Equipment

Presenter: Joe Karnaz – Shrieve Lubricants

Transition is upon us again in regards to moving to low GWP next generation refrigerants. As in the past, refrigerant changes require investigation into how this effects the current lubricants that are used or alternate lubricants to be used. Sometimes certain changes bring about opportunity to explore what's next for the market and industry. This presentation will look back at lubricant development for refrigerant changes; what was needed then when considering an effective lubricant and refrigerant combination. Then a look forward at market focused low GWP next generation refrigerants that are being considered and how this will impact lubricant selection.

Discussion will focus on evaluation of lubricant options that will best fit the next generation refrigerants and if change is needed. Trusted analytical techniques will be reviewed that help in bench top evaluation of lubricant and refrigerant combinations. The interaction of next generation refrigerants, with not only the lubricant, but also other systems chemistries and contaminants will be assessed when determining optimized system strategies. It is important to make sure the right evaluation of refrigerant and lubricant interactions is implemented using equipment and techniques supervised and understood by individuals experienced in the art. With more recent refrigerant chemistries we have come accustomed to products that have a higher degree of stability, some next generation refrigerant may not be as stable so different evaluation may be needed over previous refrigerant investigations.

Seminar #4 - Contaminant Control: What is the same and what is new when using low GWP refrigerants?

Session Chair: Brad Boggess

This seminar would focus on the contaminant control needs, differences and experiences when using next generation low GWP refrigerant containing products.

Topic #1: Chemistry Considerations and Contaminant Control for Low GWP Refrigerants

Presenter: Joe Karnaz – Shrieve Lubricants

Transitioning to different refrigerants involves a great deal of consideration and effort particularly for new product implementation. OEM's tests their units to make sure their system performance is at least maintained when compared to the incumbent unit. Sometimes new refrigerant developed for OEM operation is also used in retrofit situations. Details that need to be investigated are will the refrigerant work effectively with the other chemistries and possible contaminants that are used in the unit. Previous transitions from CFC/HCFC refrigerants to HFC refrigerants showed that some additional manipulation was needed when the HFC refrigerants were used as a replacement for CFC/HCFC units especially in respect to the lubricant and process chemicals. Today we are seeing another transition to using lower GWP refrigerants to replace both HCFC and HFC units. Once again these lower GWP refrigerants could be evaluated for use in both OEM and retrofit situations in which case understanding and investigation needs to be considered with the chemistry that is currently in the system along with the contaminant control.

This presentation will focus on the transition of both synthetic and natural low GWP refrigerants with the potential of using these refrigerants in OEM and retrofit applications. Suggestion will be made on what needs to be considered regarding chemistry and how this might vary with refrigerant option and system type and configuration. Some past examples will be discussed and how lessons learned can help with future consideration of low GWP refrigerant candidates.

Topic 2: Impact of Contamination on the Stability of Low GWP Refrigerants

Presenter: Sarah Kim, Ph.D., Associate Member, Arkema, Inc., King of Prussia, PA

Abstract: Servicing with low GWP refrigerants is becoming common in the HVAC&R industry due to the phase out of conventional refrigerants. It is important to follow best practices such as refraining from mixing refrigerants and using the recommended lubricants while considering that HFOs will exhibit a different nature than HFC or HCFC refrigerants. This session covers the impact of common contaminants that may influence the system performance and reliability of some very low GWP refrigerants containing unsaturated molecules such as R-1234yf and R-1233zd(E). In addition, stabilizers which can prevent the deterioration of performance due to contaminants is discussed.

Topic 3: Effect of Contaminants on the Stability of HFO Refrigerant Systems

Presenter: Rosine Rohatgi – Spaushaus and Associates

Abstract:

This presentation will summarize the results of two research projects that focused on the effects of contaminants on the thermal and chemical stability of the HFO refrigerants and their corresponding

lubricants. In AHRI research project 00904-RP refrigerants R1234yf, R1234ze and R1234yf blended with R32 (50/50 by weight) were tested with two POE oils (a mixed acid and a branched acid POE), and one PVE oil. In ASHRAE research project 1641-TRP, three refrigerant/lubricant mixtures, including R134a/POE, R1234yf/POE and R123/mineral oil were tested in the presence of unsaturated halogenated contaminants, in sealed tubes at 175oC for 14 days. Based on criteria such as visual changes, TAN, total organic acid (TOA) and dissolved metal concentrations after aging, concentration limits specific to the unsaturated contaminants below which the refrigerant/lubricant system was thermally stable were identified. The results from these research projects were implemented in AHRI Standard 700.