



White Paper

Ozone Friendly Refrigerants with POE Oils

Michael Guglielmono
Fred Scheideman
Yogesh Magar

Introduction:

In response to the issues raised by conventional CFC's and HCFC's stratospheric ozone depleting potential, the Montreal Protocol has mandated phase outs of this type of refrigerant and their related halon cousins.

The ozone friendly refrigerants developed to replace these refrigerants are known as HFC's. Most are zeotropic blends (also known by the double negative as "non-azeotropes") which is to say that they do not behave as pure fluids but rather when changing from liquid to vapor or vice versa exhibit different concentrations of each component in the vapor and liquid phase. This phenomenon may require extra care in equipment design.

Zeotropic blends are designated by ASHRAE's R-400 series nomenclature. The new refrigerants also do not exhibit good solubility with the traditional mineral or alkyl benzene lubricating oils formerly used with the ozone depleting refrigerants and hence require a different type of oil known as polyolester (POE) oils.

Discussion:

Most of Turbotec's customers will be using R410A as a replacement for R22, so this discussion will focus mainly on this refrigerant and its POE oil. R410A is a zeotrope, but its glide (the difference between bubble and dew points) is minimal. Nonetheless R410A must be handled as any other zeotrope. This means that in transferring R410A (as in charging a system), the refrigerant must always be transferred as a liquid in order to make sure that the proper concentration of its components (50% R32 and 50% R125) is maintained.

When using zeotropic refrigerants, it is suggested that the leak-tightness of systems should be maintained at a tighter level than the previous generation of refrigerants. This is because leaks can cause fractionating of the components. R410A has a minimal glide and most literature claims that leaking systems can be fixed and then "topped off" with more R410A rather than evacuating completely and recharging. Unless the leak is relatively small, recovery and liquid recharge is preferred.

Another related issue with R410A is the POE oil and its peculiar characteristics. This class of oils is very hygroscopic* and will quickly and insidiously absorb moisture if left in contact with air even for a short period. The conventional systems with R-22 refrigerant can safely handle moisture level up to 10%. But systems with POE oil starts acid formation by breaking down POE oil at moisture level as low as 3%. Furthermore, the moisture cannot be removed by the usual levels of vacuum developed by evacuation pumps. Only specified filter dryers can be relied upon to remove moisture from POE oils once it is absorbed. Therefore POE containers should be tightly closed. Small containers are preferred as they are more likely to be fully consumed than large containers. Compressors containing POE oil should be kept capped until ready to connect to an evacuated refrigeration system.

* Readily taking up and retaining moisture.

The POE oil also creates design challenges in that it is an effective detergent and will scour and release contaminants which may be present in a refrigeration system. These contaminants may be non-problematic in a conventional R22 system using mineral oil, but could be troublesome in a system containing POE oil. In particular, machining oils, lubricants of all types, rust-inhibiting coatings and oxides formed during brazing are all likely to be loosened and swept into the refrigerant stream. The ability of POE oil to emulsify contaminants also seems to be able to move them through the system's filter dryer. Clogged TXV's have been reported in R410A systems equipped with filter dryers. The solution to the problem is to practice extra cleanliness in manufacturing of components (i.e. removal of all oil-like contaminants) and particular care during brazing to prevent formation of oxides. A nitrogen cover gas is suggested to prevent the later.

Summary:

R410A and its associated POE oil present new challenges in system design, manufacturing, cleanliness and fluids handling. With proper care however, R410A systems can be as reliable as older R22 systems.

References:

- 1) Emersion Climate Technologies- *Flow Controls HMI White Paper*, Jan 26, 2004.
- 2) Morley John, DuPont™ SuvaRefrigerants- *Technical Information*
- 3) Dieckmann John, and Magid Hillel, "Global Comparative Global Comparative Analysis of HFC and Alternative Technologies for Refrigeration, Air Conditioning, Foam, Solvent, Aerosol Propellant, and Fire Protection Applications," *Final Report to the Alliance for Responsible Atmospheric Policy*, August 23, 1999.
- 4) Marchese Joe, "Ice Breaker-Working with POE Oils Requires Forethought", *Air Conditioning, Heating & Refrigeration News*, Page No 24, March 12, 2007

For additional information about Turbotec's products, please go to:

www.TurbotecProducts.com

Or contact

Turbotec Products, Inc.

651 Day Hill Rd., Windsor CT, 06095

Ph: 1.860.731.4200, Fax: 1.860.683.2133