REFRIGERANTS

A **refrigerant** is a substance used in a heat cycle usually including, for enhanced efficiency, a reversible phase change from a liquid to a gas. Traditionally, fluorocarbons, especially chlorofluorocarbons, were used as refrigerants, but they are being phased out because of their ozone depletion effects. Other common refrigerants used in various applications are ammonia, sulfur dioxide, and non-halogenated hydrocarbons such as methane.

USES OF REFRIGERANT

- Chillers typically cool water, which is then circulated to provide comfort cooling throughout a building or other location. Chillers can be classified by compressor type, including centrifugal, reciprocating, scroll, screw, and rotary. SNAP has identified substitutes for CFC-11, CFC-12, CFC-113, CFC-114, R-13B1, HCFC-22, R-500 and other ODSs. Chillers used to cool industrial processes are discussed under Industrial process refrigeration systems.
- Industrial process refrigeration systems cool process streams in industrial applications. The choice of substitute for specific applications depends on ambient and required operating temperatures and pressures. SNAP has identified substitutes for CFC-11, CFC-12, HCFC-22 and other ODSs.
- Ice skating rinks frequently use secondary refrigeration loops. They are used by the general public for recreational purposes. SNAP has identified substitutes for CFC-12, HCFC-22, R-502 and other ODSs.

http://www.epa.gov/ozone/snap/refrigerants/

R-744 can be used as a working fluid in climate control systems for cars, residential air conditioning, hot water pumps, commercial refrigeration, and vending machines. R12 is compatible with mineral oil, while R134a is compatible with synthetic oil. GM has announced that it will start using Hydrofluoro olefin, HFO-1234yf, in all of its brands by 2013. This new refrigerant has a GWP rating of 4 and is not a blend. Dimethyl ether (DME) is also gaining popularity as a refrigerant.

http://des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-37.pdf

TYPES OF REFRIGERANT

Halocarbons

1. Azeotropic Refrigerants
2. Zeotropic Refrigerants
3. Inorganic Refrigerants
4. Hydrocarbon Refrigerants

- Halocarbon Refrigerant is all synthetically produced and was developed as the Freon family of refrigerants.

EXAMPLES:

- CFC's : R11, R12, R113, R114, R115
- HCFC's : R22, R123
- HFC's : R134a, R404a, R407C, R410a

Inorganic refrigeration

- Carbon Dioxide
- Water
- Ammonia
- Air
- Sulphur dioxide

Azeotropic Refrigerants

- A stable mixture of two or several refrigerants whose vapour and liquid phases retain identical compositions over a wide range of temperatures.

- Examples : R-500 : 73.8% R12 and 26.2% R152

R-502 : 8.8% R22 and 51.2% R115

R-503 : 40.1% R23 and 59.9% R13

Zeotropic refrigeration

- A zeotropic mixture is one whose composition in liquid phase differs to that in vapour phase. Zeotropic refrigerants therefore do not boil at constant temperatures unlike azeotropic refrigerants.
- Examples: R404a: R125/143a/134a (44%,52%,4%)

R407c: R32/125/134a (23%, 25%, 52%)

R410a: R32/125 (50%, 50%)

R413a: R600a/218/134a (3%, 9%, 88%)

Hydrocarbon refrigerants

- Many hydrocarbon gases have successfully been used as refrigerants in industrial, commercial and domestic applications.
- Examples: R170, Ethane, C2H6

R290, Propane C3H3

R600, Butane, C4H10

R600a, Isobutane, C4H10

Blends of the above Gases

Major Substances Used as Refrigerants

■CFC

Chemical compounds consist of chlorine, fluorine, and carbon. Widely used in the past as refrigerant for air conditioners. CFCs were found to deplete the ozone layer and developed countries stopped manufacturing them in 1995. CFCs are greenhouse gases with a global warming potential three to 10 times that of HFCs.

■HCFC

Chemical compounds consist of hydrogen, chlorine, fluorine, and carbon. Used to substitute for CFCs, HCFCs have an ozone depletion potential just one-twentieth that of CFCs. Developed countries will stop manufacturing HCFCs in 2020.

The global warming potential is about the same as HFCs.

■HFC

Chemical compounds consist of hydrogen, fluorine, and carbon. A CFC substitute (hydro-fluorocarbon). With an ozone depletion potential of zero, HFCs are the best refrigerant for protecting the ozone layer. HFCs are currently in the process of being substituted for HCFCs. However, HFCs are designated in the Kyoto Protocol as a greenhouse gas whose emission must be reduced. As well, like CFCs and HCFCs, the release of HFCs into the atmosphere is forbidden under the Fluorocarbons Recovery and Destruction Law (Japan).

■Natural Refrigerants

Substances existing in the natural world and having refrigerant characteristics: Examples are ammonia, hydro carbon (propane), and CO2.

www.gov.mu/portal/goc/menv/files/Alternative%20**Refrigerants**.ppt

COLLECTED, MANAGED, AND HANDLED FOR DISPOSAL OF REFRIGERANT

Recovery – All refrigerants should be recovered from the unit by removing the refrigerant using EPA certified recovery equipment and storing it in an approved container.

Recycling – Recovered refrigerants can be recycled by filtering the refrigerant to remove impurities, such as oil, air, and moisture. Once the refrigerant is purified, it can be reused in a repaired air conditioner or appliance.

Reclaiming – Most recovered refrigerants are sent for reclamation where the recovered material is processed, usually by distillation, to remove all impurities and restore it to virgin product specifications.

Disposal – Any refrigerant that is contaminated with other refrigerants and cannot be reclaimed must be disposed of as a hazardous waste. For this reason it is imperative that refrigerants are not mixed during recovery

The facility disposing of any items that contain refrigerants must adhere to the following:

1. Refrigerants must be recovered prior to crushing vehicles or appliances (white goods).

2. Refrigerants shall be removed from all vehicles using EPA certified recovery equipment.

3. Refrigerants shall not be vented or otherwise released to the atmosphere.

4. Records shall be kept showing the amount of refrigerant recovered, the date of recovery and the final disposition of this material. If the refrigerant has been recovered prior to disposal of the appliance at a transfer station, records must reflect that the refrigerant was recovered prior to receiving the appliance at the facility.

5. Refrigerants are stored in tanks that meet US Department of Transportation (DOT) or Underwriters Laboratory (UL) standards. Tanks are labeled according to their contents: "Refrigerant/Freon.

6. Recovered refrigerant is sold or transferred only to EPA authorized reclaiming facilities that will reclaim it to its original purity specifications. Only EPA certified technicians can purchase virgin refrigerants. Recovered refrigerants should not be sold to an automobile repair facility.

7. All motor vehicle air conditioner repair and recharging must be done by a EPA certified technician.

http://des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-37.pdf

ENVIRONMENTAL EFFECTS

Depletion of the ozone layer in the stratosphere

Global warming:

Refrigerants directly contributing to global warming when released to the atmosphere

Indirect contribution based on the energy consumption of among others the compressors (CO2 produced by power stations)

www.gov.mu/portal/goc/menv/files/Alternative%20**Refrigerants**.ppt

Storage and Transportation of refrigerants:
Integrating Safety

Technicians can prevent injuries and costly mistakes by consistently following defined procedures and using common sense when handling refrigeration equipment. Taking simple precautions can be a substantial leap toward industry-wide safety. Among the more obvious practices that should become habit for refrigerant technicians are these.

First, returnable cylinders must meet Transportation specifications and are characterized by a combined liquid/vapor valve located at the top.

A returnable cylinder must never be filled above 80 percent of the container's volume.

If cylinders will be exposed to temperatures above 130 degrees, technicians should not fill them more than 60 percent. Hydrostatic pressure can be deadly in an overfilled refrigerant container. While over-pressure safety devices provide some level of safety, they do not eliminate risk. An opened valve can spew refrigerant, or the entire tank might rupture with extreme violence.

Second, technicians should weigh and inspect cylinders carefully before filling. They also should:

- not use cylinders that are dented, rusted, gouged or damaged in any way
- examine the valve assembly for leakage, damage or tampering
- handle cylinders carefully
- store refrigerant cylinders in a vertical position with their valves at the top
- become familiar with all pieces of recovery equipment
- apply all methods and instruction prescribed by the system's manual every time they use the equipment.

Disposable cylinders, which are constructed of common steel, can oxidize and become weakened by rust. As a result, their wall and seams no longer can tolerate pressure or contain gases. Technicians should discard rusted containers because they can never be used for recovery or refilling. To prevent corrosion, technicians should store containers in dry locations.

Cylinders with residual refrigerant should not be allowed to sit at a job site because saturated vapor pressure will form if even the smallest amount of liquid is present. Before discarding a container, technicians should recover any remaining refrigerant per EPA recovery efficiencies.

Third, technicians should collect used refrigerant in approved, refillable cylinders or drums, as appropriate, painted gray with the top shoulder portion painted yellow.

They need to label the cylinder or container with a four-by-four green, diamond-shaped, nonflammable gas label.

Finally, technicians must fill drums to allow vapor space equal to at least 10 percent of the drum height between the top of the liquid and the drum top. Refillable cylinders must be retested and recertified every five years, and the test date must be stamped on the cylinder shoulder. Retesting by visual inspection alone is not permitted.

Transporting and Transferring

In transporting used refrigerant, technicians need to clearly label its container with a classification tag. When moving a cylinder, they must ensure that it is firmly strapped onto an appropriate wheeled device. Never roll a cylinder on its base or lay it down to roll it. Use a forklift truck to move half-ton containers of refrigerant.

When transferring refrigerant from containers or equipment, it is mandatory to avoid contamination or venting to the atmosphere.

Containers must be the correct type and color and properly marked.

Any time a container or system undergoes the transfer of refrigerant, the technician must check it for refrigerant type, cleanliness and oils used. Also, the container used for holding transferred refrigerant must be evacuated, and under no circumstances should workers mix different refrigerants.

http://www.facilitiesnet.com/hvac/article/Refrigerant-Safety-101--4833