Press release

Count-down for the phase-out

The phase-out which started at the beginning of the year will further boost the use of natural refrigerants in industry and in air-conditioning systems for buildings. On 1 January 2016, the EU reduced the permitted total quantity of climate-damaging F-gases by 7 %. Experts see high ecological and economic potential in using natural refrigerants for air-conditioning systems in buildings.

The European Union wants to bring about a 20 % reduction in greenhouse gas emissions by the year 2020. The so-called F-gases are an important lever in this respect. F-gases are partly fluorinated hydrocarbons which are used among others as refrigerant in air-conditioning systems for buildings and for generating industrial refrigeration. The revised F-gases Regulation will, by law, implement a 79 % reduction in the quantity of climate-damaging F-gases used throughout Europe in six stages through to 2030, referred to the European average from the years 2009 to 2012. The first stage with a 7 % reduction came into effect on 1 January 2016. Implementing a controlled shortage of F-gases in this way as part of the phase-out strategy will make climate-damaging refrigerants successively more expensive, thus indirectly promoting the use of natural refrigerants. Natural refrigerants make both ecological and economic sense, and systems using them are currently in great demand for air-conditioning systems in buildings.

Natural refrigerants are sustainable

One of the reasons for gradually prohibiting F-gases consists in their large contribution to global warming. In order to quantify the impact a gas has on global warming, the global warming potential (GWP) was introduced as an objective measurement parameter. The natural refrigerant CO_2 has a GWP of 1. By contrast, the F-gas R22 has a GWP of 1,700, while the widespread refrigerant R404a even has a GWP of 3,922. Depending on the particular refrigerant, chlorofluorocarbons (CFCs) can even reach a GWP in excess of 10,000. The legislator is now intervening here with the revised F-gases Regulation: from

2020 onwards, stationary systems may no longer operate with refrigerants that have a GWP > 2,500.

Another parameter indicating the sustainability of a substance is the ODP. The ODP (ozone depletion potential) indicates to what extent a substance harms the ozone layer. In new systems, refrigerants with an ODP > 0 are not allowed anymore for a long time already. None of the natural refrigerants contributes to ozone depletion, which means ODP = 0, whereas R22 is still used as a refrigerant in many existing systems although it contributes to the ozone depletion and should thus be replaced urgently.

Leakage limits for synthetic refrigerants make hermetic systems necessary

To minimise the environmentally harmful effect of F-gases, the first version of the F-gases Regulation in 2007 stipulated maximum leakage limits for refrigerants. Depending on the system size, the leakage rate for synthetic refrigerants may not exceed a maximum of 1 to 3 percent.

Since the revision of the F-gases Regulation, system operators also have to face up to extended operator obligations, including among others verifying that their system is leakage-free. If the stipulated leakage limits are not verifiably met in the next few years, legislation can be expected to become even tighter, through to a progressive prohibition of certain refrigerants. As a result, planners and system engineers will therefore give greater significance to hermetically sealed solutions when planning systems with synthetic refrigerants. Hitherto systems with high safety requirements were required particularly when planning to use refrigerants that pose a health hazard or are explosive.

Energy efficiency scores!

When looking at the contribution refrigeration systems make to global warming, it transpires that only 20 % of the climate-damaging effect comes from leaks of synthetic refrigerants. The remaining 80 % come from the amount of energy needed during refrigeration production. Here too, systems with natural refrigerants offer benefits in both ecological and economic terms, due among others to the outstanding thermodynamic properties of natural refrigerants. NH_3/CO_2 cascade systems in particular generate energy savings of up to 35 % compared to similar systems with hydrofluorocarbons (HCFC systems).

Profitable in economic terms

Detailed analysis shows that systems with natural refrigerants are often the best choice also in economic terms. When calculating the payback period, all costs occurring during the life cycle of a system have to be taken into consideration. These include the initial outlay and all subsequent costs, in other words, the costs for planning and installing the system and subsequent expenditure on energy, servicing and maintenance. Natural refrigerants offer convincing values in this respect. Although they make higher demands of system safety than synthetic refrigerants, their higher energy efficiency generates clear cut backs in operating costs; furthermore, the systems are rated for a longer service life, usually amounting to 25 years and more. In overall economic terms, natural refrigerants offer greater cost advantages.

Optimum rating of the system

There is one important aspect that has to be taken into account to make full use of all the advantages of systems with natural refrigerants. The energy consumption of a refrigeration system is influenced not just by choosing the right refrigerant but, above all, by the rating of the system. For example, the operation of a screw compressor with shutter slide control in the lower part-load area can result in higher pressure levels that exceed the optimum operating pressure, resulting in clearly reduced energy efficiency for the overall system. Comprehensive know-how lets planners and operators realise great potential savings in this respect.

Trend: using ammonia for air-conditioning in buildings

Systems with natural refrigerants are currently finding increasing use in atypical applications. Ammonia is no longer used just in industrial refrigeration for capacities exceeding 500 kW; meanwhile it is also taking over areas that used to be the domain of synthetic refrigerants, such as air-conditioning in buildings. Many large exhibition halls in Germany have been equipped with ammonia liquid chillers for air-conditioning. Banks, insurance companies and office buildings also make increasing use of natural refrigerants for air-conditioning. Furthermore, the trend is spreading to areas with high safety requirements: risk analyses have shown that refrigeration systems with natural refrigerants are no greater potential hazard than systems with synthetic refrigerants so that refrigeration systems operating with ammonia are also being used for air-conditioning in airports. Examples here include the refurbished Düsseldorf Airport, the new Terminal 5 at London Heathrow or Zurich Airport.

Developments with hydrocarbons

The trend to use natural refrigerants for air-conditioning in buildings also applies to systems operating with hydrocarbons such as propane, butane and butene. Propane has very similar thermodynamic properties to the synthetic refrigerant R22. Some Asian countries have therefore replaced R22 with propane in central air-conditioning systems and report cut-backs in energy consumption between 10 and 30 percent with only minimum modifications necessary to the systems.

Conclusion: natural refrigerants are (usually) the best

Triggered by the F-gases Regulation, planners and operators are increasingly looking at where and how it makes sense to use refrigeration systems with natural refrigerants, thus reflecting the increasingly widespread use of natural refrigerants in air-conditioning for buildings. Besides a growing environmental awareness, this is also due to economic advantages. The significance of natural refrigerants therefore continues to grow worldwide.

Appendix

Ammonia (NH_3)

Ammonia has been successfully used as a refrigerant in industrial refrigeration plants for over 100 years. It is a colourless gas, liquefies under pressure, and has a pungent odour. In coolant technology, ammonia is known as R 717 (R = Refrigerant) and is synthetically produced for use in refrigeration. Ammonia has no ozone depletion potential (ODP = 0) and no direct global warming potential (GWP = 0). Thanks to its high energy efficiency, its contribution to the indirect global warming potential is also low. Ammonia is flammable. However, its ignition energy is 50 times higher than that of natural gas and ammonia will not burn without a supporting flame. Due to the high affinity of ammonia for atmospheric humidity it is rated as “hardly flammable”. Ammonia is toxic, but has a characteristic, sharp smell which gives a warning below concentrations of 3 mg/m^3 ammonia in air possible. This means that ammonia is evident at levels far below those which endanger health (>1,750 mg/m^3). Furthermore ammonia is lighter than air and therefore rises quickly.

Carbon dioxide (CO_2)

Carbon dioxide is known in refrigeration technology as R 744 and has a long history extending back to the mid 19th century. It is a colourless gas that liquefies under pressure, with a slightly acidic odour and taste. Carbon dioxide has no ozone depletion potential (ODP = 0) and negligible direct global warming potential (GWP = 1) when used as a refrigerant in closed cycles. It is non-flammable, chemically inert and heavier than air. Carbon dioxide has a narcotic and asphyxiating effect only in high concentrations. Carbon dioxide occurs naturally in abundance.

Hydrocarbons

Refrigeration plants using hydrocarbons such as propane (R 290, C_3H_8), propene (R 1270, C_3H_6) or isobutane (R 600a, C_4H_{10}) have been in operation all over the world for many years. Hydrocarbons are colourless and nearly odourless gases that liquefy under pressure, and have neither ozone depletion potential (ODP = 0) nor significant direct global warming potential (GWP = 3). Thanks to their outstanding thermodynamic characteristics, hydrocarbons make particularly energy efficient refrigerants. Hydrocarbons are flammable, however, with currently available safety devices, refrigerant losses are near zero. Hydrocarbons are available at low cost all over the world; thanks to their ideal refrigerant characteristics they are commonly used in small plants with low refrigerant charges.

Ozone Depletion and Global Warming Potential of Refrigerants

	Ozone Depletion Potential (ODP)	Global Warming Potential (GWP)
Ammonia (NH_3)	0	0
Carbon dioxide (CO_2)	0	1
Hydrocarbons (propane C_3H_8, propene C_3H_6, isobutane C_4H_{10})	0	<3
Water (H_2O)	0	0
Chlorofluoro-hydrocarbons (CFCs)	1	4680–10720
Partially halogenated chlorofluoro-hydrocarbons (HCFCs)	0.02–0.06	76–12100
Per-fluorocarbons (PFCs)	0	5820–12010
Partially halogenated fluorinated hydrocarbons (HFCs)	0	122–14310

Ozone Depletion Potential (ODP)
The ozone layer is damaged by the catalytic action of chlorine, fluorine and bromine in compounds, which reduce ozone to oxygen and thus destroy the ozone layer. The Ozone Depletion Potential (ODP) of a compound is shown as chlorine equivalent (ODP of a chlorine molecule = 1).

Global Warming Potential (GWP)
The greenhouse effect arises from the capacity of materials in the atmosphere to reflect the heat emitted by the Earth back onto the Earth. The direct Global Warming Potential (GWP) of a compound is shown as a CO_2 equivalent (GWP of a CO_2 molecule = 1).

About eurammon
eurammon is a joint initiative of companies, institutions and individuals who advocate an increased use of natural refrigerants. As a knowledge pool for the use of natural refrigerants in refrigeration engineering, the initiative sees as its mandate the creation of a platform for information sharing and the promotion of public awareness and acceptance of natural refrigerants. The objective is to promote the use of natural refrigerants in the interest of a healthy environment, and thereby encourage a sustainable approach in refrigeration engineering. eurammon provides comprehensive information about all aspects of natural refrigerants to experts, politicians and the public at large. It serves as a qualified contact for anyone interested in the subject. Users and designers of refrigeration projects can turn to eurammon for specific project experience and extensive information, as well as for advice on all matters of planning, licensing and operating refrigeration plants. The initiative was set up in 1996 and is open to companies and institutions with a vested interest in natural refrigerants, as well as to individuals e.g. scientists and researchers.
Internet URL: www.eurammon.com

Contacts

eurammon contact
eurammon
Dr. Karin Jahn
Lyoner Strasse 18
D-60528 Frankfurt
Germany
Phone: +49 (0)69 6603-1277
Fax: +49 (0)69 6603-2276
E-mail: karin.jahn@eurammon.com

Press contact
FAKTOR 3 AG
Judith Geller / Petra Resedaritz
Kattunbleiche 35
D-22041 Hamburg
Germany
Phone: +49 (0)40 679446-6106
Fax: +49 (0)40 679446-11
E-mail: eurammon@faktor3.de