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LOW GWP REFRIGERANTS FOR AC

With the ban on using R22 for topping up systems looming in just over 6 months, Peter Dinnage of Climalife considers the alternatives if the equipment is not to be replaced.

In the April issue I covered why Lower GWP refrigerants will be needed to meet the requirements of the new F-Gas regulations. Refrigerants such as Ammonia and CO_2 are already used in Industrial and Supermarket applications respectively, while Hydrocarbons have become standard in domestic refrigerators with hermetic compressors and very small charge sizes. In addition R407A and R407F are being used instead of the high GWP R404A.

Two HFO refrigerants, R1234yf and R1234ze are already commercially available, as is R32 which is being used in Asia for small air conditioning equipment by some manufacturers, but what of other lower GWP alternatives?

The new F-Gas regulation has created a demand for the future and also gives the green light for compressor and equipment manufacturers to proceed with testing a number of new refrigerants that are on their way to market.

Refrigerant blends

Many laboratory trials are already under way on various blends, each trying to balance the properties required for the intended application. Their goals are good energy efficiency and thermodynamic properties, low GWP, non-flammability and an economical price.

Inevitably some compromise will be needed and may vary dependent on the application. Unfortunately with very low GWP usually comes an increased risk of flammability. Other factors such as material compatibility, pressures, temperature glide and suitability for use in existing equipment design can also come into play.

Many of the refrigerant blends under consideration are based upon R32, R1234ze or R1234yf to try and attain a low GWP whilst R134a and R125 can suppress their flammability and help thermodynamic characteristics. In terms of R134a replacements it is possible to get down to a GWP of around 600 and remain non-flammable, whilst for R404A replacements the non-flammable blends have a GWP of just under 1400.

Of those low GWP blends under development, many are likely to be classified as A2L which will have its own implications. At present standards such as EN378, ISO-5149 and IEC-60335-2-40 are in the process of being updated for this classification to allow greater charge sizes than for A2 refrigerants. To meet the A2L classification a refrigerant must have a maximum burning velocity of less than 10 cm/second. R32 has a burning velocity of 6.7cm/second, whilst R1234yf is less. In comparison Propane, an A3 class refrigerant has a burning velocity of 43 cm/second.

Although classified as mildly flammable there are still a number of implications for handling and training. These are not the problem some may imagine, but this is a topic which will be covered in more detail in a future article.

Works in progress

Test are being carried out around the world on various proposed blends under the stewardship of AHRI and a low GWP Alternative Refrigerant Evaluation Programme (AREP), comparing performance characteristics either in equipment without any adjustments at all, sometimes with 'soft optimization' or comparing in calorimetric tests. There are more than fifty refrigerants under evaluation for a range of applications. As these, and other trials carried out under non-disclosure agreements, are made public there will be further clarity around which refrigerants will become commercial. Honeywell, DuPont, Mexichem and Arkema, amongst others, are all developing products to replace the current range of refrigerants that are used today. Chillventa in October is likely to see a flurry of activity of products on their way to market and reveal when they could be commercialised, along with availability and the price they will enter the market. Once a blend is assigned an Ashrae number, there is an indication that it will be commercialised, but it is only a step on the way to full approval and use.

How quickly some of these products will come to market and which ones will dominate remains to be seen with compressor manufacturer approvals determining how quickly they could be used in new equipment. It is likely that the non-flammable products will appear on the market much quicker, whilst A2L refrigerants will take considerably longer to establish themselves.

For Air Conditioning applications to replace R410A, both R32 and Solstice L41 look front runners but will there be other competing products? Blends of R32 with 1234yf and R32 and 1234ze are amongst those being evaluated. See table 1.

Some Potential R410A Replacement Candidates

REFRIGERANT	COMPONENTS	CLASSIFICATION	GWP
ARM - 70a	R32/R134a/R1234yf	A2L*	482
D2Y60	R32/R1234yf	A2L*	272
DR-5	R32/R1234yf	A2L*	490
HPR1D	R32/R744/R1234ze	A2L*	407
L41a	R32/R1234yf/R1234ze	A2L*	494
L41b	R32/R1234ze	A2L*	494
R32	R32	A2L	675
R32/R134a	R32/R134a	A2L*	713
R32/R152a	R32/R152a	A2L*	647
R744	R744	A1	1

** estimated safety group not yet assigned by Ashrae*
Source AHRI AREP study.

With the probability that there are likely to be blends that have not been formulated yet, there is plenty to think about over the next few years.

We certainly live in interesting times.