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Get to know what CO_2 can do

Manufacturers will usually highlight the environmental benefits of CO_2 as a refrigerant – but R744 has some unique properties that makes it an interesting option for HVACR contractors. While CO_2 is now a viable option for smaller applications you must have the appropriate training, as *Mervin Chumun*, Hawco's senior technical engineer, discovered.

It's a nine-hour round trip from the Hawco office in Surrey to EPTA George Barker in West Yorkshire, where EPTA offer a three-day City and Guilds qualification in the safe handling of CO_2.

For Mervin Chumun, the journey was well worthwhile. There is a growing number of Hawco customers showing an interest in CO_2 projects and Mr Chumun wanted to develop his technical understanding to better support them with their inquiries.

"It was important to me that it was a City and Guilds qualification", says Mr Chumun. "I wanted to know how to work with CO_2, not just be aware of the risks. The EPTA course was great because it was taken by a practising engineer who was talking to us as engineers. Everyone on the course had a F-Gas 2079 qualification already. And we were assessed not just on the theory but how to put it into practice."

CO2 works beautifully – so what's the catch?

Everyone knows that you can't beat R744 for its green credentials (with its GWP of one compared to an HFC like R452A with a GWP of 2141). But with some unique thermal properties, it is an interesting refrigerant from an engineering point of view.

"CO_2 is a very easy refrigerant to work with," says Mr Chumun. "It's non-corrosive, non-flammable and when it's working, it works beautifully. It also has excellent heat transfer, with a refrigeration capacity around five times greater than R404A."

This thermal efficiency means greater energy efficiency, smaller charge sizes and reduced pipe diameters.

At less than £4 a kilo, it is significantly cheaper. And because R744 is a single gas, rather than a blend, it can be used to top up a system to the right temperature and pressure without the need to reclaim, test and vacuum. In fact, there is no such thing as a CO_2 recovery cylinder or reclaim unit as the gas can be vented straight into the atmosphere.

"If CO_2 is such an attractive refrigerant, you think to yourself, what's the catch?" asks Mr Chumun. "Well, the catch is that as an engineer, you've got to understand how CO_2 is different to other refrigerants – and make sure you do your job by the book."

All about ambient temperature

The main thing to understand about CO_2 is its critical point, which is much lower than for standard HFC refrigerants. This means that R744 behaves differently under certain ambient conditions.

All refrigeration systems operate at a subcritical level - with liquid coming out of the condenser and into the evaporator – and most of the time a CO_2 system works in the same way. The difference takes place when

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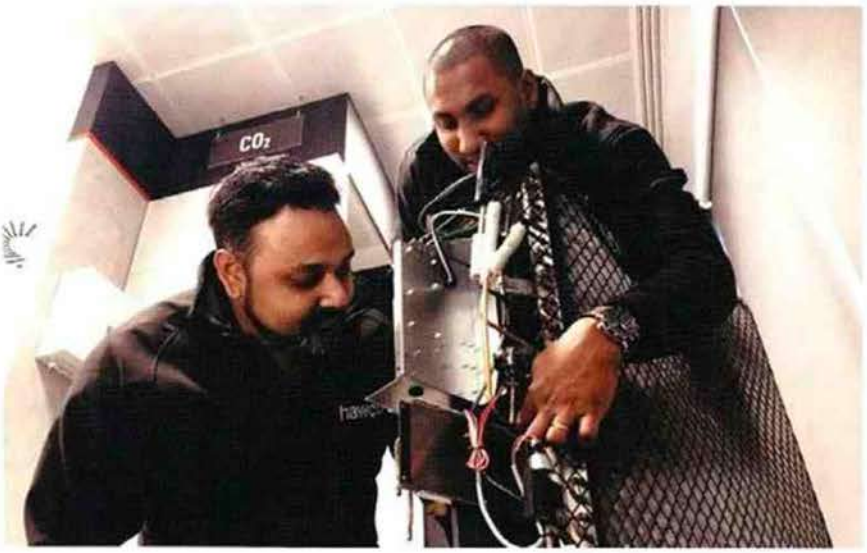


R744 climbs above its critical point of 31°C and it turns into a supercritical fluid – a strange combination of vapour and liquid. In this transcritical state, the refrigerant is no longer able to operate as a liquid.

"The first thing I learned on the course was that transcritical has nothing to do with evaporating temperature or what's going on inside the refrigerated cold room," explains Mr Chumun. "It's all to do with the ambient temperature outside. It's fairly straightforward.

"If the ambient temperature stays below say 23°C, the CO_2 system operates in a normal subcritical state, just like any other condensing unit. Above 23°C though, a secondary transcritical valve allows the unit to change from working like a traditional condensing unit into working as a gas cooler. This reduces the temperature (and pressure) of the refrigerant back below its critical point and maintains it as a useable subcritical liquid.

"In the UK, this means that in London and the South East where there are more warmer days each year, a CO_2 unit will operate more frequently in a transcritical mode than a unit further north."

Be confident; be safe

When it comes to working safely with CO_2, the recommendation is do things by the book, even for the simplest task. Mr Chumun is clear: "You have to do things in a set way; no shortcuts. If you follow a simple method statement for each procedure, the system will be safe, the site will be safe, everyone will be confident with what it is meant to do."

For example, unlike a standard HFC refrigeration system, liquid R744 should never be added into a new system - because at atmospheric pressure, CO_2 will immediately turn into solid dry ice. It is essential to add vapour to the system first and get the pressure well above 5.2 bar absolute before any liquid is added.

"One of the things I found seriously interesting is that if you create solid dry ice which blocks a pipe, the last thing you want to do is to try and warm it up and melt it," says Mr Chumun. "CO_2 has an incredibly high expansion rate, so even a small increase in temperature increases the pressure significantly. What I learnt is that you must never trap liquid in a CO_2 system. If there is ever a situation where dry ice is made, you need to turn off the liquid going in and introduce more vapour, not heat."

Engineers also need to be aware of the pressures associated with CO_2, which are typically higher than other types of refrigeration systems. However, according to Mr Chumun, this is just a number.

"When you consider that the high side of a typical R410A system reaches a pressure of 25 bar or so, engineers are already dealing with high pressures. You need to understand every refrigeration system, whatever the pressure, and treat it with respect."

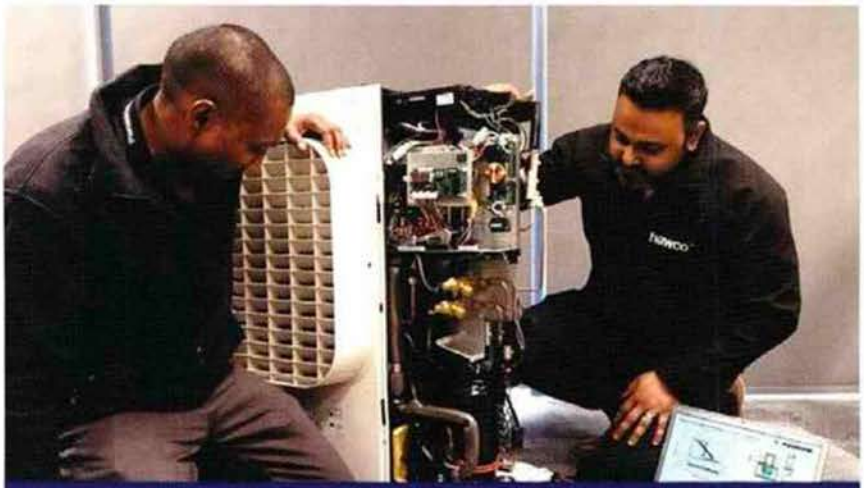
What CO_2 offers

In recent years, manufacturers, like Panasonic, have been improving CO_2 technology, equipment and components to a point where R744 is becoming accessible to more and more engineers. There is renewed interest in natural refrigerants for a broader range of large and small applications.

"There is a perception that CO_2 is a premium option that's only ever going to be for supermarkets, never for contractors," says Mr Chumun. "The improvements in technology are such that CO_2 is a viable option for standard applications, like small cold rooms or convenience stores."

Mr Chumun concludes: "CO_2 is a great refrigerant that's been around for well over a century. And unlike new low-GWP refrigerants, you're not trying to get to the next F-Gas deadline. CO_2 has no deadline. As long as you take responsibility and get properly trained, contractors can be confident in offering the benefits of CO_2 to their environmentally-conscious customers."

Hawco is proud sponsor of the ACR News Trainee of the Year award, which recognises the importance of engineers developing their skills at every stage of their career.



Mervin Chumun inspects a 2HP CO_2 unit with Panasonic technical specialist, Indy Tharnvithian. Visit www.hawco.co.uk/co2 for full product details.