

Moving towards a low GWP future

Reefer container owners are not yet at a crossroads, when it comes to decisions on refrigerants for new reefer machinery, but that point is drawing ever closer.

On a global level, the refrigerant industry is being driven to ultra-low global warming potential (GWP) products, and the 'writing is on the wall' for the main two reefer refrigerants today, HFC R134a and HFC R404A.

As should be well known by now, Carrier Transicold is the first reefer machinery manufacturer to introduce a reefer machine with CO₂ refrigerant, which is now commercially available as its NaturaLINE range.

Carrier is standing firm in its belief that, as a non-flammable substance with a GWP of 1, CO₂ is the best option for the industry. One of the biggest obstacles it has to overcome is that the CO₂ option is not a 'drop-in' replacement for R134a in Carrier's own machinery. The NaturaLINE system is a very different system, using a purpose-built, exclusive, multi-stage compressor and a custom designed variable speed drive, plus other unique features like the operating software.

Moving ahead

Willy Yeo, director of marketing, Global Container Refrigeration, Carrier Transicold, says some of the major shipping lines are now moving ahead with NaturaLINE. Earlier this year, Maersk Line took delivery of 100 of a planned 200 NaturaLINE refrigeration units for trial. At the time, Maersk Line said the NaturaLINE units were being installed on 40ft high-cube containers, which it plans initially to deploy on closed-loop routes between Europe and the Americas.

"Indicative of growing customer interest in the NaturaLINE unit, we also have units on order and in evaluation with other major shipping lines, including Hapag-Lloyd, and leasing companies," said Yeo. "As well, some of our intermodal container leasing customers in Europe are also introducing NaturaLINE units into their fleets, to offer customers more environmentally appealing alternatives that also respond to anticipated phase-downs of HFC refrigerants."

The latter group include Braun Container Trading of Germany and Unit45 of the Netherlands. Unit45 has included NaturaLINE in the 45ft "green" reefer container it unveiled at the biennial Transport Logistic trade fair in Munich this May.

Rotterdam-headquartered Unit45 is marketing its green reefer to customers seeking alternatives to synthetic refrigerants, and believes the timing for CO₂ is right. "The trend is toward more environmentally sustainable products, especially with the phase-down of traditional refrigerants," said Jan Koolen, general manager of Unit45. "Our customers, particularly those in stationary containers, but also shortsea carriers and logistics companies, are ready for green solutions that will present new business opportunities. We believe our new container featuring the NaturaLINE unit will appeal to them."

Complementary

In particular, Unit45 believes NaturaLINE will appeal to customers using CO₂ elsewhere in their business. "We think the NaturaLINE-refrigerated containers will be the perfect complement for supermarkets that already use CO₂-based refrigeration and now require additional refrigeration capacity," said Jan Nouwen, technical manager, Unit45. "For applications such as these, the NaturaLINE unit's low-sound output will be appreciated by our customers."

For Carrier, Yeo stressed that, with a GWP of 1, CO₂ (or R-744) is a long-term alternative to synthetic hydrofluorocarbon (HFC) refrigerants used in conventional container refrigeration systems. "This can help fleets reduce the potential environmental impact of their shipping operations," he said. "With its carbon-neutral GWP of 1, CO₂ is unaffected by phase downs of HFC refrigerants, such as the European Union's

As the reefer industry inches towards a low GWP future, machinery manufacturers are eyeing CO₂, propane and other alternative refrigerants

F-Gas Regulation. It takes customers directly to an end state, bypassing the need for intermediate refrigerant solutions with GWP's that are not close to that of CO₂."


Carrier is also focusing on the flammability advantage of CO₂, noting that "CO₂ is also a non-ozone-depleting gas that has an A1 safety rating by the American Society of Heating, Re-

frigerating and Air-Conditioning Engineers for low toxicity and no flame propagation. This is significant, as some alternatives being considered by the industry are flammable, which in our view is an unnecessary risk to introduce to a container vessel".

Interestingly, although it is not flammable, CO₂ was classified under Japan's High Pressure Safety Gas Act as a Group




Star Cool reefers from MCI factories in China and Chile are now delivered ready to use R513A

















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3 refrigerant, the most restrictive category, and the same as propane (R290). This was based on concerns about the required pressure in CO₂ systems, and safety issues this might create around piping and compressors.

For some years, the Japan Refrigeration and Air Conditioning Industry Association (JRAIA) has been lobbying to get CO₂ reclassified. After requiring tests and evaluations, the regulators agreed to reclassify CO₂ as a Group 1 refrigerant, the least restrictive category, and the same as inert HFC gases. The move is expected to increase the use of CO₂ in air conditioning and other applications.

The JRAIA welcomed the change, noting that CO₂ is now competing on a level playing field with HFCs.

The case for propane
Meanwhile, Maersk Container Industry (MCI) continues to push ahead with the development of propane as its next-generation refrigerant, and has made progress in the last year.

"The design and test phases

have been successfully completed and field tests planned," MCI noted. "The 'final test' has been performed at BAM (Bundesanstalt für Materialforschung und -prüfung) and evaluated by a certified body. In April 2017, MCI had field test reefers certified and approved for operation on vessels by DNV-GL," MCI told *World-Cargo News*.

For MCI, propane is preferred to CO₂ for its performance as a refrigerant, as well as on energy consumption criteria. "The performance and energy tests have been passed with excellent results, better or comparable than the R134a system. Thereby, the clear TEWI advantage has been reaffirmed," MCI noted. This refers to the total equivalent warming impact (TEWI) that MCI believes is more important than a low GWP number on its own.

TEWI considers the total energy use with average annual fleet operation profiles, leakage and efficiency in operation over the full 15-year minimum lifetime of a reefer container. As has been noted previously, the TEWI of R290 is 0.89, while for CO₂

it is 1.08, indicating that R290 is 21% more environmental friendly than CO₂.

With this in mind, MCI continues to follow the process for establishing an operating protocol for a propane reefer container. "The compliance process with ISO certification is progressing very well, and in regard to IMO approval, we are commencing the initial fulfilment of their defined requirements," the firm said.

"All in all, we have come far, and the product works really well, both for the users and the environment. Time to market is subject to compliance process and, of course, customer demand," MCI concluded.

Daikin - R32

As noted by *WorldCargo News* last year, Daikin has been evaluating refrigerant options including R1234yf, R513A/B and R32. It considers a blend of R32, which has a GWP of 675, and HFO gases to offer one of the best answers to the container refrigerant issue, following the development work the company has already carried out in the air-conditioning field.

R32 is a "mildly flammable" Class A2L refrigerant, and Daikin is conducting a risk assessment, in order to clarify the potential risks of using A2L refrigerants and to develop the necessary counter-measures.

Daikin believes that the risks can be mitigated. "Compared to other flammable refrigerants, A2L Class refrigerants are more difficult to ignite, with small propagation, because they have a higher low flammability limit (LFL) and a lower burning velocity and higher minimum ignition energy. Therefore, in Japan, a risk assessment has been done for usage on appliance ACs, which all have been switched in to R32 without any accidents," the company noted.

Lab testing, however, is only part of the work, as Daikin explained. "It is easy to conduct a combustion experiment, by using the worst scenario of A2L refrigerants. We can simulate a propagation of a fire in the vicinity of the leaked refrigerant of the container and evaluate. But the key focus point is to analyse the possibility of the actual field



Unit 45 believes customers that use CO₂ in other parts of their business will embrace Carrier's NaturalLINE

occurrence of these experiments in reefer operation.

"What's unique with containers," Daikin continued, "is that the machine itself moves around and is repaired worldwide." The biggest risk, therefore, is the absence of an established standard level for repair work, which Daikin notes can be said of any refrigerant. To address this issue, Daikin is developing a "platform" with built-in safety measures to prevent major accidents from occurring, regardless of how containers are repaired.

Get ready

As to when customer demand for ultra-low GWP reefer containers will start to emerge, access to and the cost of today's synthetic refrigerants are expected to be one

of the major drivers. The cost of refrigerant is actually only a very small factor in the cost of a new reefer, but suppliers point out that, over a large fleet of reefers, the cost is certainly not insignificant.

It is difficult to measure the extent to which prices for HFCs have affected the reefer market to date. MCI notes that refrigerant prices have, over the last months, "really started to increase to a higher degree", as have the awareness and focus of its customers on refrigerant prices.

MCI expects prices will increase further, and notes that "significant price increases of nearly 100% for R404A were already evident in the spring of 2017".

It continued: "In the summer,






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C sense for Seatrade

A new company, Rotterdam-based C sense, will be monitoring Seatrade's new fleet of reefer containers.

As noted previously, Seatrade has acquired around 6,400 new reefer containers, of which 2,400 were fitted with Carrier Transcold PrimeLINE machinery, while 4,000 were Star Cool integrated reefers from MCI. All of the containers were fitted with Emerson's RMM power-line remote monitoring modules. Data is transmitted from Seatrade vessels by VSAT satellites.

It has now emerged that C sense will monitor and control the reefers using a web-based platform that integrates with third-party monitoring devices and booking applications. The reefers will be monitored 24/7 from a central control centre, with operational data checked against parameters from booking systems, manifests and loading lists.

Seatrade states: "By establishing integrations with our booking systems, we are not only receiving reefer malfunctions. Issues like false temperature settings or not loaded or connected reefers are just as important."

C sense enables Seatrade to monitor containers from shore without vessel-based personnel needing to physically inspect the containers. If an issue requires onboard service, a message with instructions is sent to the vessel.

"In doing so, the crew has more time to focus on other tasks, and the risk of cargo damage will further decrease," noted C sense.

Monitoring is just the beginning. In Q4 this year, C sense is planning a "large upgrade" that will leverage data to analyse and predict when a reefer needs attention, enabling service to be scheduled more conveniently, further reducing costs.

Seatrade is planning to outfit a further six dedicated container vessels with smart technology in the future. "We believe in this technology and this is just a start. We need to keep investing in innovation to stay a premium reefer carrier," said Gerben van Zwieten, global manager container logistics at Seatrade.

Meanwhile, Several of Seatrade's new reefer boxes are currently stranded on the KEA TRADER, which is stuck on the Durand Reef off the coast of Nouméa. The six month-old vessel, with a capacity of 2,194 TEU, is chartered to Seatrade, and was grounded on 12 July, on its way from Papeete to Nouméa.

Owner Lomar Shipping has brought in a helicopter, and is sending a crane barge to help with container removal, which is being hampered by winter weather in the Southern Hemisphere. By late August, 55 containers had been successfully removed from the vessel and landed in Nouméa.

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