THE FUTURE OF TRANSCRITICAL CO_2 REFRIGERATION

KYSOR WARREN
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There are various drivers and barriers that are influencing the uptake of transcritical CO_2 systems in the refrigeration sector. Where do the opportunities really lie with these systems?

– By Conner Meadows, Systems Product Manager at Kysor Warren (part of the Epta Group)

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WHAT ADVANTAGES DO TRANSCRITICAL CO_2 REFRIGERATION SYSTEMS PROVIDE?

Transcritical CO_2 provides many advantages in terms of environmental sustainability, safety, and energy efficiency. CO_2 has a global warming potential (GWP) of 1 which means it is the baseline used to quantify the impact that a greenhouse gas has on global warming. Being that CO_2 is non-flammable and non-toxic, it is an ideal refrigerant to aid in the advancement of natural refrigerant solutions around the globe.

The thermodynamic characteristics of CO_2 also make it an efficient refrigerant in terms of capacity and as a result the line sizes are reduced one to two sizes compared to that of an HFC system, which reduces the cost for the store piping. Also, the cost of refrigerant grade CO_2 is relatively cheap at US$1-2/lb [EUR2-4/kg]. compared to R407A which is US$7-8/lb [EUR14-16/kg]. With new enhancements like Epta's Full Transcritical Efficiency (FTE), the efficiencies of transcritical CO_2 systems continue to increase, and in many cases, out-performs the current HFC systems.

WHAT ARE THE MAJOR CONSTRAINTS OR BARRIERS TO THE MARKET FOR TRANSCRITICAL CO_2 SYSTEMS?

The three barriers that we find most prevalent amongst customers are defined as reduced efficiency in warmer climates, increased capital investment, and serviceability/industry knowledge. The relatively low critical point of CO_2 introduces challenges to the efficiency levels in high ambient conditions. There have been many advancements in

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the technology aimed at helping mitigate this obstacle, which are showing positive results and improving the efficiency of transcritical CO_2 systems in hot climates. Another obstacle that is present in the U.S. market is the cost parity of the transcritical CO_2 system compared to an HFC system.

One influencing factor is that in the U.S. market the number of CO_2 systems is much lower than that of European countries where the cost of CO_2 systems is lower. The U.S. market also has certification requirements that drive up component pricing. As the adoption rate of transcritical CO_2 systems increases, component prices should decrease, thus reducing the cost parity. With the technology advancements also comes increased complexity in terms of serviceability, which must be managed with increased training opportunities and after sales support from the OEMs. Epta's innovative yet simplistic FTE enhancement mitigates the effect of these barriers by providing 10% energy savings in any climate region at a fraction of the cost of other seasonal efficiency enhancements available on the market. With the current technological advancements in combination with superior training and support the stage is set for future growth of transcritical CO_2 systems.

WHERE DO YOU THINK THE BIGGEST OPPORTUNITIES FOR TRANSCRITICAL CO_2 LIE?

The vast opportunities for transcritical CO_2 are in the commercial supermarkets, cold storage warehouses, convenience stores, and specialty markets such as ice rinks. With many retailers scaling back new brick and mortar stores and moving to online sales, self-pickup, and delivery options, the cold storage market and self-service grocery opportunities are predicted to be on the rise. Also, many retailers are scaling back the size of the stores, which also brings opportunities for smaller capacity transcritical CO_2 opportunities.

WHAT HAVE BEEN THE MOST INFLUENTIAL REGULATORY DEVELOPMENTS FOR TRANSCRITICAL CO_2?

There are many states taking the lead in implementing regulations introduced as part of the Environmental Protection Agency's (EPA) SNAP rules 20 and 21. For example, the California Air Resources Board (CARB) initial proposal included a GWP limit of 150 for commercial refrigeration systems containing more than 50lbs [22.7kg] of refrigerant, starting on January 1, 2022. Refrigerants such as isobutane (R600a), ammonia (R717), propane (R290), and CO_2 (R744) all have GWPs less than 150.

More recent proposals include goals of reducing retailers' weighted average GWP to 1,400, equating to a 55% reduction by 2030. Many other U.S. states including Washington, Vermont, New Jersey, Colorado, Oregon, and Hawaii have also announced that they too intend to adopt similar regulations. Also, there are some incentives to help offset higher upfront cost to end users for implementing systems utilizing natural refrigerants such as CO_2.

The North American Sustainable Refrigeration Council has launched an Aggregated Incentive Program (AIP) with the goal of accelerating and increasing the funding resources for natural refrigerant solutions. CO_2 meets all the criteria for a future proof refrigerant option, as it's non-flammable, non-toxic, and has a GWP of 1. Transcritical CO_2 systems will play a major role in the global effort to eliminate the use of high GWP refrigerants and the progression to more environmentally sustainable solutions.