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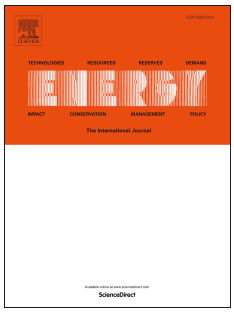

Crossing CO_2 equator with the aid of multi-ejector concept: A comprehensive energy and environmental comparative study

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Crossing CO_2 equator with the aid of multi-ejector concept: A comprehensive energy and environmental comparative study

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Abstract:

The ever-stricter regulations put into effect worldwide to significantly decrease the considerable carbon footprint of commercial refrigeration sector have forced the transition to eco-friendlier working fluids (e.g. CO_2, R290, R1234ze(E), R450A, R513A). However, the identification of the most suitable long-term refrigerant is still today's major challenge for supermarkets located in high ambient temperature countries, especially as their air conditioning (AC) need is considered.

The results of this theoretical study revealed that multi-ejector "CO_2 only" systems can outperform R404A-, R290-, R1234ze(E)-, R134a-, R450A- and R513A-based solutions in an average-size supermarket located in various cities below the so-called "CO_2 equator". In fact, energy savings as well as reductions in environmental impact respectively up to 26.9% and 90.9% were estimated over conventional hydrofluorocarbon (HFC)-based solutions for the scenario including the AC demand. Also, the solution using multi-ejector block (in non-optimized operating conditions) enabled reducing the power input up to 50.3% over HFC-based units at outdoor temperatures from -10 ℃ to 5 ℃. Finally, the study demonstrated that transcritical CO_2 multi-ejector systems integrated with the AC unit allow potentially pushing the "CO_2 equator" further South than Northern Africa.

Keywords:

Air conditioning; Supermarket; System integration; TEWI; Transcritical CO_2 refrigeration system; Warm climates.