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Vapor-injected reciprocating compressor for two-stage domestic refrigerator/freezers

Vapor-injected reciprocating compressor enables dual evap pressures, cutting fridge energy up to ~29.7% and compressor work ~10.7%.

Researchers at Purdue University have developed a vapor-injected reciprocating compressor for use in two-stage domestic refrigerator/freezer systems. This innovative compressor uses a specialized control valve that allows it to establish two distinct evaporation pressures in a refrigeration cycle. Through a combination of numerical modeling and prototype testing, it has been shown to reduce specific work by 10.7% compared to a baseline compressor. When implemented within a refrigerator along with optimized control, a 29.7% reduction in energy consumption was determined compared to a state-of-the-art system.

Technology Validation:

The prototype was tested on a hot-gas-bypass test stand with R600a to confirm its ability to respond to different injection pressures and injection timing. Experimental results also confirmed the compressor's ability to separate suction and injection flow. The two-stage domestic refrigerator/freezer system was demonstrated to reduce energy consumption compared to the state-of-the-art bypass circuit cycle system by up to 29.7%. This technology was further shown to improve the reciprocating compressor's performance by reducing its specific work up to 10.7%, which means it can compress more refrigerant per unit amount of power.

Advantages:

-Improved energy efficiency and system controllability

-Independently adjustable injection mass flow rate

-Adjustable evaporator cooling capacity

-Optimized system performance

Applications:

Technology ID
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Category
Infrastructure & Construction/HVAC & Building Energy Efficiency
Infrastructure & Construction/Demand-Responsive Heating & Cooling Systems

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-For use in two-stage domestic refrigerator/freezer systems

Publications:

Liang, Changkuan; Benadof, Daniel A.; Liu, Haotian; Groll, Eckhard A.; Ziviani, Davide; and Braun, James E., "Experimental Investigation of a Vapor-injected Reciprocating Compressor for the Use In a Multievaporator Domestic Refrigerator/Freezer" (2024). International Compressor Engineering Conference. Paper 2858. https://docs.lib.purdue.edu/icec/2858

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Intellectual Property:

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