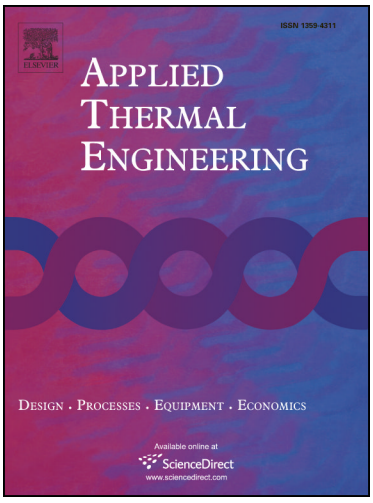

Energy and exergy analysis of a household refrigerator using a ternary hydrocarbon mixture in tropical environment- Effects of refrigerant charge and capillary length

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Energy and exergy analysis of a household refrigerator using a ternary hydrocarbon mixture in tropical environment- Effects of refrigerant charge and capillary length

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Highlights

- The refrigerator uses hydrocarbon mixture of R290:R600:R600a of 60:26.6:13.4%.
- Twenty five combinations of refrigerant charge and capillary tube length are examined.
- The best charge and capillary tube combination is identified to be 70g and 4m.
- Optimized refrigerator achieves better energy and exergy characteristics than R134a.
- Constant speed compressor and capillary tube are the main source of exergy destruction.

ABSTRACT

This paper examines the energy quality of a household refrigerator working with a ternary hydrocarbon mixture (THM) of 60% propane, 26.6% isobutane, and 13.4% n-butane. Exergy and energy analyses are based on experimental continuous tests of a single evaporator refrigerator for different charges (30-70g) and capillary tube lengths (4-6m). The tests are conducted in a climatic chamber at 43°C and 50% relative humidity. Analysis of experimental data indicated that both THM charge and capillary tube length have substantial effects on the energy and exergy characteristics of refrigerators. The results indicated that exergy efficiency increases as subcooling degree or refrigerant charge increases and as capillary tube length, pressure ratio, and superheating degree decrease. Also, constant speed compressor and capillary tube are responsible for over 88% of refrigerator exergy loss. Refrigerator, using 70g THM charge and 4m capillary tube, affords the largest COP, exergy efficiency and cooling capacity and the lowest pressure ratio. Also, it secures cycle stabilization as it achieves the largest subcooling degree and lowest superheating degree. This household refrigerator achieves better characteristics than those obtained with R134a as it achieves larger COP, exergy efficiency, and cooling capacity by 14%, 3.43%, and 20%, respectively.

keywords: