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Experimental performance of a safe charge of LPG refrigerant enhanced with varying concentrations of TiO_2 nano-lubricant in a domestic refrigerator

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Abstract

This paper presents an experimental investigation of energy consumption and heat transfer performance characteristics of a safe mass–charge of liquefied petroleum gas refrigerant, enhanced with varying concentrations of TiO_2 nano-lubricants (i.e. 0.2 gL^{-1}, 0.4 gL^{-1} and 0.6 gL^{-1}) in a domestic refrigerator. Performance parameters investigated at steady state included: instantaneous and mean power consumption, cooling capacity, coefficient of performance

(COP), discharge thermal conductivity and discharge temperature. Analysis was based on temperature and pressure readings obtained from appropriate gauges attached to the test rig. Refrigerant properties were obtained from Ref-Prop NIST 9.0 software. Findings showed that reductions in mean power consumption were observed to be 14, 9 and 8% at 0.2 gL^{-1}, 0.4 gL^{-1} and 0.6 gL^{-1} nano-lubricants respectively; the highest mean power consumption was obtained using pure compressor mineral oil while the lowest was with 0.2 gL^{-1} TiO_2 nano-lubricant. The estimated mean cooling capacities for the various compressor lubricants were found to be higher with 0.4 gL^{-1} and 0.6 gL^{-1} nano-lubricants than pure compressor lubricant, and lower with 0.2 gL^{-1} nano-lubricant when compared with pure mineral oil lubricant. All the TiO_2-based nano-lubricants were of higher instantaneous and mean COP values than the pure lubricant. All nano-lubricant mixtures were also found to give lower discharge temperatures than the pure lubricant. In conclusion, selected TiO_2-based nano-lubricants improved the efficiency of the domestic refrigeration system considerably.

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