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ENERGY PERFORMANCE OF ECO-FRIENDLY R432A AND R433A AS ALTERNATIVE TO R22 IN SUB-COOLING HEAT EXCHANGER REFRIGERATION SYSTEM

[1]Bolaji B.O. and [2]Huan Z.
[1,2] Department of Mechanical Engineering, Faculty of Engineering and Built Environment, Tshwane University of Technology, Private Bag X680, Pretoria, South Africa
E-mail: BolajiBO@tut.ac.za

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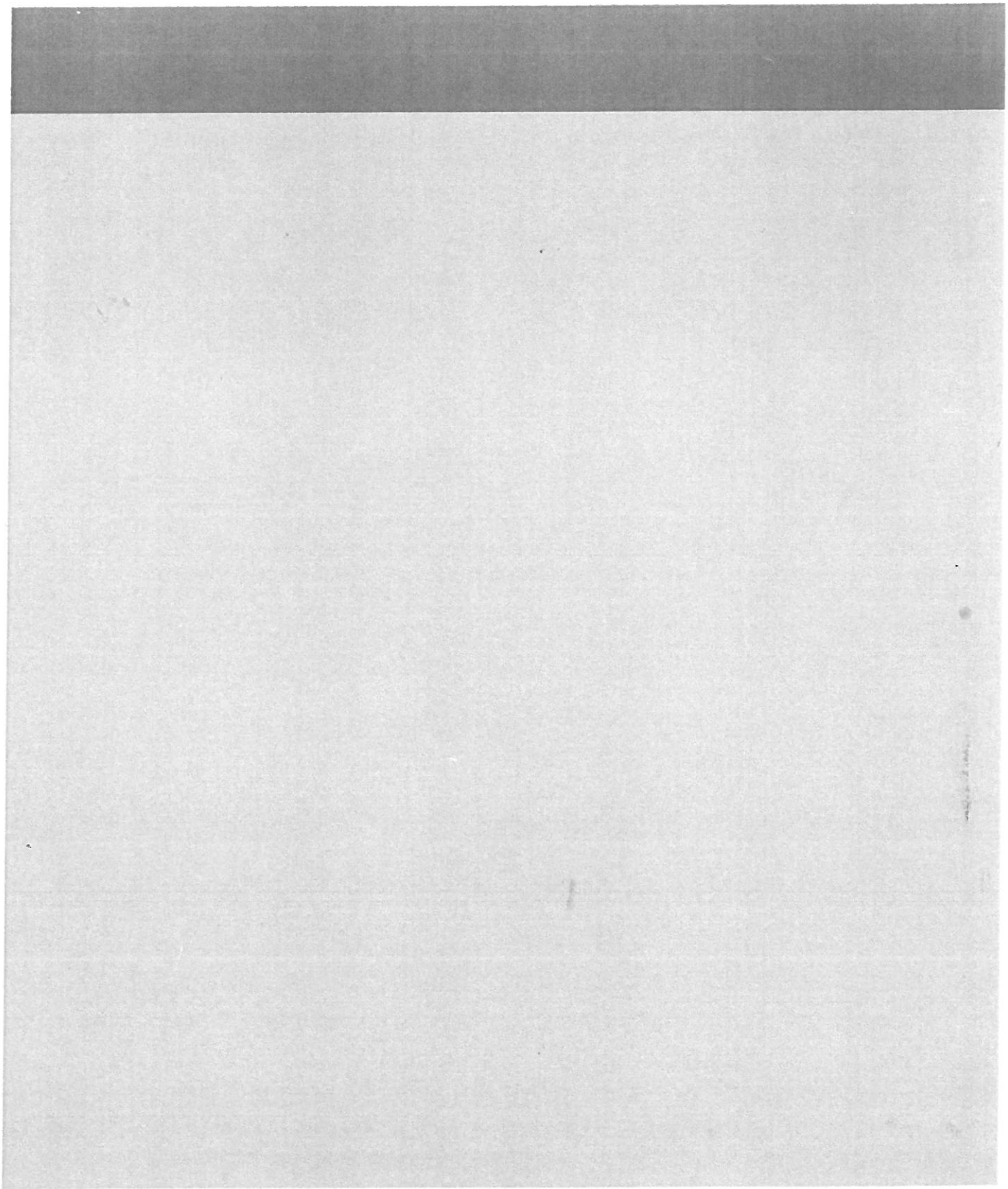
Abstract
This study investigates the energy performance of eco-friendly R432A and R433A as alternatives to R22 in a vapour compression refrigeration system with sub-cooling heat exchanger. The effects of sub-cooling on the various refrigeration cycle performance parameters were evaluated. The results obtained showed that the saturated vapour pressure and temperature characteristic profiles for R432A and R433A are similar to those of R22 without any significant deviation between the curves. This indicates that R432A and R433A exhibited similar properties and could be used as substitute for R22. The two alternative refrigerants exhibited higher coefficient of performance (COP) and higher relative capacity index (RCI) than R22. The average COPs obtained for R432A and R433A were 12.9 and 16.7% higher than that of R22. They also exhibited lower power per ton of refrigeration (PPTR) than that of R22, but R433A emerged as the most energy efficient refrigerant among all the investigated refrigerants with average PPTR of 13.3% lower than that of R22. Generally, incorporation of sub-cooling heat exchanger in the system, greatly improved the performance of the system; it increases the COP, reduces the compressor energy input and the specific power consumption of the system. The two alternative refrigerants, consistently exhibited better performance than R22 in sub-cooling heat exchanger refrigeration system. R433A performed better than both R22 and R432A in that the highest RCI, COP, reduction in energy input and lowest PPTR were obtained using R433A in the system.

INTRODUCTION

The continuous depletion of the ozone layer, which shields the earth's surface from the biologically damaging ultraviolet sunlight called UV-B radiation, has resulted in a series of international treaties demanding a gradual phase out of chlorofluorocarbons (CFC) and hydro-chlorofluorocarbons (HCFC) refrigerants. The CFCs have been phased out in developed countries since 1996, and 2010 in developing countries [1]. Initial alternative to CFCs included some HCFCs, but they will also be phased out internationally by year 2020 and 2030 in developed and developing nations respectively [2].

Since R22 came into common use as a refrigerant in 1936, it has been applied in systems ranging from smallest window air-conditioners to the largest chillers and heat pumps because of its inherent efficiency and high refrigeration capacity and it has the largest sales volume among all refrigerants. Individual equipment using this versatile refrigerant ranges from 2 kW to 33 MW in cooling capacity. No other refrigerant has achieved such a wide range of applications [3]. However, R22 is one of a class of chemicals, HCFCs, being phased out due to the environmental hazard of ozone depletion [4].

[1] Corresponding author; Alternative address: Department of Mechanical Engineering, Federal University of Agriculture, PMB. 2240, Abeokuta, Nigeria.



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