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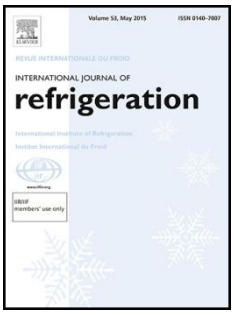

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LOW-GWP REFRIGERANTS FOR MEDIUM AND HIGH-PRESSURE APPLICATIONS*

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Highlights

1. An extensive database search revealed a small number of low-GWP refrigerants.
2. Single-component low-GWP options for replacing R410A and R404A are very limited.
3. Single-component alternatives to R410A and R404A are at least mildly flammable.
4. The probability of finding new well-performing high-pressure fluids is minimal.

ABSTRACT

The merits of an alternative refrigerant are established based on many attributes including environmental acceptance, chemical stability in the refrigeration system, low toxicity, flammability, efficiency and volumetric capacity. In an earlier work, these criteria were used to screen a comprehensive database to search for refrigerants with low global warming potentials (GWP). The present paper summarizes the screening process and presents the performance of the 'best' replacement fluids for small and medium-sized air-conditioning, heating, and refrigeration applications. In addition to considering cycle calculations based only on thermodynamic properties, a simulation model that included transport properties and optimized heat exchangers was used to assess the performance potentials of the candidate fluids. The need for this more detailed modeling approach is demonstrated for systems relying on forced-convection evaporation and condensation. The study shows that the low-GWP refrigerant options are very limited, particularly for fluids with volumetric capacities similar to those of R 410A or R-404A. The identified fluids with good COP and low toxicity are at least mildly flammable. Refrigerant blends can be used to increase flexibility in choosing tradeoffs between COP, volumetric capacity, flammability, and GWP. The probability of finding 'ideal', better-performing low-GWP fluids is minimal.

Keywords: Air Conditioning, COP, Global Warming Potential, Refrigerants, Volumetric Capacity

1. INTRODUCTION

As anticipated for some time, an amendment to the Montreal Protocol adopted in October 2016 requires a significant reduction of the weighted value of global warming potential (GWP) of fluids used in air-conditioning and refrigerant equipment (UNEP, 2016). Consequently, hydrofluorocarbon (HFC) refrigerants having a high GWP will be eliminated or their use will be significantly reduced. Hence, new replacement fluids with a low GWP must be found. This paper presents results of our multiyear study, in which we searched for low-GWP replacement refrigerants for small and medium-sized air-conditioning (AC), heat pumping, and refrigeration equipment. Such systems are comprised of a positive-displacement compressor,

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