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Chapter 24

Theoretical and experimental evaluation of LPG as refrigerant for domestic refrigerators and freezers

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ABSTRACT

The increasing concern about global warming and depletion of the ozone layer has caused renewed interest in natural refrigerants for replacing synthetic refrigerants in household refrigeration and car air-conditioning applications. This study investigates the use of LPG, which is commonly available as cooking gas, as a replacement refrigerant for domestic refrigerators and freezers. A computer model, which evaluates the performance of hydrocarbon mixtures (propane and butane) as refrigerants, is used in this study to compare LPG with R134a. For given evaporator and condenser temperatures, the model computes the refrigeration effect, refrigerant mass and volume flow rates, the compressor power input, COP, and compressor discharge temperature. The comparison is made on the basis of 1.0 KW of refrigeration capacity at different values of the evaporator temperature. The range considered for the evaporator temperature is typical to that usually met in domestic refrigerators and freezers. The paper also reports the results of a test comparing the performance of LPG with that of R134a on an educational test rig.

Keywords: Natural Refrigerants, Hydrocarbons, LPG, Propane-Butane Mixtures

INTRODUCTION

Before the 1930's, only natural substances such as ammonia (NH3), carbon-dioxide (CO2), and hydrocarbons, were used as refrigerants. However, the hazardous nature of ammonia and hydrocarbons, which are toxic and/or flammable, and the technical difficulties associated with CO2, has lead to the development and widespread use of synthetic chlorofluorocarbons (CFCs) and hydrochloro-fluorocarbons (HCFCs). But the extensive use of these man-made substances has contributed to two of the serious environmental problems we face today, which are global warming and the ozone-layer depletion[1]. Production of the main CFCs, such as R11 and R12, was banned after the Montreal Protocol of 1989. Subsequently, a third generation of synthetic refrigerants was produced from hydrofluorocarbons (HFCs). Although HFC refrigerants, such as R134a, do not cause ozone depletion, they still have high global warming potentials (GWP)[2]. With the public concern