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Selection of the best refrigerant for replacing R134a in automobile air conditioning system using different MCDM methods: A comparative study

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ABSTRACT

This article describes in detail how optimizing performance studies were measured on the selection of low global warming potential (GWP) refrigerants for automobile air conditioning to obey the environmental protocols with the multi-criteria decision-making (MCDM) tools. Among 14 alternatives, three different types of MCDM tools are used in this study, i.e., the technique for order of preference by similarity to ideal solution (TOPSIS) approach, evaluation based on distance from average solution (EDAS), and multi-objective optimization based on ratio analysis (MOORA) for time consumption. For the data processing, the thermodynamic characteristics, environmental friendliness, and economic circumstances are optimized with the multiple response attributes, including the latent heat of vaporization, thermal conductivity, vapor pressure, saturated fluid density, specific heat capacity, dynamic viscosity, GWP, ozone depletion potential, and cost per pound. From MCDM techniques, the grade values and weights assigned by decision-makers are standardized into a comparable measure. Among the 14 refrigerants, R430A has been applied foremost in EDAS, TOPSIS, and MOORA methods with the highest closeness coefficient values of 0.786, 0.701, and 0.064, respectively. R-744 was found to be the worst refrigerant by both EDAS and TOPSIS methods, while R1233zd (E) was found to be the worst refrigerant by the MOORA method.

1. Introduction

The anxiety over the carbon dioxide emission due to the use of the high global warming refrigerant R134a in the automobile air conditioning (AAC) units frames many environmental protocols to limit/ban its usage [1,2]. According to the standards developed in the European Union, the maximum permissible global warming potential (GWP) is 150 [3]. Along with this, some other essential properties, viz. thermodynamic properties, flammability, toxicity, and performance specifications, also have a major role in the new

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