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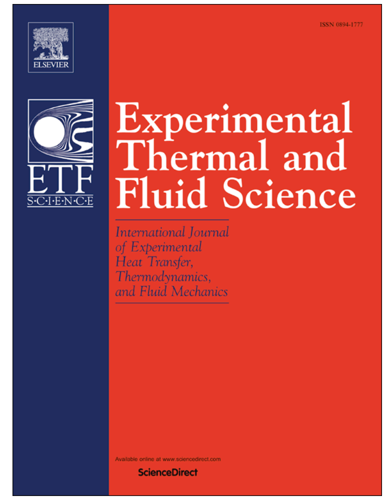

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Energetic and Exergetic performance analysis of the vapor compression refrigeration system using adaptive neuro-fuzzy inference system approach

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According to Kyoto protocol R134a must be phased out soon due to its high global warming potential of 1430. In this work, an experimental investigation has made with R134a and LPG refrigerant mixture (composed of R134a and LPG in the ratio of 28:72 by weight) as an alternative to R134a in a vapor compression refrigeration system. Performance tests performed under different evaporator and condenser temperatures with controlled ambient conditions. The results showed that the R134a and LPG refrigerant mixture has higher values of coefficient of performance and exergy efficiency as compared to R134a by about 10.57–15.28 % and 6.60-11.40 %, respectively. The applicability of adaptive neuro-fuzzy inference system (ANFIS) to predict COP, Total Exergy destruction and Exergy efficiency of R134a/LPG system also investigated. For this aim, some of the experimental data utilized for training, an ANFIS model for the system developed. The ANFIS predictions agreed well with the experimental results with an absolute fraction of variance (R^2) in the range of 0.994-0.998, a root mean square error (RMSE) in the range of 0.0018-0.1907 and mean absolute percentage error (MAPE) in the range of 0.103-0.897 %. The results suggest that the ANFIS approach can be used successfully for predicting the performance of vapor compression refrigeration systems.

Keywords: R134a/LPG, Exergy Efficiency, Total Exergy Destruction, COP.

Nomenclature

		Greek Letters	
e	Specific Exergy , $kJkg^{-1}$	ξ	Mass flow rate, kg s^{-1}
S	Entropy, $kJkg^{-1}K^{-1}$	μ	Dynamic viscosity, Pa-s
E_{eff}	Exergy Efficiency (%)	ρ	Density , kgm^{-3}
T	Temperature K	**Subscripts**	
E_{dest}	Total exergy destruction, kW	evap	Evaporator
COP	Coefficient of performance	Cap	Capillary
ODP	Ozone depletion potential	Comp	Compressor
P	Pressure, Bar	Cond	Condenser
h	Enthalpy, kJ kg^{-1}	in	Inlet
W	Compressor power kW	Out	Outlet
Q	Refrigeration capacity, kW	b	boundary
M_R	Refrigerant charge, g	o	Dead state
d	Diameter of capillary tube, mm	f	fluid
ΔT_{sub}	Inlet Subcooling, K		
L	Capillary tube length,m		
D	Coil Diameter, mm		
LPG	Liquefied petroleum gas		
E	Exergy Destruction, kW		

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1. Introduction

The analysis of energy and exergy is essential for the efficient use of energy resources for a variety of systems. As a result, ever growing development has witnessed towards these analyses within the last two decades. Traditional methods of energy analysis based on the First Law of Thermodynamics. This approach does not take into account the changes in the quality of the energy during a process since it does not take into account the properties of the environment in the system and does not characterize the irreversibility of the processes within the system. It, therefore, makes traditional thermodynamic analysis methods rather