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Experimental evaluation Mechanical performance of the compressor with mixed refrigerants R-290 and R-600a

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Abstract

Mixed refrigerant systems are reported to be thermally efficient. However, the mechanical input required by the compressor is not investigated in the literature. Hence, in the present work, two refrigerants are chosen (R-290 and R-600a) to evaluate the mechanical performance of compressor of domestic refrigerators. The refrigeration cycle consists of four major processes. The isentropic compression in the compressor, isobaric heat rejection in the condenser, isenthalpic reduction in pressure and isobaric heat addition in the evaporator. The present work aims at investigation of mechanical performance of compressor with mixed refrigerants (R-290 and R-600a). The boiling point of the each of the refrigerant is different and hence the specific volume occupied by each is different. This in turn affects the work input required. Hence, the present work is aimed at evaluating the compressor performance with mixed refrigerants. The temperature distribution during the cycle operation process is estimated. This turn enables the effective design of the compressors for domestic refrigeration systems for effective operation.

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Keywords: Mixed Refrigirents; VCRS;Data Aquitisation system;Compressor;R290/R600a;

1. Introduction;

Refrigeration and Air conditioning supplies are broadly and imperatively utilized as a part of numerous fields. Both Choloro Flouro Carons (CFCs) and Hydro-Chloro Flouro Carbons (HCFCs) were regularly utilized as the refrigerant as a part of the most recent couple of decades. Shockingly, these sorts of refrigerant truly drain the ozone layer and add to the nursery impact.

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Nomenclature

COP Coefficient of performance	P_1 Suction Pressure (bars)
CFC Chlorofluorocarbons	P_2 Discharge Pressure (bars)
HC Hydrocarbons	P_3 Condensation Pressure (bars)
HFC Hydrofluorocarbons	P_4 Evaporator Pressure (bars)
h_{1ef} Enthalpy of saturated vapour at the exit of evaporator (kJ/kg)	T_1 Suction Temperature (^oC)
h_{4ef} Enthalpy of saturated liquid at the exit of condenser (kJ/kg)	T_2 Discharge Temperature (^oC)
m_r Mass flow rate of the refrigerant (kg/sec)	T_3 Condensation Temperature (^oC)
M_1 Molecular weight of R290 (g/mol)	T_4 Evaporator Temperature (^oC)
M_2 Molecular weight of R600a (g/mol)	w_c Isentropic work done (kJ/kg)
Q_e Refrigeration capacity, kW	W_c Power Consumption (kW)
R290 Propane	
R600a Isobutane	

The aim is to investigate the mechanical performance of compressor with mixed refrigerants (R-290 and R-600a) [1]. The experiment works on the bases of thermal transfer of heat in vapour compression refrigeration system. This results can be used for future research works and can be used in the compressor for the maximum refrigeration effect. This results in optimize the R290/R600a mixture as usable volumetric concentration in domestic refrigerating system as refrigerant. A reasonable refrigerant not just needs to give worthy natural properties, yet should likewise meet the accompanying prerequisites which are critical for its utilization 1. No combustibility; 2. Low danger; 3. High compound and warm dependability; 4. Reasonable physical and thermodynamic properties; 5. Similarity with materials; 6. Miscibility with other refrigerant. Most imperative as the primary choice standard is the thermodynamic properties, which choose whether a substance is appropriate as a refrigerant in a specific temperature extend or not [2]. Be that as it may, the refrigerant most usually considered as the future substitute for CFC12 in household hardware was HFC 134a. Numerous computations taking into account straightforward Rankine cycle models, in any case, have presumed that HFC134a is less vitality productive than CFC123s. These cases were affirmed by trial results which demonstrated efficiencies for HFC134a which were 4-10% less than those for CFC12 [3]. Test execution attributes of household fridges working with propane/iso-butane blend were assessed by numerous specialists reported that the propane/ iso-butane blend at half mass division of propane yields higher COP, lower charge and lower compressor shell temperature when contrasted with R12.They affirmed that vitality investment funds of up to 6% were accomplished with a mix of 70% propane and 30% n-butane contrasted with R12This expressed that R134a spillage and administration emanations yield 15% expansion in Total Equivalent Warming Impact (TEWI) [4]. The investigations have demonstrated that, even without outline changes or framework streamlining, a cooler in which propane has been substituted for R12 is equipped for comparative execution with a lower charge. The blast dangers are little and the flame dangers are comparable, yet huge in terms of smoke and oil blazing. Propane introduces an appealing other option to current CFCs in little frameworks, for example, the residential cooler, given right specialized application for operational and wellbeing elements. [5]. In this experiment, we intend to run the refrigeration rig in our laboratory using blends of refrigerants, which are R600A and R290 at different proportions. A perfect vapor-pressure refrigeration framework is utilized for the execution investigation of option new refrigerant blends as substitutes for CFC12, HFC134a, and CFC22. Considering the examination of execution coefficients (COP) and weight proportions of the tried refrigerants furthermore the primary ecological effects of ozone layer consumption and worldwide warming, refrigerant mixes of HC290/HC600a (40/60 by wt.%) furthermore, HC290/HC1270 (20/80 by wt.%) are observed to be the most reasonable choices among refrigerants tried for R12 and R22 separately [6]. A minimized VCC model was composed and created. Broad parametric studies were conveyed out to better comprehend framework attributes under changing working conditions. Moving limit models were created for recuperator and condenser to discover the impact of changing the working condition on this warmth exchanger's execution. The recuperator model could foresee the sum of super-warmth and sub-cooled degrees added to the refrigerant at various working focuses. The model is combined with other part models and