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RESEARCH ARTICLE

STATE OF THE ART REVIEW ON THE DIFFERENT TYPES OF FREON AND THEIR EFFECTS

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Abstract

Freon is viewed as a vital component in the cooling process. Nevertheless, it poses significant risks to human health and plays an indirect role in environmental degradation. The expanding hole in the ozone layer has severe repercussions for living organisms today. Research indicates that refrigerants commonly utilized in air conditioning significantly contribute to the depletion of the ozone layer, potentially rendering habitats uninhabitable due to its deterioration. Moreover, Freon itself presents direct threats through its adverse effects on human health; inhaling this gas can lead to serious respiratory issues and disrupt overall bodily functions. Additionally, it may inflict damage at the genetic level and weaken the immune system due to harmful cosmic radiation, increasing susceptibility to various illnesses. Therefore, it's crucial to implement prevention strategies and establish first aid procedures when exposure occurs. A comparison will also be made regarding refrigerants employed in air conditioning systems.

Introduction:-

Natural substances like carbon dioxide, air, water, and ammonia were utilized as refrigerants in cooling systems that began to emerge in the latter part of the 19th century. In the subsequent century, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) took over some of these substances and were extensively employed. Unfortunately, the release of these chemicals into the atmosphere has led to various environmental issues, including atmospheric damage and the greenhouse effect. The ozone layer—crucial for shielding life on Earth from harmful solar radiation—is particularly affected as chlorine atoms escape from refrigerant compounds and attack delicate ozone molecules. The degradation of this protective layer has become a global concern, prompting countries to collaborate on solutions. The Montreal Protocol was signed by 43 nations in 1987 to progressively limit the production and use of CFC-based refrigerants such as R12.

Beyond those nations that ratified this agreement, other countries have implemented new regulations governing the importation, exportation, and manufacture of these harmful refrigerants. Medical experts have indicated an uptick in certain clinical diseases correlated with enlarging ozone holes. Research highlighting this critical issue for both human health and environmental integrity revealed that CFC-type refrigerants possess considerable potential for degrading the ozone layer.

To counteract these damaging agents, many alternative refrigerants have been developed while ongoing research aims at creating even more options. Present-day replacements for hydrofluorocarbons (HFCs) include R134a, R404A, R407A, R410A, R22—as well as hydrocarbons like propane and butane—and ammonia is also considered viable. With proper safety measures in place during car air conditioning applications; propane can be used with

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manageable risk levels. Notably, tens of thousands of vehicle air conditioning units across Australia and the USA have been "unofficially" converted to operate using propane by private individuals.

The Comparison Of The Thermodynamic Statistics Of Cooling Liquids

When designing air conditioning systems or cooling mechanisms — it is advisable to choose refrigerants that do not harm the ozone or contribute to global warming over others possessing similar physical properties but causing adverse effects.

Table 1:- Refrigerants of thermodynamics property.

REFRIGERANTS	MOLAR MASS (KG/KMOL)	SATURATED TEMPERATURE(°C)	T_C(°C)	P_C (BAR)	TLV (PPM)	LFL (%)	DELTA h_{comb} (MJ/Kg)	ODP	GWP (100 YEARS)	ATMOSPHERIC LIFETIMES (YEARS)
R600a	58,112	-11,670	134,67	36,4	800	1,8	49,4	0	~20	-
R134a	102,03	-26,074	101,06	40,593	1000	0	4,2	0	1300	14,6
R290	44,096	-42,090	96,675	42,471	2500	2,3	50,3	0	~20	-
R1270	42,080	-47,690	92,420	46,646	375	2	-	0	2	-
R32	52,024	-51,651	78,105	57,820	1000	13,3	9,4	0	650	5,6
R22	86,468	-40,810	96,145	49,900	1000	0	2,2	0,04	1500	12,1
R152a	66,051	-24,023	113,26	45,168	1000	3,1	17,4	0	140	1,5

Theoretical Analysis

This research focuses on a compressed vapor cooling cycle operating at an evaporation temperature of -30 °C and a condensation temperature of 40 °C, specifically designed for frost-free refrigerators. The properties of saturated and boiling steam for the refrigerants R22, R134a, R32, R152a, R290, R1270, and R600a have been obtained using Ref prop 7.0 software for analysis.

The following figures illustrate how the mass flow rate of various refrigerants changes with varying evaporation temperatures when maintaining a cooling capacity of 2.2 kW. It is observed that the mass flow rate decreases linearly as the evaporation temperature increases across all refrigerants examined. Within the -40 °C to -10 °C temperature range, R134a exhibits the highest mass flow rate while R1270 demonstrates the lowest. A reduced mass flow rate within this system contributes positively by lowering operational costs.

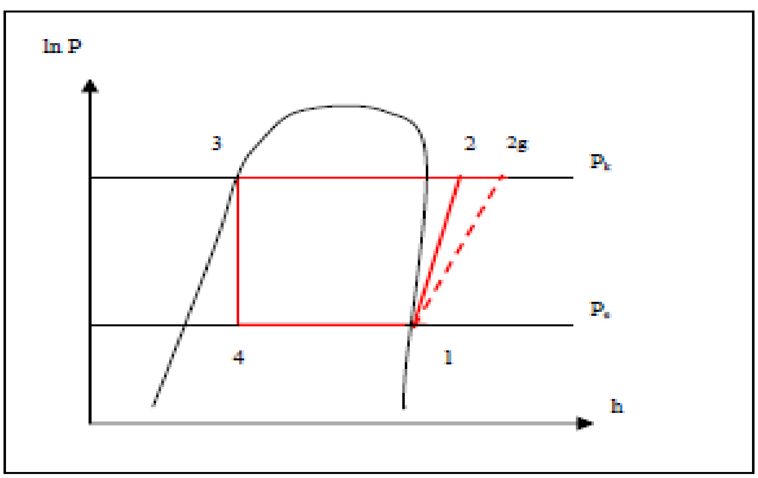

Figure 1:- lnP-h diagram of ideal vapor compression cycle.

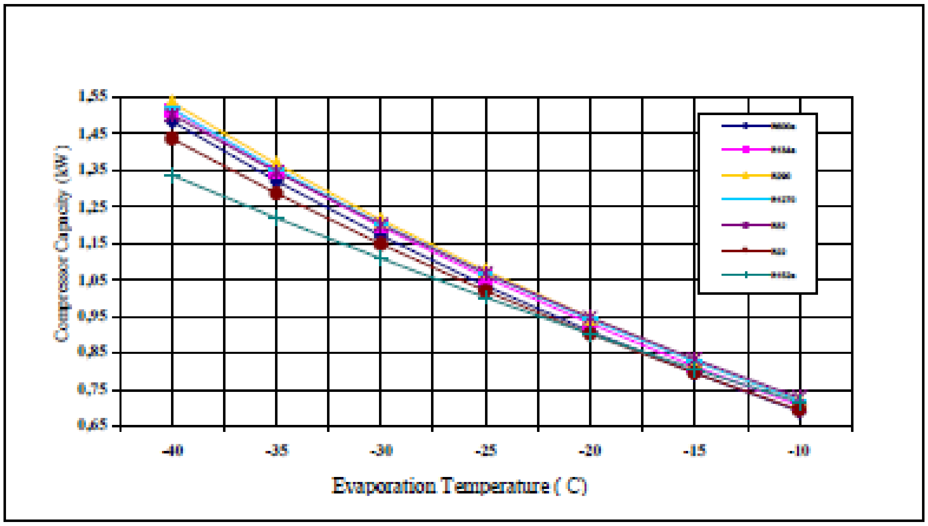

Figure 2:- Effect of evaporation temperature changes of refrigerants on compressor capacity.

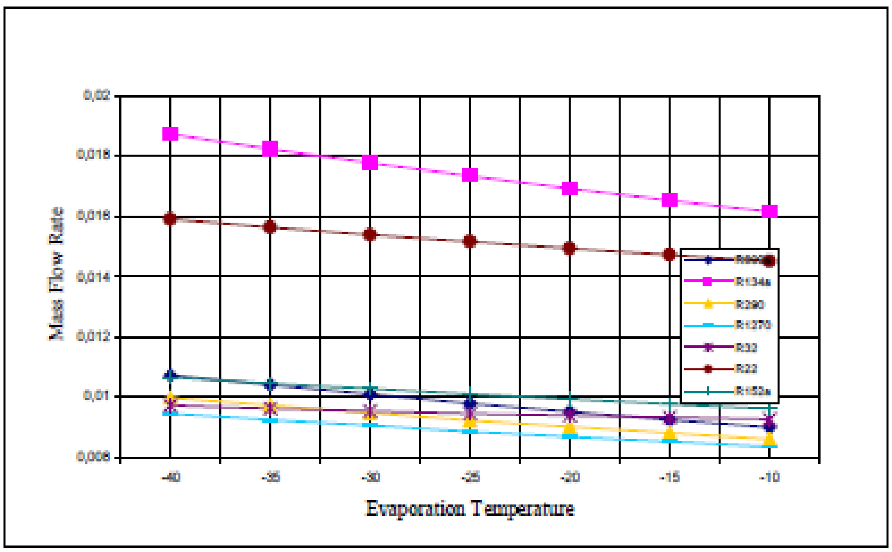

Figure 3:- The mass flow rate changes of refrigerants with the changing evaporationtemperatures, for 2.2 kW's of cooling capacity.

Table 2:- Refrigerants enthalpy value.

Refrigerants / Enthalpy	R600a	R134a	R290	R1270	R32	R22	R152a
h_1 (kj/kg)	515,21	380,32	540,22	548,17	506,27	392,69	485,55
h_2 (kj/kg)	605,19	432,33	639,23	650,83	603,17	450,38	569,1
h_{2g} (kj/kg)	627,68	445,332	663,982	676,495	627,395	464,802	589,98
h_3 (kj/kg)	297,03	256,41	307,82	305,01	275,61	249,65	271,35
h_4 (kj/kg)	297,03	256,41	307,82	305,01	275,61	249,65	271,35

Results-:

In conclusion, the study has revealed the following findings:

- A comparison was made between the coefficients of performance (COP) for vapor compression cooling cycles under various conditions involving superheating and subcooling.
- The analysis indicated that both superheating and subcooling contribute to an enhanced COP, although the degree of this enhancement differs depending on the specific refrigerant utilized. Among hydrocarbon refrigerants such as R600a, R290, and R1270, a more significant increase in COP was observed.
- An improvement in COP directly translates to energy savings. This suggests that hydrocarbons may present a viable option for alternative refrigerants moving forward.

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