A FLOW OF VARIOUS ALTERNATIVE REFRIGERENT IN AIR CONDITIONER: A REVIEW

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ABSTRACT:

The objective of this paper is to present review on the alternative refrigerants used in the window air conditioner to have better performance with minimum losses to the surroundings .There are various refrigerant which is used for window air conditioner like R22 ,R407C ,R410A etc. This paper give the summary and range of various refrigerant used in the window air conditioner and their efficiency and also take the issue of global warming which effect our environment by the use of refrigerant, and our aim is to reduce the effect of global warming as well as optimize the performance of window air conditioner by using the latest refrigerants. This paper also gives the approach ,correlation ,proposed and some special information regarding the global warming.

KEYWORDS:

Alternative Refrigerant, Condenser, Evaporator ,C.O.P , Window Ac ,Split Ac

INTRODUCTION:

At present, for air conditioning application R22 is the most widely used refrigerant. The published literature revealed that the only drop in substitute for R22 is R407C ,because it offers a close match to R22 in existing window air conditioner with respect to energy efficiency and compressor discharge temperature.HFC407C is azeotropic refrigerant mixture of HFC32/HFC125/HFC134A(23/25/52%by weight). However, with R407c , polyolester (POE) oil must be used instead of mineral oil. The montreal protocol banned ozone depleting substance (ODSS) as refrigerant in current vapour –compression refrigeration system .Flour chemicals were the centre of attention, with HCFC's for interim use and hydroflurocarbon (HFCS) for longer term .The montreal protocol set limit for the HCFC consumption defined as production plus import less export and specified destruction : in 1996 (freeze at calculated cap),2004 (65% of cap) 2010 (25%) ,2015 (10%) and 2020(0.5%) with full consumption phase out by 2030 in non article 5 countries. Most western and central European countries accelerated HCFC phase out while the majority of other developed countries required to phase out of R22 (the most

widely used refrigerant today)by 2010, and then banned all HCFC use in new equipment 2020.

Due to phase out of CFCS (chloroflurocarbon) and HCFC (hydroflurocarbon) , the system must be redesigned to satisfy design requirement for alternative refrigerant system modification can be employed into three categories " drop in with no hardware changes" soft optimization "with moderate hardware changes" and "hard optimization" with major hardware changes . R407c has similar thermodynamic property are those of R22 with an exception of the temperature gliding during the phase change process at a constant pressure. HCFC 22, the generally accepted and most suitable refrigerant for air conditioner must be phased out 2030 by developed countries and 2040 by developing countries because its ozone depleting potential. The phasing Out of ozone depleting refrigerant has led to the quest for eco friendly alternative refrigerant. One of the first steps in evaluating alternative refrigerant is to perform simple thermodynamic cycle analyze to estimate the cycle performance. Typically these analysis include the compressor efficiencies ,but do not consider any heat exchange modeling.

Because of environmental and energy efficiency concerns ,the air conditioning industry has look alternatives to long standing fluid such as CFCS and HCFS and at the same time ,to examine new technologies that will allow air conditioning systems ,using the next generation of refrigerant to be more efficient in their energy consumption than their predecessors

The predicted world demand of air conditioner by the end of 2004 is about 47.2 million ,which include room air conditioner and packaged air conditioner .out of this ,36.3 million will be room air conditioner ,mostly window mounted [19]. In India ,it is estimated that about 1million room air conditioner will be manufactured with HCFC22 every year ,comprising approximately 75% of the window unit. Window air conditioner manufactured in India ,range in capacities from 1.71kw (0.5tr)to 6.84kw (2.0tr). Considering the average life of a typical window air conditioner to be about 15 years implies that millions of window air conditioners are operating HCFC22.

In the present work an attempt has been made to study the possibility of using HFC407c ,HFC 410a /HC blend refrigerant mixture as a substitute for HCFC 22 in a window air conditioner and to evolve an optimal composition for the mixture.

LITERATURE REVIEW:

Donsoo jung* [etal] 1999 [1] In this paper the performance of refrigerant mixture CFC 12 is investigated by computers analysis of automobile air condition was carried out on refrigerant mixture compared of R22, R134A, R142B, R170, HC 600A were proposed to supplement CFC12 . It is found that mixture of HFC134a and RE 170 having zero ozone depletion potential and is of best long term coeff. of performance with supplement of R12. But at present automobile air conditioner should be used carefully due to its flammability.

J.D. Douglas *[etal]1999 [2] This paper describes the development and application of a general purpose method for comparing alternative refrigerants. This method utilizes a cost effective

performance index for a simplified system operating with a given cooling capacity and efficiency .A computer model based upon this method was used to evaluate the performance of several leading R22 replacement candidate for window air conditioner .It is found that the difference between most of the alternatives refrigerant were smaller then uncertainties in the analysis.

S. Devotta *[etal] 2001 [3] In this paper some selected fluids have been assessed for this suitability as alternative to HCFC 22 for air conditioner .Among the refrigerant studied HFC 134a, HC 290, R407c, R410a and their blend of HFC 32, R134a, and R 125. The characteristics of HC290 are very close to those of HCFC 22. Therefore HC 290 is a potential candidate

Man-Hoe Kim* [etal] 2001[4] This paper presents experimental results on the shut down and start up characteristics of a residential split system R410A air conditioner with capillary tube all the experiment performed in a psychometric calorimeter. The test result shows that the cooling capacity and COP after start up can be expressed as the combination of two exponential function of time approaching the cooling capacity of steady state.

S.Devotta *[etal] 2005 [5] This paper presents the experimental performance analysis of a 1.5 TR window air conditioner ,retrofitted with R407C as substitute of HCFC22 .This paper presents the simulation result of heat exchange of an R 12 window air conditioner retrofitted with R407C. It is found that pressure drop of R407C are lower in both the evaporator and condensers compared to HCFC22. The outlet temperature of air for R22 and R407C in both heat exchanger are nearly same.

D.B.Jabaraj*[etal] 2005[6] In this the present work experimental analysis has been conducted in a window air conditioner retrofitted with eco friendly refrigerant mixture of R407C/HC290/HC600A,without changing the mineral oil. Here its performance of HC290/HFC407 blend is better option and eco friendly to R22.

P.Sarntichartsak*[etal]2006[7]The mathematical modeling and experimental study were carried out investigate effect of oil circulation in an inverter air conditioner using R22 and R407c . Two tested lubricant were mineral oil (MO) and polyol ester lubricant (POE).The experiments varied with the compressor frequency range 30-50 Hz. The predicted result were validated with experimental data.

Zheng Li*[etal]2008[8]This paper report on a experimental study to investigate the inherent operational characteristics of a DX A/C unit at a fixed inlet air state when the speeds of both its compressor and supply fan are varied. The experimental result of the inherent operational characteristics related to both equipment sensible heat ratio (SHR) and operating efficiency are reported.

D.B.Jabraj*[etal][9] In this paper the work is an attempt has been made to study the possibility of using R 407c/ R 290/ R600a, refrigerant mix as a substitute of R22 in a window air conditioner. To achieve this various parameter consider like condenser length ,evaporator inlet temp., evaporator outlet temp, etc. it is found that the new refrigerant mixture performed better

than that of R22, infact new mixture an improve the actual COP by 8% to 11% and also reduce energy consumption.

T.S.Ravi Kumar*[etal] [10]In this paper states that R134 has been single major refrigerant in automobile industry ,but it uses PAG oil as lubricant .This leads to serious service issue. Therefore a refrigerant which will readily available to replace R12 and also compatible with mineral oil. The R134A is mixed with the commercially available hydrocarbon blends (45.2% R290 and 56.8% R600A) . This test results show that the new blend can be substitute for the existing R12 system and it can eliminate the use of hygroscopic PAG oil.

M.Fatouh*[etal] [11] The experiment performance assessment based on a solid packed bed desiccant system integrated with a R407C vapour compression refrigeration air conditioning system . The parameters were proposed are desiccant mass , air mass flow rate, shelves no. and shelves span. It is found that mass of desiccant has little effect in actual COP ,while increase the air mass flow rate lead to a decrease in the saturation time during dehumidification and increase the adsorption rate ,and adsorption rate for the lower shelves no is higher then that of higher no.

Tolga N. Aynur*[etal] [12] In this paper the study of detail overview of operation ,application ,marketing and cost of variable refrigerant flow. Technically refers to the ability of a system to control the refrigerant mass flow rate according to heating /cooling load. This paper is basically focus on 3 main subjects :

- Control strategies of variable speed compressor and Electronic Expansion Valves (EEVs)
- Field performance testing and integration with ventilation system.
- Comparison of the energy consumption and thermal comfort air conditioning system.

M.Fatouh*[etal] [13] This paper based on experimental investigation of a direct expansion air conditioning system working with R407c as an R22 alternative and parameter that had been consider as:

- Evaporator inlet temperature.
- Evaporator air inlet volume flow rate
- Evaporator air inlet humidity ratio.

It is found that R22 has the best performance characteristics in compared to R407C for all investigation parameters ; R407c is still possible substitute of the R22.

Claudio Zillio*[etal] [14] Experiment were conducted for a typical R134 a compact European automobile air conditioning system having nominal cooling capacity 5.8 KW at a compressor volumetric flow rate of $7.8m^3h^{-1.}$.three 1234yf system were tested using the baseline hardware with some modification:

- The baseline system operating with an optimal change of R1234yf with the baseline TXV system.
- The system of above operating with ATXV setting is optimized for R1234yf.

- The system of just above operating with variable displacement compressor control valve deactivated.

This paper shows that for a given cooling capacity and set of operating condition ,R1234yf system could be further improved beyond among another things ,optimizing the condenser and evaporator refrigerant circuitries.

Bukola Olalekan[*] [etal][15] in this paper experimental research were carried out to investigate the performance of R22 and its ozone friendly alternative refrigerant (R404a and R507)in a window air conditioner. The parameter that have been considered:

- Compressor or pressure ratio
- Compression work
- Compression discharge temperature.
- COP
- Refrigeration capacity and energy consumption

The result found that as ambient air temperature increase ,the pressure ratio , compressor work ,discharge temperature and energy consumption increase, while COP and refrigerant capacity reduce for all the investigated refrigerant and also result show that R507 has highest COP then those of R22 and R404A at any ambient air temperature.

Maiorino[*][etal][16] in this paper new refrigerant R422D is introduced as a substitute of R22. This new fluid is non ozone depleting and compatible with mineral oil but it has high GWP. The experimental analysis confirmed that the system when retrofitted with R422d lead to increase of TEWI*

C.J.Wu [*][etal][17] In this paper the aerodynamic and acoustic performance of an indoor unit of dc inverter split air conditioner is simulated by CFDA CAA. The parametric influence upon the values of FR and BSPL for the unit is analyzed for various cases of geometrical parameters of the indoor unit and the cross flow fan. Two improved design are developed that can increase the FR for the existing prototype of indoor unit while the BSPL remain lower.

Pongsakron Sarntichartsak[*][etal][18]In this paper the system performance of R410A inverter air conditioning was performed experimentally and numerically . The parameters was used as varying frequency water flow rate ,and spraying temperature. It was found that the proposed model give a satisfactory agreement with test data.

TABLE: PROPERTIES OF DIFFERENT REFRIGERENTS-:

	R 22	**R 134A**	**R 290**	**R 407C**	**R 410 A**	**R 422 D**	**R 600A**	**R 1234 yf**
Composition	$CHCIF_2$	$C_2H_2F_4$	C_3H_8	23±2% CH_2F_2 25±2% C_2HF_5 52±2% $C_2H_2F_4$	50+.5,-1.5% CH_2F_2 50+1.5,-.5% C_2HF_5	65.1+.9,-1.1%C_2HF_5 31.5±1%$C_2H_2F_4$ 3.4+.1,-4%C_4H_{10}	C_4H_{10}	$C_3H_2F_4$
Critical Temp. (^{o}c)	96.14	101.06	44.09± 0.0039	86	70.17	-	-11.7	-
Critical Pressure(kpa)	4990	4059	-42.1± .2	4634	4770	-	134.7	-
ODP	0.05	0	group= lower alpha	0	0	0	group= lower alpha	0
GWP(100years)	1810	1430	<0 (smog)	1774	2088	2729	0	4
Boiling Temp. ^{0}c	-40.7	-26.3	9.5	-43.8	-51.4	-	58.1221 ±0.0051	-29.4
Atm life(yrs)	96.1	14	12±3	15.657	16.95	27.29	12±3	0.030116

CONCLUSION:

This paper present the summary of literature on flow of various refrigerant in air conditioner (window/split air conditioner).In many of the literature, effect of global warming with other parameters that is better substitute of R22 refrigernts used in air conditioning given. In this paper the main appraoach is to pay attention all better possibility to increase the performance of air conditioning by using better substitute of R22 refrigerents and also proper take care of global warming which mostly effect our environment. Since the literature available for air conditioning is appreaciable , and further more work can be possible for better performance.

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