International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 01 | Jan 2021 www.irjet.net p-ISSN: 2395-0072

"Experimentally Evaluate Different Environment Friendly Refrigerant in 1 Ton Window AC"

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Abstract - *Refrigeration is one of the important parts in mechanical field. This project describes the fundamentals and characteristics of refrigerant. This project is about the experimentally evaluate different environment friendly refrigerant in domestic Air conditioners. In this experiment we find the alternative refrigerant. In the experimental investigation different operational parameters like: eco friendly, high efficiency, stability will be study to know the different refrigerant.*

Key Words: **Low Global Warming Potential (GWP), Refrigeration System, Low ozone depletion potential (ODP), Green House Effect, Heat Transfer**

1. INTRIDUCTION OF AC

Air conditioning (often referred to as AC, A/C, or air con) is the process of removing heat and moisture from the interior of an occupied space to improve the comfort of occupants. Air conditioning can be used in both domestic and commercial environments. This process is most commonly used to achieve a more comfortable interior environment, typically for humans and other animals; however, air conditioning is also used to cool and dehumidify rooms filled with heat-producing electronic devices, such as computer servers, power amplifiers, and to display and store some delicate products, such as artwork.

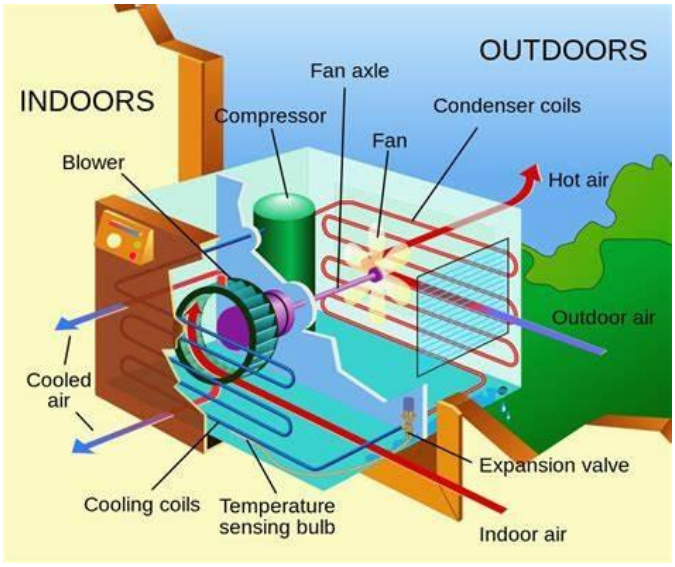

Fig.No:1 Window AC

1.1 DEVELOPMENT OF AC

The basic science of air conditioning has been known for many years the production of air conditioning equipment started in 1930.

Extremes of heat and cold, because of seasons are always present. The temperature of range within which people feel comfortable depends upon

1. Clothing worn

2. The physical activity

3. The amount of moisture present in atmosphere.

Air conditioning implies a grate deal more then only temperature control.

There are four atmospheric conditions which affect human comfort

1. Temperature of the surrounding air.

2. The humidity of air means moisture contain and its relation to human comfort

3. Air purity people sitting air conditioned space are not comfortable when breathing contaminated air. Hence cleanliness of air plays very important role in air conditioning

4. Air movement Even if temperature. Humidity and air purity are satisfactory; certain amount of air motion seems to be necessary for human comfort.

Based on this, Air conditioning can be defined as

"It is a process of producing air, controlling, simultaneously its temperature, humidity, cleanliness and distribution for the fulfillment of required condition of the confined space"

True air conditioning implies that all four of these atmospheric conditions for human comfort are being met.

1.2 ROLE OF LOW GWP REFRIGERANT IN CURRENT SCENARIO

Facing regulatory pressures to eliminate high-GWP refrigerants, many alternatives are being proposed. There is a trade-off between lower GWP and flammability. Most of the current refrigerants have no simple low-GWP drop-in

solutions: flammability is linked to GWP and refrigerant capacity.

Lower GWP and higher capacity comes with increased flammability.

To date, the focus has been on new unsaturated fluoro-chemicals, also known as hydrofluoroolefins (HFOs), especially R1234yf, R1234ze(E), and R1233zd. They have very low GWP levels, and are non-flammable or mildly flammable, and belong to a group of lower density refrigerants. R1233zd has a very low ODP value (only a small percentage of R22) but this remains a problem in a few countries like Denmark.

To lower the GWP of higher density HFCs, HFOs are mixed with HFCs. As seen in the 2 illustrations below, the proposed blends within the same group are similar to each other, with the main differences being based on which R1234 type is used and the exact refrigerant it is replacing Facing regulatory pressures to eliminate high-GWP refrigerants, many alternatives are being proposed. There is a trade-off between lower GWP and flammability. Most of the current refrigerants have no simple low-GWP drop-in solutions: flammability is linked to GWP and refrigerant capacity.

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2. Comparison of regular refrigerant to low GWP Refrigerants.

Due to environmental and legislative concerns, the refrigeration and air-conditioning industry is making major efforts to improve the energy efficiency of residential appliances and switch to more environmentally friendly refrigerant types. Unfortunately, many of the viable alternative low global warming potential (GWP) replacement options (GARS) for the current refrigerants tend to have less favorable thermodynamic properties that result in undesirable reductions in system performance, or other drawbacks. Some of the other drawbacks include high flammability, such as in the case of isobutene and propane. Government regulations prohibit the use of these flammable refrigerants in some applications for safety reasons. In order to meet the challenge of minimizing energy consumption while replacing the currently used refrigerants in accordance with regulations, potential working fluid replacement options must be explored through both experimentation and simulation.

One of the major segments of the Air conditioning industry is the household Domestic Air conditioners. The widespread use of household Domestic Air conditioners provides an opportunity for substantial energy savings, and the 100 million new units sold annually across the globe represent a considerable quantity of Air conditioning. Household Air conditioning in the North American market typically use HFC-134a as a refrigerant because it has zero ozone depletion potential, favorable thermodynamic properties, and is non-flammable. The issue with R134a is that it has a relatively high 100-year GWP of 1,430. Which is a measure of its effect on the environment as a green house gas relative to carbon dioxide.

Two alternative low GWP options that are being considered as replacements for R134a in household Air conditioning are HFO-1234yf and HFO-1234ze. The household Air conditioning is paying particular attention to using R1234yf as an R134a replacement due to the similar thermodynamic characteristics. Another reason that R1234yf is being considered as a replacement option for R134a is because it has a very low 100-year GWP rating of ~4, which is approximately 350 times lower than R134a. Among the various alternative low GWP refrigerant choices, one of the advantages of using R1234yf as an R134a replacement is that it shows promise as a direct drop-in replacement without system modifications because of the similar thermodynamic properties. The biggest issue for the acceptance and implementation of R1234yf is the fact that it is mildly flammable, which can create potential fire hazards for equipment which utilizes the refrigerant. The burning velocity of R1234yf has been found to be less than 10 cm/s, which qualifies it for the new 2L classification defined in ANSI/ASHRAE Standard 34. Pending new regulations, this classification has the potential to allow the implementation of R1234yf for Domestic air conditioners, from which Class 2 refrigerants are currently banned. The thermodynamic and transport property libraries of Engineering Equation Solver were used to develop a chart of the thermo physical properties of R134a, R1234yf, and R1234ze over a temperature range common for household Air conditioners. Some of the relevant properties are shown in Table 1.

Refrigerant	Temperature	Saturation Pressure	Latent Heat	Specific Heat (c_p)		Density		Thermal Conductivity		Viscosity	
	°C	kPa	kJ/kg	kJ/kg-K		kg/m^3		mW/m-K		µPa-s	
				Liq.	Vap.	Liq.	Vap.	Liq.	Vap.	Liq.	Vap.
R134a	-25	106.5	216.3	1.280	0.796	1374.0	5.5	104.7	9.6	371.8	9.9
	-7.5	221.3	204.2	1.320	0.862	1319.0	11.0	97.8	11.4	292.9	10.6
	10	414.9	190.8	1.369	0.941	1261.0	20.2	90.3	13.1	234.2	11.3
	27.5	716.8	175.5	1.433	1.040	1197.0	34.9	82.0	14.8	188.5	12.1
	45	1161	157.6	1.529	1.177	1125.0	57.7	73.1	16.6	151.2	13.0
R1234yf	-25	123.0	177.9	1.217	0.847	1251.0	7.2	83.5	7.5	305.4	10.3
	-7.5	243.1	168.1	1.283	0.911	1199.0	13.7	77.8	8.6	242.0	11.1
	10	437.7	156.8	1.350	0.983	1144.0	24.2	71.3	9.8	193.7	11.9
	27.5	731.7	143.7	1.427	1.070	1083.0	40.6	64.2	11.2	156.3	12.7
	45	1153	127.9	1.530	1.186	1012.0	65.9	56.4	12.8	125.9	13.8
R1234ze	-25	78.5	197.1	1.179	0.742	1311.0	4.5	65.1	N/A	187.6	N/A
	-7.5	164.5	186.5	1.225	0.811	1260.0	9.1	61.7	N/A	162.9	N/A
	10	310.3	175.1	1.269	0.889	1208.0	16.7	58.2	N/A	142.4	N/A
	27.5	538.8	162.3	1.320	0.982	1154.0	28.8	54.6	N/A	124.3	N/A
	45	876.7	147.5	1.388	1.100	1094.0	47.6	50.6	N/A	107.6	N/A

Table 1.1 - : Thermo physical properties of R134a, R1234yf, and R1234ze

To simplify the identification of the differences between the two alternative low GWP refrigerants and R134a, a second chart was created which shows the properties of R1234yf and R1234ze relative to R134a. The chart of the relative properties is shown in Table 2, where the magnitudes of the relative differences have been color-coded. Green is used to identify values within 10%, yellow within 10% to 20%, and red for greater than 20%. One of the important things to note is that the saturation pressures of R1234ze are significantly lower than R134a, which means that the cycle will operate significantly below atmospheric pressure during evaporation. The vapor density of R1234ze is also significantly lower than R134a, which means that the mass flow rate of a compressor would be reduced, possibly requiring a redesign of the compressor.

3. MERITS & LIMITATIONS OF LOW GWP REFRIGERANT

3.1 Merits

[1] Low Global Warming Potential (GWP)

[2] Low ozone depletion potential (ODP)

[3] Eco friendly

[4] No chemical reaction with material

3.2 Limitation

[1] Cost is high

[2] Moderate thermal conductivity

[3] Production is difficult

[4] Not easily available

4. CONCLUSIONS

Any machine must be inexpensive and easy to build if it is to be accepted by the society. This need is recognized and a “Experimentally Evaluate Different Environment Friendly Refrigerant in 1 Ton Window AC " is designed for Prototype model. This machine will only contain parts that are readily available and in use regularly. This project is mainly to find environmental data and some other calculate we can concluded Nowadays, Refrigeration and Air Conditioning related Industries are using R-22 and R-32 refrigerants in common practice. These gases are highly flammable, and it has high Global Warming Potential rate which is 1700 and 675 respectively**.** So we are using R-1234yf in window AC as an alternative refrigerant which is eco-friendly and has low Global Warming Potential rate.

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