LOW GWP REFRIGERANT R407F ALTERNATIVE FOR 404A

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Abstract:

New refrigerant with positive attribute of both high thermal performance and low environmental impact are currently in development. Initial evaluation of these refrigerants in refrigeration systems shows good energy efficiency and lower global warming impact than current refrigerants .low GWP value were investigated as a alternatives to different refrigerants used commonly in refrigerating and air conditioning equipment.

1. Introduction:

Production of the cold solution is mainly based on refrigeration system. To protect the environment, for reducing the greenhouse gas emissions and better protection of the ozone layer we use the natural refrigerant [2]. Natural refrigerant is an alternative solution to replace halogenated refrigerants. These natural refrigerant contents no chlorine, no fluorine and does not reject any co_2 emission in the atmosphere [1] . Among these are R407F and R404A, R404A has relatively high GWP (3952) so, R407F is the alternative for R404A.we calculating the performance evaluation of R407F and R404A.

2. GWP:

This is an index that characterizes the participation of the molecule to greenhouse effect we calculate the value this index compared to reference molecule namely co_2 .co_2 has GWP=1

3. COMPRESSOR DATA & STANDARD CONDISION:

We are going to evaluate the performance analysis of Low GWP refrigerants R407F and R404A.For theoretical calculation, Compressor data and Design/test condition as per EN13215:2000 is given below in table.

COMPRESSOR DATA	Unit	
Compressor Swept volume	cm^3/rev	107.48
	M^3/rev	0.00010748
Speed	RPM	2900
	RPS	48.33
Mass flow	kg/sec	0.110
	kg/hr	370.13
CONDITION		
Evaporating Temp	°C	-10
Condensing Temp	°C	45
Degree of Subcooling	°K	0
Degree of Super heating	°K	10

4. THEROTICAL CACULATIONS:

From p-h chart or REFPRO software we get the properties of refrigerants values of refrigerants. Calculated properties is as follows

Property	Unit	R404A	R407F
Actual Entropy at Comp discharge	KJ/Kg k	1.732	1.939
Actual enthalpy at compressor Discharge	KJ/Kg	431.35	500
Actual Temp at Compressor Discharge	°C	93.25	107
Heat rejection	KW	16.97	16.70
Refrigeration capacity	KW	11.51	10.93
Work done by compressor	KW	5.46	5.77
COP		**2.11**	**1.89**

5. CONDENSING UNITS:

In this project we are going to validate theoretical calculation in condensing unit, condensing unit covers products that are specifically designed to provide cooling to other equipment and systems that incorporate evaporators (and associated expansion valve control systems). Condensing units are factory-assembled units that consist of an condenser, one or more compressors, and interconnecting pipe work. They may include liquid receivers, filter driers, oil separators, shut off valves and related controls, and a weatherproof housing.

5.1Technology Description: Condensing unit is a factory-assembled, packaged unit that consists of a refrigeration compressor, Condenser, Receiver, and various ancillary components. This packaged unit does not contain a complete refrigeration system, but is designed to provide a convenient method for cooling a cold room or other equipment fitted with an evaporator that is controlled by an expansion valve. Condensing units are used in a variety of commercial and industrial cooling applications, including cold rooms, refrigerated display cabinets, back-bar equipment, temperature controlled food preparation areas, and for air conditioning systems. Condensing units are available in a range of different designs and efficiencies. The ECA Scheme aims to encourage the purchase of the higher efficiency products. The ECA Scheme covers products in three temperature categories:

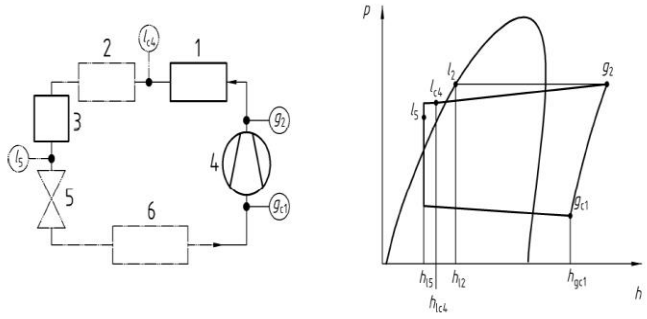
1. High temperature units.
2. Medium temperature units.
3. Low temperature units.

Temperature Category	Evaporating (Dew Point)
High temperature units	+5°C
Medium temperature units	-10°C
Low temperature units	-35°C

These categories are defined in terms of the product performance at a particular temperature rating point. Products may be submitted under more than one category.

6. EXPERIMENTAL SET UP:

To validate the theoretical calculation, we test the condensing unit with three different refrigerants, Before start the testing coupled the condensing unit with Test rig, test rig mainly consists Evaporator, electronic expansion valve, Mass flow meter, As per standard EN13072-2, Method –E is used to calculate the capacity of condensing unit.In this method refrigerant flow is determined by using either a volumetric or mass flow meter inseted into liquid line ,in this testing flow meter is used and is connected to thee liquid line between the condensing unit outlet and expansion valve as shown in bellow diagram



a) Circuit diagram b) Pressure vs enthalpy diagram

7. EXPERIMENTAL SET UP READING:

Refrigerant	**Unit**	**R404A**	**R407F**
Ambient	**˚C**	**32**	**32**
Evaporating pressure	**bar**	**3.3**	**3.7**
Condensing Pressure	**bar**	**19.8**	**20.9**
Mass flow rate	**Kg/hr**	**346.5**	**240.5**
Evaporating Temp	**˚C**	**-10**	**-9.54**
Cond. Temp (Dew)	**˚C**	**45.3**	**47.63**
Suction Gas Temp.	**˚C**	**0.2**	**-0.55**
Cond. out Temp	**˚C**	**44.6**	**44.91**
Discharge temp	**˚C**	**74.2**	**93.2**

8. RESULTS:

	Theoretical			Actual	
	Unit	**R404A**	**R407F**	**R404A**	**R407F**
Refrigeran capacity	**KW**	11.51	10.93	10.02	9.994
Power Consumption	**KW**	5.46	5.77	5.91	6.19
Heat rejection	**KW**	16.97	16.70	15.94	16.22
COP		2.11	1.89	1.70	1.62

9.CANCLUSION:

From the theoretical and the experimental result it can be conclude that refrigeration capacity reduced with R407F by 2% to 3% because less flow rate while power consumption is decreased with R407F by 5% to 6%. COP of R404A is decreased with R407F

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