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Performance Evaluation of Rotary Vane Compressor Using Oil Separator in Car AC System

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Abstract— One of the primary functions of an automobile climate control system is to provide the desired cooling and stabilize cabin temperatures to comfortable levels in hot climatic conditions. With the increasing demand for more energy efficient systems and thermal comfort in automobiles, the automobile AC system needs to be optimized to deliver the required cooling performance with minimum AC power consumption. Proper selection and integration of AC compressor with other system aggregates results in improved energy efficiency of the system.

There are varies ideas to improve compressor efficiency .But considering manufacturing feasibility ,design and validation lead time and cost as many of the ideas dropped down. Oil separator is one of the way to improve cooling efficiency of compressor in which low investment and lead time involved. The function of oil separator is that separate the oil and refrigerant from the AC system.AC System contains compressor ,condenser, evaporator and txv as main parts. During AC system on condition, refrigerant flow on in the compressor ,condenser and evaporator txv too.

Compressor contains OIL which is used for lubrication purpose for compressor internal parts.So that compressor moving parts will not damage as wear and tear. During compressor on condition oil also mix with refrigerant which can circulate the system.This paper response to implication of oil separator in Rotary vane compressor.

Key Words: Compressor, Oil separator

I. INTRODUCTION

Air conditioning compressor is an integral component for an air conditioning system; when it begins reciprocate, lubricant will be very pivotal to protect equipment. But when refrigerant is

Exhausted from compressor, a little of lubricating oil will be taken away from it and will accumulate inside the compressor eventually. Therefore, an oil-gas separator need be collocated to compressor, which could separate lubricating oil from refrigerant and then lubricating oil would flow back compressor. For the separator construction, the swirling motion is brought

About by designing the inlet in such a manner that it forces the gas to enter the unit on a tangent to the inner body wall1

There are many different varieties of oil-gas separator available in the market. One such variety is the cyclone phase separator works on the principle of double vortex. The oil-gas mixture is injected into the cylinder using a pipe which is held in tangentially to the separator body is gas swirls, it moves axially downwards in the outer part of the separation space. In the conical part of the cyclone, the gas is slowly forced into the inner region of the cyclone, where the axial movement is upwardly directed and the downwardly directed axial flow takes oil particles along with it.

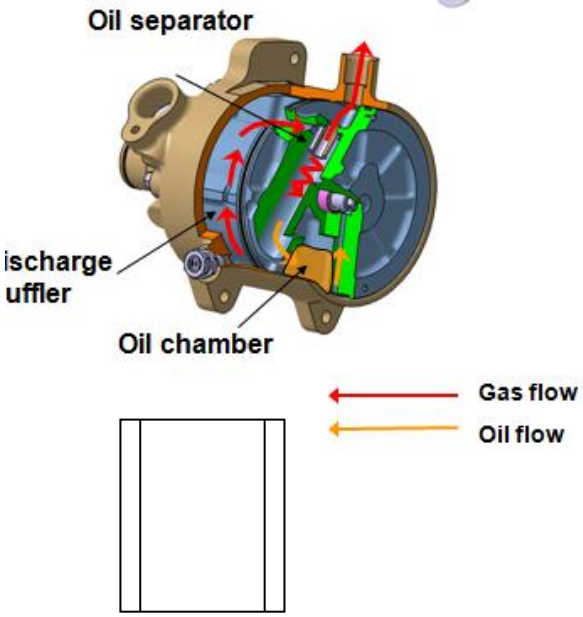
This flow Pattern is often referred to as a 'double vortex': an outer vortex with downwardly directed axial flow and an inner one with upwardly directed flow.

II. OIL SEPARATOR

The function of oil separator is that separate the oil and refrigerant from the AC system.AC System contains compressor, condenser, evaporator and txv as main parts. During AC system on condition, refrigerant flow on in the compressor, condenser and evaporator txv too.

Oil Separator in Rotary vane compressor reduce the Oil circulation ratio (OCR)in the refrigeration System.

Oil separator design as prepared as simple kind of bush which is fitted in the inside compressor below discharge port.



OIL Separator concept sketch

III. OIL SEPARATOR WORKING METHODLOGY

When Compressor rotates, Refrigerant Gas compressed and compressed high pressure gas enter in the condenser and whole system. Definitely Oil mixing can happen with refrigerant. Higher oil circulation ratio lead performance Detroit of the system.

When refrigerant with Oil enter in the compressor through suction port, then low pressure gas flow in between vanes and Cylinder of the compressor. Due to volume decrease in the cylinder and vanes as pressure converted to high pressure.

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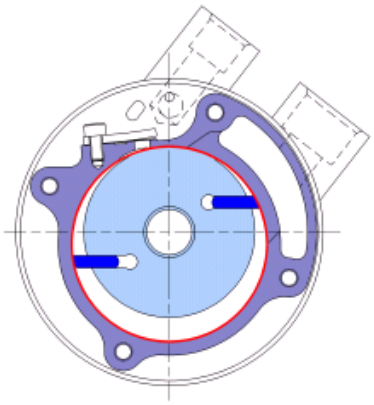


Oil separator located below the discharge port meaning that ensure the optimized OCR should flow to Discharge port Mixed oil with Refrigerant flow through Oil separator which creating the resistance in the flow by oil separator .When resistance occurred in the flow ,due to viscosity difference oil fall down and oil will be collected in the Oil chamber in the compressor. Gas flow to top side due to light weight.

IV. OIL SEPARATOR CONCEPT AND MATERIAL SELECTION

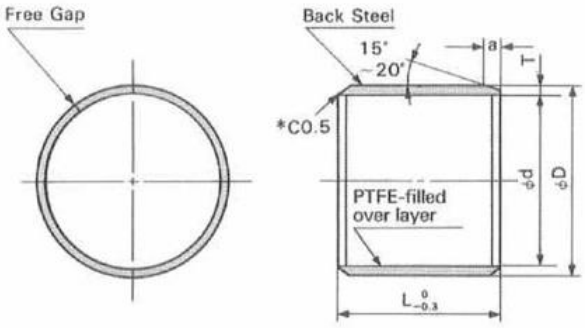
Oiles offers a diverse family of thin walled, low friction, multi-layered bearings. Styles are available in straight bore, flanged washers, plates and made-to-order types. Oiles has several engineered solution bearing types each having an unique operational characteristics and each designed to perform lubrication free.

Oiles multi layered bearings incorporate two or three strategic layers to provide superior long life performance. The first layer, Oiles integrates various proprietary steel alloyed backing for rigidity and structural integrity. Second, a controlled layer of proprietary sintered bronze is fused to the steel backing. Third, Oiles integrates proprietary low friction bearing surfaces to create the world's finest thin walled bearing.

For application and engineering assistance, please feel free to contact Oils America Corporation or an authorized Oiles agent.

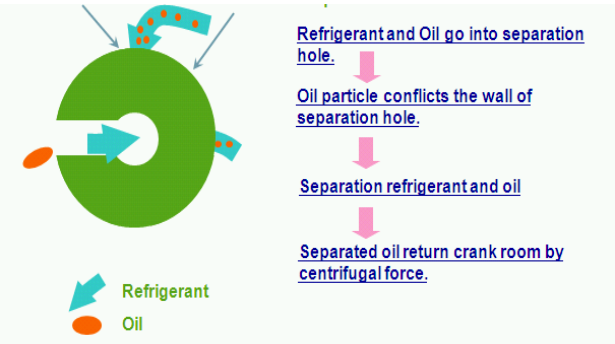
Oils Drymet LF is a self lubricating, high performance lead free bearing, available in standard metric sizes from 2-50mm bore sizes. Larger bore sizes are available on a made-to-order basis. LF utilized a layer of proprietary tetrafluorethylene (PTFE) and other resins layered over a special sintered bronze layer integrated into the rigid steel backing..

For this project purpose, Aluminum alloy.(Si 16%,Fe 0.9%,Cu 5%,Mn 0.5%,Mg 0.5%,Ni 0.3%,Zn 1.5%,Sn 0.1%)



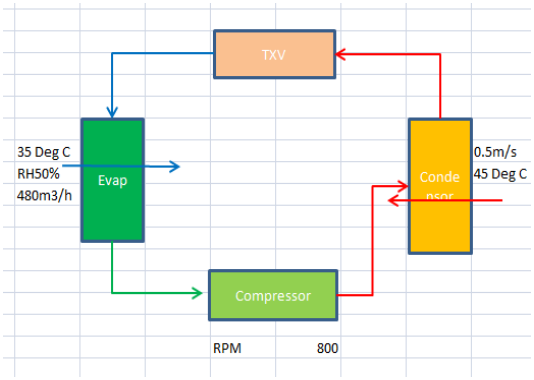
Specifications	
I.D. (d)	16
O.D. (D)	18
Tolerance OD. (D)	0.035 0.07
Thickness (T)	1
Tolerance Thickness (T)	-0.025
Length	15
Max. Load	11760 N

A) Concept:



V. TESTING OF COMPRESSOR WITH OIL SEPARATOR

Compressor assembled with proto oil separator and tested in the bench test.



A) Performance Testing condition

Evaporator inlet temp = 35 Deg
Relative Humidity =50%
Air flow = 480 m3/h
Compressor RPM =800
S.H/S.C=10/5 Deg

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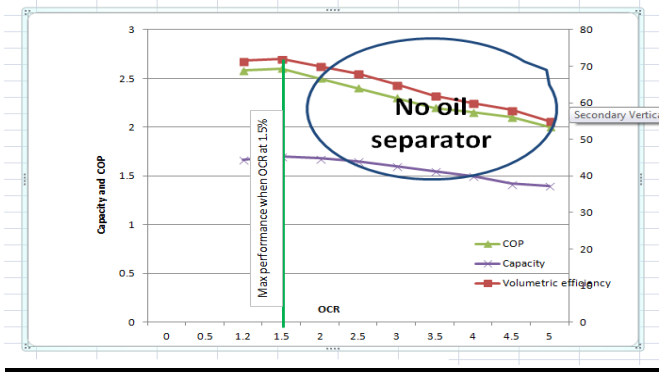
OCR%	V eff%	COP	Capacity
0			
0.5			
1.2	71.5	2.58	1.67
1.5	72	2.6	1.7
2	70	2.5	1.68
2.5	68	2.4	1.65
3	65	2.3	1.6
3.5	62	2.2	1.55
4	60	2.15	1.5
4.5	58	2.1	1.42
5	55	2	1.4



The above test results shows that no oil separator increase the oil circulation ration (OCR)in the system which reduce the performance as volumetric efficiency and cooling capacity of the compressor.

When we apply Oil separator in rotary vane compressor ,OCR 1.5% where we got good performance and cooling capacity.1.5% of OCR as optimized one. Further down in OCR in the system will reduce performance.

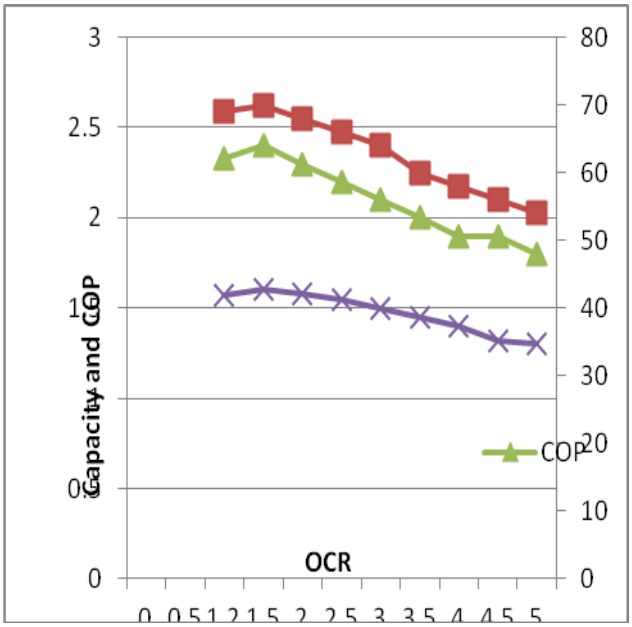
The above test conducted based on above condition.

To understand more in the performance, condition changed.

B) Test condition 2: Change point evap temp 35 Deg c to 40 Deg c.

Evaporator inlet temp = 40 Deg
Relative Humidity =50%
Air flow = 480 m3/h
Compressor RPM =800
S.H/S.C=10/5 Deg

Readings			
OCR%	**V eff%**	**COP**	**Capacity**
0			
0.5			
1.2	69	2.33	1.57
1.5	70	2.4	1.6
2	68	2.3	1.58
2.5	66	2.2	1.55
3	64	2.1	1.5
3.5	60	2	1.45
4	58	1.9	1.4
4.5	56	1.9	1.32
5	54	1.8	1.3



The above test conducted with change of evaporator temp to 40 deg c as worst condition. The results shows that no significant change in the performance by using oil separator.

VI. CONCLUSION AND FUTURE WORK

Thus the Project carried on performance evaluation of rotary vane compressor using oil separator in car a/c system . This Project reports give explanation on Compressor validation and Facility too. Also this reports help to understand performance like cooling performance, power consumption and COP of compressor with Oil separator. Test has been conducted with Oil separator to know the performance impacts on in Rotary vane compressor with various test condition like Humidity change and evaporator temp change etc,. Just I take opportunity to thank to my project guide, PG staff of modern college and my colleagues from Valeo Japan. In future, Possible to introduce in regular production and different type of oil separator to be designed based on the this paper Oil separator.

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