

# A Comparison of the VCRC with VARC in Vehicle for the Air Conditioning System

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**ABSTRACT:** Air conditioning is the process of eliminating heat and moisture from the interior of an inhabited place to enhance the comfort of inhabitants. The air conditioning arrangement that is mainly utilized in cars is now a VCRC cooling system, Since the VCRC (VCRC) is presently used for air conditioning in vehicles, it utilizes compressors that contribute to engine efficiency deterioration. This article examines VCRC and VARC Cycle (VARC) and also provided information how VARC is superior to VCRC. By research VCRC and VARC we study that the exhaust gases from vehicle is further utilized in engine and improve the efficiency of engine and Coefficient of performance by utilized VARC is decreased which is offset by improved efficiency of engine which is further may be used in vehicle having refrigeration system.

**KEYWORDS:** Absorption, Air Conditioning System, Arrangement, Compression, Refrigeration.

## 1. INTRODUCTION

Automobile is characterized as a motor vehicle designed for use on regular roads that typically has four wheels and an internal combustion engine for gasoline or diesel. The number of door, seat arrangement, and structural structure are all used to define automobile body designs. Traditionally, the roofs of cars are supported by the pillar on the either sides of the vehicle[1]. The process of removing heat and moisture from the interior of an inhabited space to improve occupant comfort is known as air conditioning. Air conditioning has been most commonly used to start creating a more enjoyable indoor areas for the humans and animals however, it's being used to dehumidify beds containing heat producing electronic devices like computational power and web service amps, and to display and store subtle goods[2].

### 1.1 Parts of Air Conditioning System:

Mainly they have 4 parts are present in air conditioning arrangement are given below with diametric sketch as shown in the Figure 1:

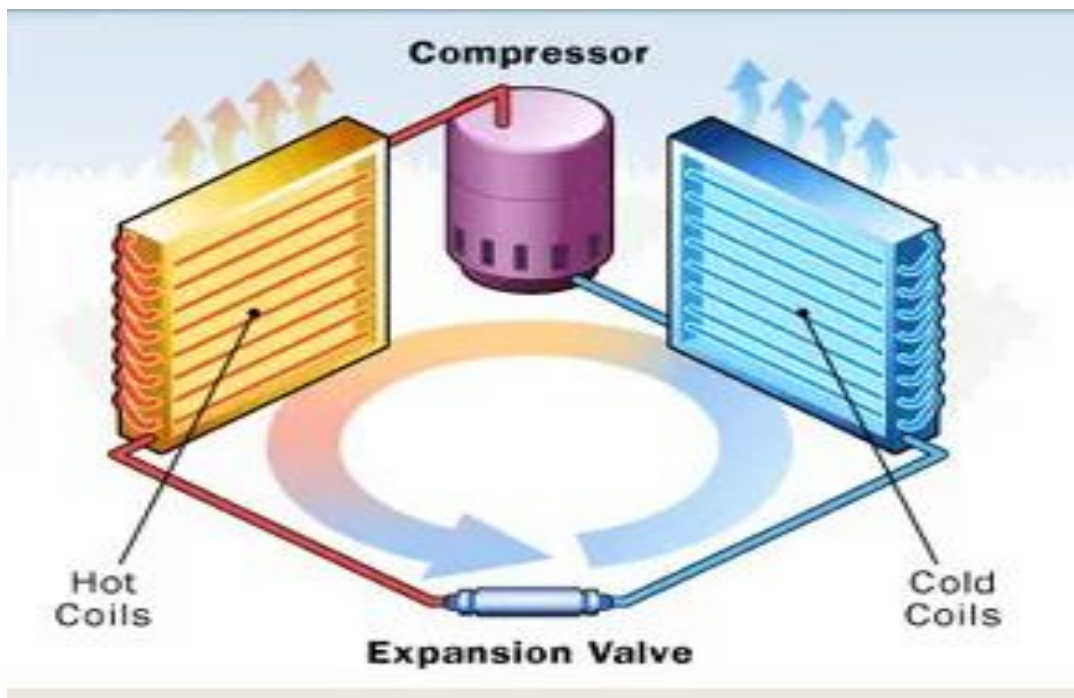
1. Condenser
2. Compressor
3. Evaporator
4. Expansion Valve

#### 1. Compressor:

The compressor's duty is to pressurize refrigerant and thus raise their temperature. Because of the combined gases rule, which says that as pressure rises, temperature rises as well, the gas will heat up. It achieves this by strongly compressing the gas[3].

#### 2. Condenser:

The refrigerant enter condenser at the high pressure and temperature, just like it does in the traditional VCRC condenser. The condenser is cooled by water. The outdoor air conditioning unit includes the condenser. The compressor sends high-pressure, high-temperature refrigerant to it[4].



**Figure 1: The Diametric Sketch of the Arrangement of Air Conditioning System[5].**

### 3. Expansion Valve:

The refrigerant has diffused heat when it exits the condenser in its liquid state, this still too hot to reach the evaporator coil. The refrigerant should be cooled before it can reach evaporator coil. This is when expansion valves, which is typically a thermostatic expansions valve, enters the scene. The pressure on liquid refrigerant is alleviated by an expansion valve, which enables refrigerant to convert from liquid to the gas/vapor in evaporator. It also controls the flow of refrigerant and voltage into evaporator.

### 4. Evaporator:

The air conditioner's evaporator coil essential. It's here that the heat from inside your house is taken up by the air conditioner. The expansion valve distributes depressurized liquid refrigerant to copper tubing. The heat from inside the home is absorbed when interior air passes over cold coil. This is related to the second rule, which states that heat flows from hot to cold naturally. The evaporator coils depend on the inside air handler's fan to move air over them, much as the condenser coils require the aid of the condenser fan to allow heat transfer. The refrigerant starts to evaporate and become a vapour when it absorbs heat from the interior air.

### 1.2 Air Conditioning Arrangement in Automobile:

Car air conditioning is a system installed the vehicle that enables the interior air of car to be cooled in the hot weather, providing a cooler atmosphere for the passengers. Condenser, evaporator, and compressor are the three main components of a car's air conditioning system. They basically work together to transport a chemical called refrigerant through a confined arrangement with high or low pressures. Refrigerant is a key component of air conditioning system and process because it transforms from gasses to liquid and back to gases[6].

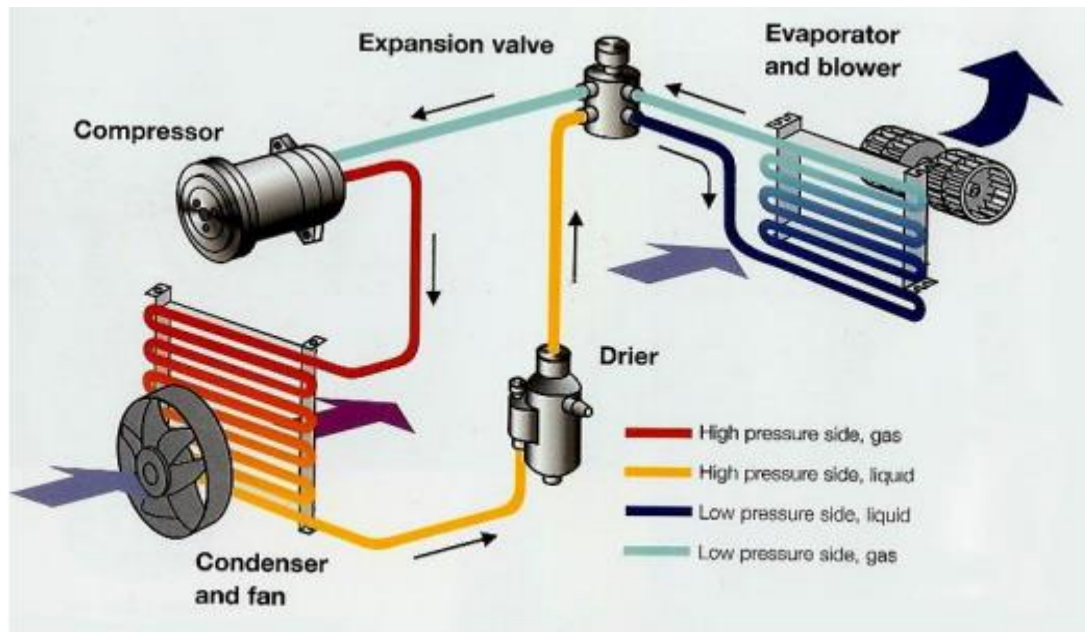
### 1.3 Types of Air Condition Arrangement in Automobile:

They have two type of air conditioning use in automobile are given below:

- 1) VCRC system
- 2) VARC system

#### 1) VCRC system:

Nowadays, the most commonly used air conditioning arrangement in automobiles is the VCRC arrangement, however this work provides a study of air conditioning in automobiles utilising the VARC arrangement with lithium bromide as absorber and freshwater as refrigerant. To achieve a cooling effect, experimental set-up is designed and built utilising various components.



**Figure 2: VCRC Arrangement in which Air Conditioning take Place[7].**

Figure 2 shows the vehicle's air conditioning system. The refrigerant is compressed and utilize a compressor, which increases pressure and temperature of refrigerant, causing refrigerant to evaporate. The refrigerant is now supplied through the condenser, where it experiences a phase change.

The pressure and temperature of the refrigerant are then reduced as it goes through expansion valve. After that, the cooled refrigerant is delivered via evaporator to produce the required cooling effects. The function of a blower is to push air through the evaporator in order to produce the necessary cooling within the vehicle's cabin. This refrigerant now absorbs heat from compartment's air and vaporises, before being supplied through compressor. As a consequence, a cooling effects is produced inside the vehicle.

## 2) VARC system:

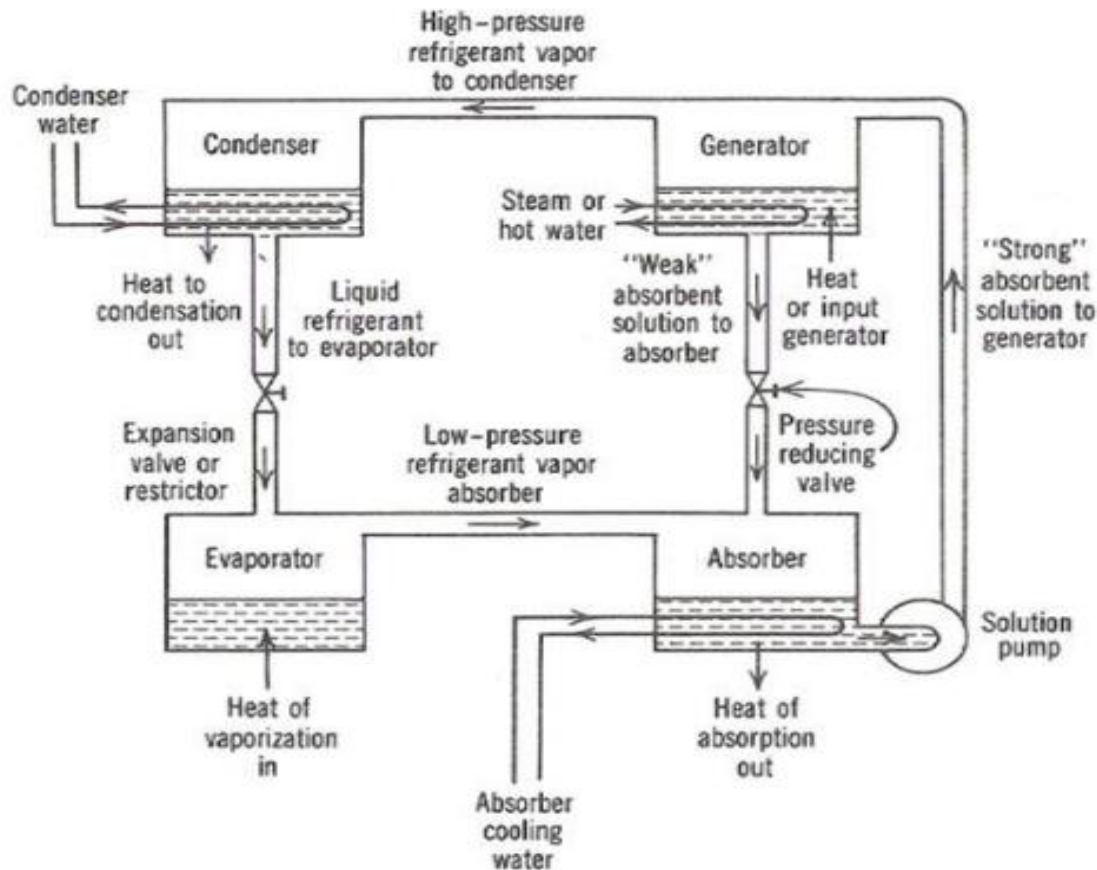
The compressors is substituted by such an absorbers, a pumps, a generation, and a volume reducing valve in the VARC system. Water is the most common refrigerant in the system where lithium bromide stays in liquid form and return back to the absorber. As an absorber we utilized Lithium Bromide instead of ammonia as indicated in Figure 3 There are primary two major drawbacks for not utilizing ammonia as a refrigerant:

1. Owing to its corrosive nature, ammonium as a coolant is incompatible with provided a good copper tube.
2. In large quantities, it is toxic.
3. Ammonia is ecologically beneficial.
4. Methane is three to ten percent more productive than CFCs as a refrigerant.

There are two major drawbacks of utilizing ammonia as a refrigerant:

1. It is not compatible with copper, therefore it cannot be utilized in any configuration with copper pipes.
2. Ammonia is toxic in large quantities. Two variables, however, reduce this risk: ammonia's characteristic scent is recognizable at quantities far below those thought to be hazardous, and ammonia is lighter than air, so if any does escape, it will ascend and evaporate in the sky.

The schematic design of this VARC setup is shown below in Figure 3.



**Figure 3: VARC Arrangement in which Arrangement in which Air Conditioning take Place[8].**

The evaporator & absorber are now on the low flow side of the system, while condensation and generator will be on the high-pressure side. Low refrigerants vapour from generator is reduced into low-pressure liquid refrigerant in the condenser and then supplied via the expansion valves into evaporator. So because absorbent is included in absorber, it changes into a strong hot solutions. This low-pressure strong solution is put into the high-pressure generator once again. The generator's powerful mixture was heated, separating vapour and solution. This low absorbency solution is returned to the absorber, and the highly pressurized vapours refrigerant is transported into condenser, completing cycle. Because the power needed for pumping is so minimal, a VARC system may offer a refrigerating effect without needing any mechanical energy. However, the refrigerating effect supplied by a VCRC installation is greater than simply that generated by a VARC setup of similar size.

#### *1.4 Advantages of VARC Arrangement over VCRC System:*

The benefits of VARC configuration over VCRC arrangement are mentioned below:

- The VARC System has no moving components.
- Because the operation is silent and sensitive to minimal wear, the VARC System's maintenance expenses are reasonably low.
- In compared to the motor needed for a compression arrangement of the same capacity in the VARC System, the pump motor in the VARC Arrangement is comparatively small.
- The compressor of the vapor compression cycle needs significant amounts of electricity for its operation and it rises as the size of the refrigeration system increases.
- The vapour absorption system is usually driven by waste or surplus heat in the plant. As a consequence, surplus steam again from boiler may be utilized, or additional steam can be produced and hot water can be used.
- The vapour compression refrigeration technology can only be powered by energy, and it uses a lot of it.



## 2. LITERATURE REVIEW

They have different researcher who investigate and experiment substitution of VCRC with VARC in Automobile in air Conditioning System. Tushar Charate et al. examined the energy from combustion engine's exhaust gas is frequently utilized to run an absorption refrigeration system that cools a conventional passenger vehicle. They use a chemical process to replace the mechanical processes of the VCRC arrangement, whereby energy from of the internal combustion engine's exhaust gas is used to power the VARS arrangement to cool a normal passenger car [9]

Divyesh Gajera studies Rather than VCRC, VARC with vehicle air conditioning is utilized. They simply utilize excess heat from engine exhaust as a source of energy, which improves efficiency by eliminating the use of fuel consumption. Ammonia is used as refrigerant on the refrigerant side. As a consequence, the environmental effect of HFCs is decreased. With that change, all current components except the compressor may be used as normal. However, in order for the system to operate effectively, a cost-effective heat producer / exchanger should be built [10].

Above the research scientist did study as well as test about the VCRC and VARC throughout vehicle for air con arrangement but those who did not give straightforward details about VCRC and VARC and added benefit of VARC placed above a white Serves an important purpose over VCRC but this paper will give all details regarding VCRC and VARC and so this paper inform how VARC is better than VCRC.

## 3. DISCUSSION

Automobile air conditioning is a system installed the vehicle that allows the inside air of car to be cooled in the hot weather, creating a cooler environment for the passengers. Condenser, evaporator, and compressor are the three major components of a car's air conditioning system. They essentially operate together to transfer a substance called refrigerant through a restricted arrangement with high or low pressures. Refrigerant is a vital component of air conditioning system and process because it converts from gasses to liquid and back to gases. Firstly, VCRC is to use in vehicle for air con which caused a decrease in effectiveness of engine so because exhaust from car is totally waste in surroundings but now a VARC is to use for the use of waste engine exhaust in cooling agreement which improves the effectiveness of motor and automobile. By the use of VARC coefficient of performance is lowers but it increases efficiency of engines and they balance it also by the use of VARC setup pollution also is reduce inside the environment by taking waste exhaust gases in refrigeration system. After examined many study paper we investigated the performance of absorbance refrigeration in vehicle refrigeration arrangement may be improved by the utilizing double effect and also semi generating absorber explanation heat exchanger method.

## 4. CONCLUSION

There is heat flow in exhaust fumes of a vehicle which can utilized to power air-conditioning equipment. Using a VARC cooling systems air conditioner inside a car not reduce the vehicle's fuel depletion, it will also have many other advantages, such as not significantly reducing the engine's performance. The lower number of COP (efficiency) is an indication that cycle modifications are needed. Aqua ammonia combination appears to excellent candidate as in work liquid for absorption car air conditioning system till additional fluids like glycol or water employed. This reduces possible danger of passenger. Scope for future work by utilizing this a compressors replaced easily with pump, absorber, generator and pressure dropping valves is replaces compressors which improves the efficiency of motor and simply use for any kind of vehicle.

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