A REVIEW ON STUDY OF AN AIR COMPRESSOR

Gohel Ketankumar Nathalal,
Lecturer in Mechanical engineering,
Government Polytechnic, Porbandar, India

Abstract: ***An air compressor is a device which converting mechanical energy into pneumatic energy. There are many types of compressor with different working principles and working condition. The function of all is to draw air from atmosphere and produce higher pressure air for different application. The present paper gives a brief introduction of an air compressor and its application, overhauling, condition monitoring and maintenance program of two stage reciprocating air compressors, a brief introduction to the latest developments of a compressed-air vehicle, development of compressed air engine and power source, effect of temperature on moisture separation in air compressor etc. A case study on compressor of a locomotive for improving performance and development of two stage reciprocating air compressor also studied.***

Index Terms – Air compressor, Compressed Air Vehicle, Overhauling, Moisture Separation.

I. INTRODUCTION

It is a mechanical component (machine) to compress the air with raise its pressure. The air compressor sucks air from the atmosphere and compresses it then further delivers with a high pressure to a storage vessel. From the storage vessel, it may be transmit by the channel (pipeline) to a place where the supply of compressed air is required. Afterward the compression of air requires some work to be done on it; therefore a compressor must be driven by some prime mover.

II. APPLICATION OF AIR COMPRESSOR

The main uses of high-pressure (compressed) air are:

… to drive compressed air engines (air motors) used in coal mines,
… to inject or spray fuel into the cylinder of a Diesel engine (air injection Diesel engine),
… to operate drills, hammers, air brakes for locomotives and railway carnages, water Pumps and paint sprays,
… to start large (heavy) Diesel engines,
… for cleaning workshop machines, generators, automobile vehicles, etc.,
… to operate blast furnaces, gas turbine plants, Bessemer convertors used in steel plants, etc,
… to cool large buildings and air crafts, and to supercharge I.C. engines.[1]

1.2 Classification of Air Compressors

Compressors are broadly classified as 1. Positive displacement compressor and 2. Dynamic compressor.

Positive displacement compressors increase the pressure of the gas by reducing the volume. Positive displacement compressors are further classified as reciprocating and rotary compressors.

Dynamic compressors increase the air velocity, which is then converted to increased pressure at the outlet. Dynamic compressors are basically centrifugal compressors and are further classified as radial and axial flow types.

The flow and pressure requirements of a given application determine the suitability of a particulars type of compressor.

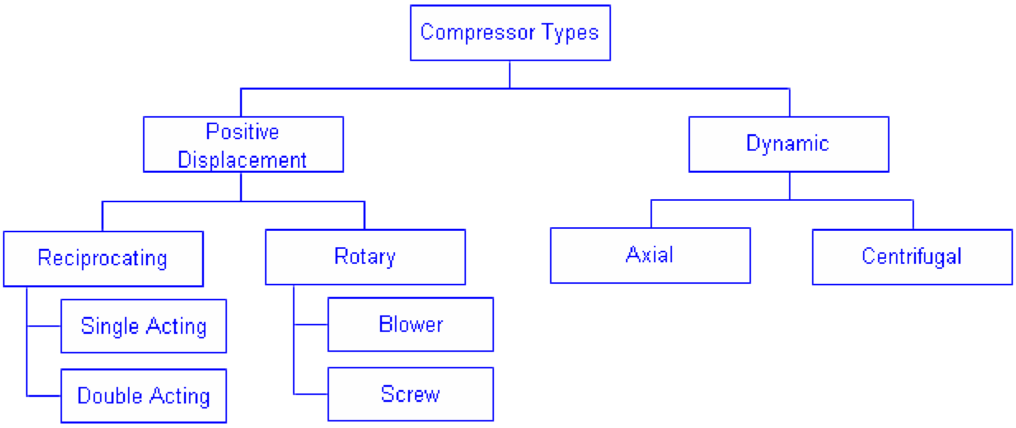

Figure 1.1 Compressor types based on operating principles

1.2.1 Positive-Displacement Compressor

Positive displacement compressors deliver a fixed volume of air at high pressures; it commonly can be divided into two types: rotary compressors and reciprocating compressors. In all positive displacement machines, a certain inlet volume of gas is confined in a given space and subsequently compressed by reducing this confined space or volume. At this elevated pressure, the gas is next expelled into the discharge piping or vessel system.

1.2.1.1 Reciprocating Compressors

The reciprocating, or piston compressor, is a positive displacement compressor that uses the movement of a piston within a cylinder to move gas from one pressure level to another higher pressure level. Reciprocating compressors might be considered as single acting, when the compressing is accomplished using only one side of the piston, or double acting when it is using both sides of the piston. They are used mainly when high-pressure head is required at a low flow. Generally, the maximum allowable discharge-gas temperature determines the maximum compression ratio. Reciprocating compressors are furnished in either single-stage or multistage types. For single stage design, the entire compression is accomplished with a single cylinder or a group of cylinders in parallel.

Intercoolers are provided between stages on multistage machines. These heat exchangers remove the heat of compression from the gas and reduce its temperature to approximately the temperature existing at the compressor intake. Such cooling reduces the volume of gas going to the high-pressure cylinders, reduces the power required for compression, and keeps the temperature within safe operating limits.

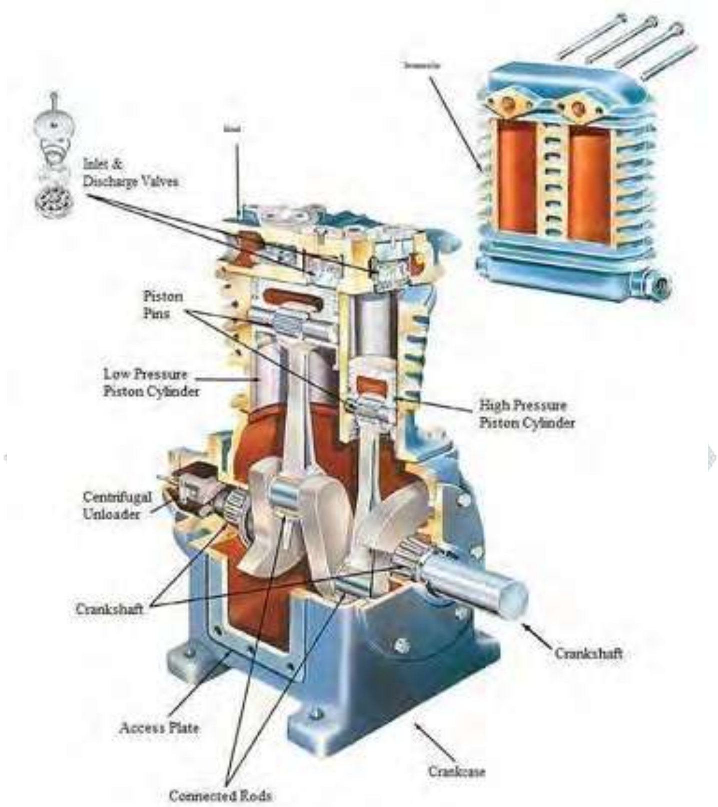

Figure 2.2 Compressor Reciprocating Two-stage, Two Cylinder.

Typical compression ratios are about 3 per stage to limit discharge temperatures to perhaps 300 ^{0}F to 350°F. Some reciprocating compressors have as many as six stages, to provide a total compression ratio over 300.

The intake gas enters the suction manifold into the cylinder because the vacuum condition is created inside the cylinder as the piston moves downward. After the piston reaches its bottom position it begins to move upward. The intake valve closes, trapping the gas fluid inside the cylinder. As the piston continues to move upward it compresses the gas fluid, increasing its pressure. The high pressure in the cylinder pushes the piston downward. When the piston is near the bottom of its travel, the exhaust valve opens and releases high pressure gas fluid. Some advantages and disadvantages of reciprocating compressor are as in Table 1.1

Table 1.1 Advantages and disadvantages of reciprocating compressor

Advantage	Disadvantage
Simple design, easy to install	Higher maintenance cost
Lower initial cost	Many moving parts
Large range of horsepower	Potential for vibration problems
Special machines can reach extremely high Pressure	Foundation may be required depending on Size
Two stages models offer the highest efficiency	Many are not designed to run at full capacity

1.2.1.2 Rotary Compressors

Rotary compressor is a group of positive displacement machines that has a central, spinning rotor and a number of vanes. This device derives its pressurizing ability from a spinning component. The units are compact, relatively inexpensive, and require a minimum of operating attention and maintenance. In a rotary compressor, the pressure of a gas is increased by trapping it between vanes which reduce it in volume as the impeller rotates around an axis eccentric to the casing. It is pictured below in Fig.1.4

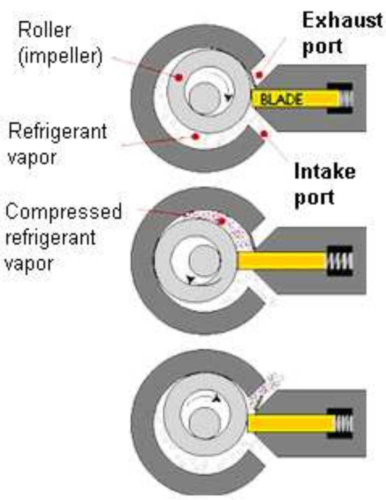

Figure 1.3 Rotary compressor

The volume can be varied only by changing the speed or by bypassing or wasting some of the capacity of the machine. The discharge pressure will vary with the resistance on the discharge side of the system. Rotary compressors are generally classified as screw compressor, vane type compressor, lobe and scroll compressor. The main difference between each type is their rotating device. The advantages and disadvantages of rotary compressor are shown in a table 1.2.

Table 2.2 Advantages and disadvantages of rotary compressor

Advantage	Disadvantage
Simple design	High rotational speed
Low to medium initial and maintenance Cost	Shorter life expectancy than any other designs
Two-stages design provide good efficiencies	Single-stage designs have lower efficiency
Easy to install	Difficulty with dirty environment
Few moving parts	

1.2.2 Dynamic Compressor

Dynamic compressor is a continuous-flow compressor which includes centrifugal compressor and axial flow compressor. It is widely used in chemical and petroleum refinery industry for specifies services. They are also used in other industries such as the iron and steel industry, pipeline booster, and on offshore platforms for reinjection compressors.

The dynamic compressor is characterized by rotating impeller to add velocity and pressure to fluid. Compare to positive displacement type compressor, dynamic compressor are much smaller in size and produce much less vibration.

1.2.2.1 Centrifugal Compressor

The centrifugal compressor is a dynamic machine that achieves compression by applying inertial forces to the gas (acceleration, deceleration, and turning) by means of rotating impellers. It is made up of one or more stages; each stage consists of an impeller as the rotating element and the stationary element, i.e. diffuser. There are two types of diffuser: vane less diffusers and vaned diffusers.

Vane less diffuser is widely used in wide operating range applications, while the vane less diffuser is used in applications where a high pressure ratio or high efficiency is required. Those parts of centrifugal compressor are simply pictured in Fig 1.4.

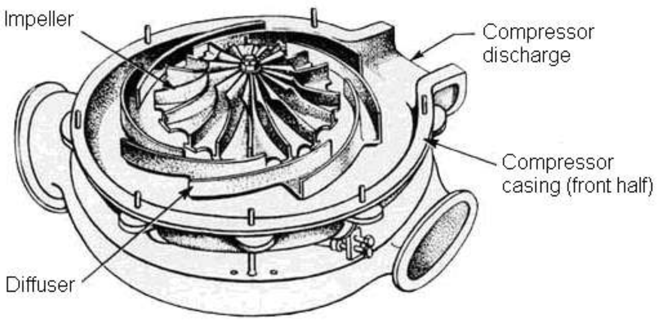

Figure 1.4 Centrifugal Compressors

In centrifugal compressor, the fluid flow enters the impeller in an axial direction and discharged from an impeller radially at a right angle to the axis of rotation. The gas fluid is forced through the impeller by rapidly rotating impeller blades. The gas next flows through a circular chamber (diffuser), following a spiral path where it loses velocity and increases pressure.

The deceleration of flow or “diffuser action” causes pressure build-up in the centrifugal compressor. Briefly, the impeller adds energy to the gas fluid, and then the diffuser converts it into pressure energy.

The maximum pressure rise for centrifugal compressor mostly depends on the rotational speed (RPM) of the impeller and the impeller diameter. But the maximum permissible speed is limited by the strength of the structural materials of the blade and the sonic velocity of fluid; furthermore, it leads into limitation for the maximum achievable pressure rise.

Hence, multistage centrifugal compressors are used for higher pressure lift applications. A multistage centrifugal compressor compresses air to the required pressure in multiple stages.

Typical centrifugal for the single-stage design can intake gas volumes between 100 to 150,000 inlet acfm. A multi-stage centrifugal compressor is normal considered for inlet volume between 500 to 200,000 inlet acfm.

It designs to discharge pressures up to 2352 psi, which the operation speeds of impeller from 3,000 rpm to higher. There is limitation for velocity of impeller due to impeller stress considerations; it is ranged from 0.8 to 0.85 Mach number at the impeller tip and eye. Centrifugal compressors can be driven by electrical motor, steam turbine, or gas turbines.

The advantages and disadvantages of centrifugal compressor can be summarized into a table 1.3.

Table 3.3 Advantages and disadvantages of centrifugal compressor

Advantage	Disadvantage
High efficiency approaching two stages reciprocating compressor	High initial cost
Can reach pressure up to 1200 psi	Complicated monitoring and control systems
Completely package for plant or instrument air up through 500 hp	Limited capacity control modulation, requiring unloading for reduced capacities
Relatives first cost improves as size Increase	High rotational speed require special bearings and sophisticated vibration and clearance monitoring Specialized maintenance considerations
Designed to give lubricant free air	
Does not require special foundations	

1.2.2.2 Axial Flow Compressor

Axial flow compressors are used mainly as compressors for gas turbines. They are used in the steel industry as blast furnace blowers and in the chemical industry for large nitric acid plants.

Compare to other type of compressor, axial flow compressors are mainly used for applications where the head required is low and with the high intake volume of flow. The efficiency in an axial flow compressor is higher than the centrifugal compressor. They are available in sizes producing pressures in excess of 100 psi at intake volumes between 23,500 to 588,500 acfm.

The component of axial flow compressor as shown in Figure 1.5 consist of the rotating element that construct from a single drum to which are attached several rows of decreasing-height blades having airfoil cross sections. Between each rotating blade row is a stationary blade row. All blade angles and areas are designed precisely for a given performance and high efficiency.

One additional row of fixed blades (inlet guide vanes) is frequently used at the compressor inlet to ensure that air enters the first stage rotors at the desired angle. Also, another diffuser at the exit of the compressor might be added, known as exit guide vanes, to further diffuse the fluid and control its velocity.

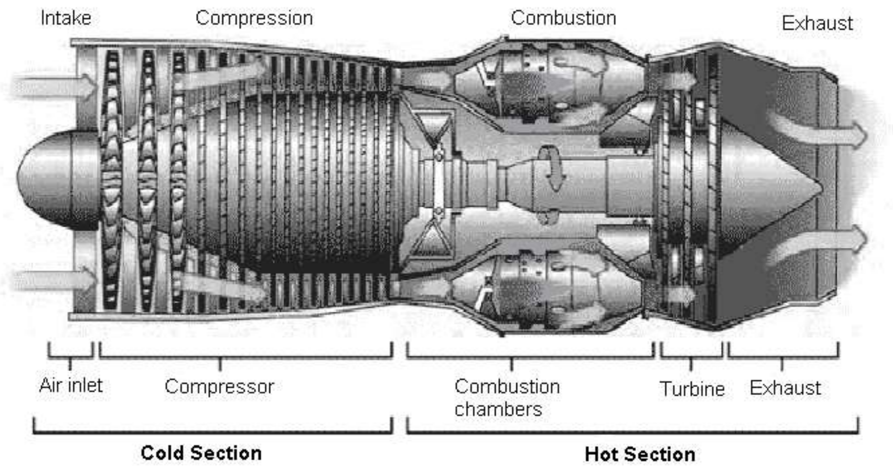

Figure 1.5 Axial flow compressor.

Axial flow compressors do not significantly change the direction of the flow stream; the fluid flow enters the compressor and exits from the gas turbine in an axial direction (parallel with the axis of rotation). It compresses the gas fluid by first accelerating the fluid and then diffusing it to increase its pressure.

The fluid flow is accelerated by a row of rotating airfoils (blades) called the rotor, and then diffused in a row of stationary blades (the stator). Similar to the centrifugal compressor, the stator then converts the velocity energy gained in the rotor to pressure energy. One rotor and one stator make up a stage in a compressor. The axial flow compressor produces low pressure increase, thus the multiple stages are generally use to permit overall pressure increase up to 30:1 for some industrial applications.

Driver of axial flow compressor can be steam turbines or electric motors. In the case of direct electric motor drive, low speeds are unavoidable unless sophisticated variable frequency motors are employed. Here are the advantages and disadvantages of axial flow compressor as in table 1.4. [2]

Table 4.4 Advantages and disadvantages of Axial flow compressor

Advantage	Disadvantage
High peak efficiency	Good efficiency over narrow rotational speed range
Small frontal area for given airflow	Difficulty of manufacture and high cost.
Straight-through flow, allowing high ram efficiency	Relatively high weight
Increased pressure rise due to increased number of stages with negligible losses	High starting power requirements

1.3 Important Definitions:

1. Inlet pressure: It is the absolute pressure of air at the inlet of a compressor.

2. Discharge pressure: It is the absolute pressure of air at the outlet of a compressor.

3. Compression ratio (or pressure ratio): It is the ratio of discharge pressure to the inlet pressure. Since the discharge pressure is always more than the inlet pressure, therefore the value of compression ratio is more than unity.

4. Compressor capacity: It is the volume of air delivered by the compressor, and is expressed in m3/min or m3/s.

5. Free air delivery: It is the actual volume delivered by a compressor when reduced to the normal temperature and pressure condition. The capacity of a compressor is generally given in terms of free air delivery.

6. Swept volume: It is the volume of air sucked by the compressor during its suction stroke.

Mathematically the swept volume or displacement of a single acting air compressor is given by

$$V_s = (\pi/4) * D^2 * L$$

Where D = Diameter of cylinder bore, and
L = Length of piston stroke.

7. Mean effective pressure: As a matter of fact, air pressure on the compressor piston keeps on changing with the movement of the piston in the cylinder. The mean effective pressure of the compressor is found out mathematically by dividing the work done per cycle to the stroke volume.

2. IMPROVING PERFORMANCE AND DEVELOPMENT OF TWO STAGE RECIPROCATING AIR COMPRESSOR

R.C.Wadbudhe, Akshay Diware, Praful kale presents a case study on reciprocating air compressor of a locomotive highlighting the associated problems, diagnosis and effective solutions supported by appropriate maintenance strategies for overhauling and repairing arising out due to frequent failure of parts.[3]

According to an aspect of the invention, they prepare a two stage reciprocating compressor includes a casing; a first compressing unit disposed in the casing and including a first piston and a first cylinder, the first compressing unit being driven by a reciprocating motor to linearly reciprocate the first piston in the first cylinder to suck in and compress gas; a second compressing unit disposed in the casing and including a second piston and a second cylinder, the second compressing unit being driven by vibration of the first compressing unit to linearly reciprocate the second piston in the second cylinder to suck in and compress gas; and a vibration transfer member that transfers the vibration from the first compressing unit to the second compressing unit. The first and second compressing units extend in parallel and face toward each other. The test rig as shown in Figure 2.1.

Figure 2.1 Test rig of Two stage reciprocating Air compressor.

In their compressor, the first compressing unit and the second compressing unit may be configured such that the first piston of the first compressing unit and the second piston of the second compressing unit are moved in opposite directions. The first compressing unit and the second compressing unit may have opposite sucked gas flowing directions. The first piston of the first compressing unit and the second piston of the second compressing unit may be aligned. The second piston of the second compressing unit may be fixedly-coupled to the vibration transfer member, and a support frame may be coupled with the second cylinder.

Table 5.5 Technical Specification of Test Rig

Sr no	Compressor Specification	Motor Specification	Other Specification
1	Bore of low pressure (L.P) Cylinder = 70 mm	Power = 2 H.P	Diameter Of Orifice = 90 MM
2	Bore of High pressure(H.P)Cylinder = 50 mm	Phase = 3	Diameter of motor Pulley = 770 MM
3	Stroke of L.P Cylinder = 75 MM	Rated Power = 1400 Rpm	Diameter of Compressor Pulley =1880MM
4	Stroke of H.P Cylinder = 75 MM		
5	Rated Speed = 670 MM		
6	Maximum Working Pressure = 10.3421 Bar		
7	Air receiver capacity = 0.16 m3		

Finally they concluded that, the simulation model of variable speed air compressor provides a satisfactory performance study. The model can predict volumetric efficiency; free air delivered, indicated power, shaft power, cylinder air pressure, cylinder air temperature, resultant torque and mass of air drawn in or discharged out per cycle, by varying any operating parameters like, speed, discharge pressure, etc., and physical parameters like, clearance volume, crank radius, connecting rod length and cylinder diameter.

3. LATEST DEVELOPMENTS OF A COMPRESSED AIR VEHICLE.

S. S. Verma gives a brief introduction to the latest developments of a compressed-air vehicle along with an introduction to various problems associated with the technology and their solution. While developing of compressed air vehicle, control of compressed air parameters like temperature, energy density, requirement of input power, energy release and emission control have to be mastered for the development of a safe, light and cost effective compressed air vehicle in near future..[4]

Compressed air car engines are fueled by a tank of compressed air, instead of an engine that runs with pistons and an ignited fuel air mixture. Basically, compressed air cars are powered by the expansion of compressed air. Vehicles that run on compressed air sound like a fantastic idea on paper, but bringing this technology to the masses have proven, well, a difficult road to travel because of some inherited technical problems with compressed air.

In this article author gives a brief report to highlight such problems associated with the technology and their solution like Engine Technology, Air Storage & Refueling, Input Energy, Temperature Control, Multistage Compression, Properties of compressed air Energy Released, Adiabatic Expansion and Pollutant Emissions so that some methods can be designed to counter to improve the efficiency of compressed air vehicle. Figure 3.1 shows the typical control characteristics of energy release by the compressed air on its isothermal or adiabatic expansion as a function of compressed air pressure, volume of compressed air and flow rate.

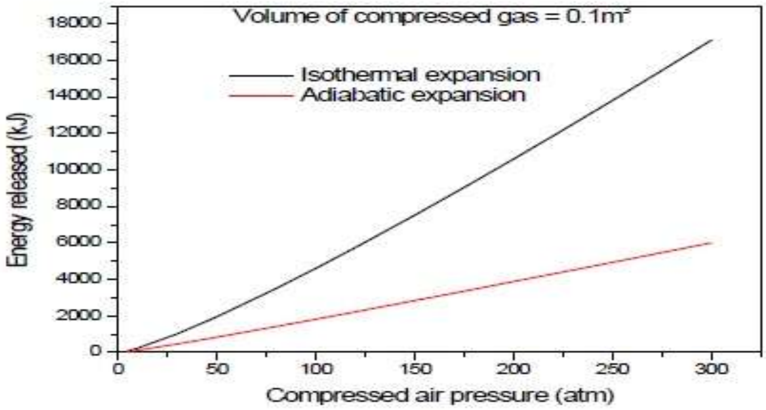

Figure 3.1 Energy released as a function of compression pressure at constant volume of compressed air.

Finally he concluded that, The storage of compressed air (initially as well as during journey) with all benefits like no heating, high energy density and provisions to make use of cooling produced during adiabatic expansion during the energy release have to be taken care off in a much more controlled manner. Electric-powered cars and bikes already available on the market put a strong competition to compressed air car not only in terms of cost but also their environment friendly role. The technology still looks distant but that has not deterred inventors from working on it.

4. STUDY AND DEVELOPMENT OF COMPRESSED AIR ENGINE AND THERE POWER SOURCE.

Gauravkumar Tandan in his review study reveals aim is to run the four strokes bike with help of compressed air, it will try to achieve a 50 km/h speed and range of refilling compressed air is after running of 70-80 km.[5]

Two technologies have been developed to meet different need

(1) Single energy compressed air engines.

(2) Dual energy compressed air plus fuel

The single energy engines will be available in both Minicabs and City cats. These engines have been conceived for city use, where the maximum speed is50 km/h and where MDI (Motor Development International) believes polluting will soon be prohibited with use of compressed air technology which having zero pollution level. The dual energy engine, on the other hand, has been conceived as much for the city as the open road and will be available in all MDI vehicles. The Layout of compressed air engine as shown in figure 4.1.

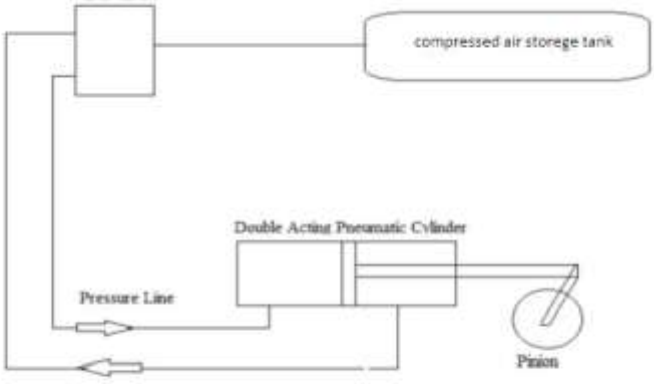

Figure 4.1 The Layout of compressed air.

At last author gives his idea that, It is important to remember that while vehicles running on only compressed air might seem like a distant dream, but they still have public interest due to their environmental friendly nature. After ten years of research and development, the compressed air vehicle will be introduced worldwide. If further improvement is carried out with stress analysis, thermodynamic analysis, minimize compressed energy loss and other losses then efficiency of CAE may be further increases.

5. CONDITION MONITORING AND MAINTENANCE PROGRAM OF TWO STAGE RECIPROCATING AIR COMPRESSOR

Jitendra Kumar Sasmal , Amit Suhane, Geeta Agnihotri presented an article that highlights the different failure modes of reciprocating compressor under varied operating conditions along with the appropriate maintenance strategies to diagnose and tackle the problems occurring very often. Condition monitoring technique is a vital step in maintaining the condition of working equipment at normalcy. It helps in detecting the premature and catastrophic failures leading to drastic productivity and system deterioration. [6]

5.1 Maintenance Strategies

Maintenance strategies define the sequence of proper maintenance work held in industries. Many maintenance strategies are available few of them are as shown in Figure 5.1

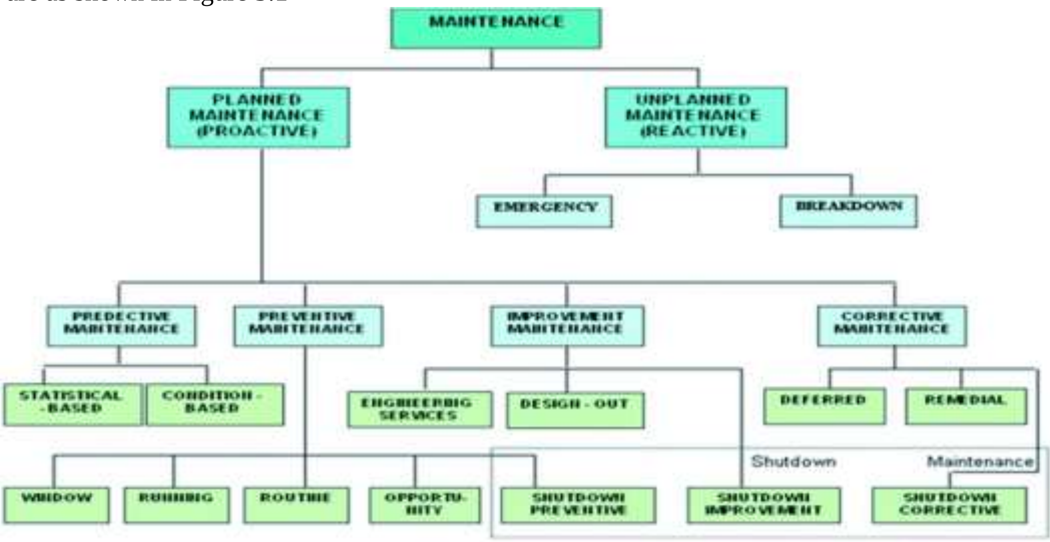

Figure 5.1 Maintenance strategies

5.2 Failure Modes of Reciprocating Compressor

The failure of air compressor may be results of many factors such as Electrical and Mechanical. In electrical failure includes system control problems, overheating and single phasing. In mechanical failure includes cylinder leakage, inoperative suction and discharge valves, damage piston rings, and damage crankshaft, cylinder fail to move, damage connecting rods and unbalance of crankshaft. Some time air compressor fail due to improper operation, improper application, and improper cleaning purpose. Table 5.1 represents the failure modes of air reciprocating compressor due to different causes and effects of these failure on compressor.

Table 5.1 Failure modes, cause and effect

Sr. No.	Failure types	Cause of failure	Effect of failure
1	Cylinder fail to move	valves fail to open	Loss of gas output
2	Cylinder leakage	Mechanical wear, Damage seal	Reduces compressor efficiency
3	Damage piston rings	Low compressor oil, Wear out	Permanent compressor failure
4	Inoperative suction and discharge valve	Valve leakage, Discharge valve open to fail	Reduces compressor efficiency
5	Damage cylinder packing rings	Moisture entering cylinder	Permanent valve damage, Reduces compressor efficiency
6	Damage crankshaft, connecting rod	Mechanical bending, Loss of lubricants	Noisy compressor, Shutdown of compressor
7	Unbalance crankshaft	Misalignment, Mechanical bending	Noisy compressor
8	Failure of piston rod	Wear, Excessive duty cycle	Compressor failure

5.3 Maintenance Procedures

Although monitoring of reciprocating compressors is not as simple and definitive as monitoring other rotating equipment, there are some things that can be and should be monitored. The first step in the program is to decide what is to be monitored. An effective predictive maintenance program should include the following:

… Daily Operating Reports and Logs,
… Maintenance Records and Wear Measurements,
… Infrared Thermography,
… Lubricating Oil Monitoring,
… Vibration Monitoring,

… Acoustic Emissions or Ultrasonic Detection,

… Oscilloscope Analyzers.

Finally they concluded that proper maintenance program of reciprocating compressor increases the reliability, availability and decrease the downtime, maintenance cost of machine. Maintenance program also helps in increasing the productivity and effectiveness of reciprocating compressor.

6. OVERHAULING OF TWO STAGE RECIPROCATING AIR COMPRESSOR OF A CONVENTIONAL LOCOMOTIVE

Ravishankar, Amit Suhane, Manish vishwakarma presents a case study on reciprocating air compressor of a locomotive highlighting the associated problems, diagnosis and effective solutions supported by appropriate maintenance strategies for overhauling and repairing arising out due to frequent failure of parts.[7]

6.1 Application of Air Compressor in Locomotive

Compressed air in locomotive is used for the locomotive brake system as well as for secondary Air Conditioning, Air Brake, Exhauster, Train Horns, and Wind Shield Wipers etc. Figure 6.1 shows a typical arrangement for compressed air supply on a locomotive. The main items of equipment are a compressor, cooling pipes, an air dryer, a storage reservoir and controls.

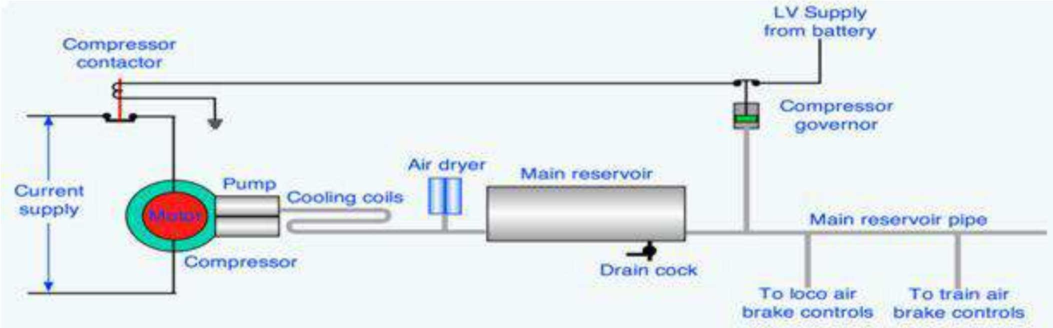

Figure 6.1 Schematic of compressed air supply on electric locomotive.

6.2 Overhauling Procedure of Reciprocating Air Compressor

Maintenance schedule proposed to perform an audit on the reciprocating compressor to determine the cause of failing. During these schedules, vibration measurements, visual inspections foundation are performed. Besides this, the maintenance planning, technical data use of wearable parts is reviewed. These comprehensive compressors schedule allow us to draw up the condition of compressor and propose potential solutions. The schedule showed that an overhauling of the reciprocating compressor was necessary to prevent wear of moving parts and auxiliaries would lead to an unplanned shutdown. Additionally, it was advised to renew the compressor foundation. To ensure its continuous operation, scheduling the overhaul becomes necessity. Steps involved in overhauling of reciprocating compressor are as under:

1. Compressor for Overhauling
2. Check the compressor suitability for application
3. Check the efficiency of compressor by Volumetric Efficiency Test
4. Connect the compressor to Compressor Testing Panel
5. Calculate the efficiency of compressor for overhauling
6. Take the decision for overhauling of compressor
7. Replacement of parts on the basis of dimensional accuracy and precession
8. Evaluate the economical analysis of cost of repair and replacement.

6.3 Tests on Overhauled Compressor

Following tests are conducted on overhauled compressor

a. Temperature rise test
b. Leak back test
c. Vacuum test
d. Sub merge test
e. Volumetric efficiency test

Based on the finding of case study, the conclusions are as summarized:

1. Appropriate overhauling strategy reduces the chance of uncertainty in failure and extra maintenance cost.
2. Inspections and checks of dimensional clearance using appropriate gadget, tool, and devices, increase the accurate decision regarding replacement and overhauling as per need.
3. Skills of labor help in time saving, which intern increase the productivity.
4. Economical study perform on the reciprocating air compressor suggest good savings by implementing the modified strategy.

7. EFFECT OF TEMPERATURE ON MOISTURE SEPARATION IN AIR COMPRESSOR

Suraj Ghiwe, K.V. Srinivasan, Kiran Chaudhari presented works that explore the effect of temperature on the filter performance of a Compressor i.e. filter efficiency and the pressure drop across it. Both experimental analysis as well as CFD analysis has been carried out to study the performance of filter at various temperature in the range of 10 0C to 35 0C. [8]

The effect of temperature on the filtration of compressed air through coalescing filter was analyzed. Coalescer filter media are specifically designed to remove submicron droplets from compressed air. Coalescence occurs when two drops merge into one droplet. Droplets carried by the air are captured or their velocities are slowed by the fibers within the filter medium. Trailing droplets collide with the leading droplets. When two colliding drops stay in contact long enough, and the collision has sufficient energy, the two drops merge into one drop. This may occur whether the drops are physically attached to fibres or not. Drops that are attached to fibres may also merge due to a thin liquid film spreading between the drops on a fibre. The Coalescence filtration occurs in 3 steps are as under:

1. Droplets are captured on the fibers.

2. Captured droplets coalesce into larger drops.
3. The enlarged drops migrate through the medium.

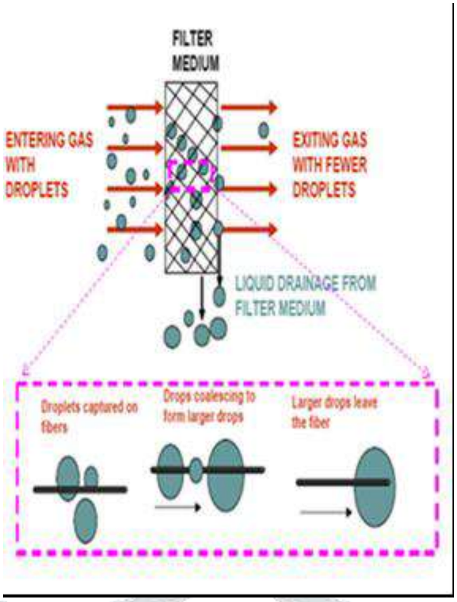

Figure 7.1 Coalescing Filtration

The overall filter performance depends upon the combination of particle capture, droplet coalescence, and liquid drainage. Initially the filter medium is liquid free. At the start of the filtration, drops collect but little or no drainage occurs. As the liquid concentration in the filter increases the liquid will start to drain from the filter. The filter continues to accumulate oil until the collection rate is balanced by the drainage rate at which point the filter operates at steady state.

For CFD analysis model of the existing filter were made by using software SOLID WORKS and then it was imported to the ANSYS 14.5 for further simulation work.

Experimental results shows that the efficiency of filter were maximum in the range of 15 ˚C to 20 ˚C. CFD results shows that pressure drop is 0.2 bar across the filter and the efficiency of filter is maximum i.e. 99% in the range of 15 ˚C to 20 ˚C. It shows that the maximum of the moisture removed in the filter and hence desiccant chamber is protected against the contamination. Hence life of system components increases.

8. CONCLUSION

Various applications and potential areas for an air compressor from literature have been described. The simulation model of variable speed air compressor provides a satisfactory performance study. Proper maintenance program of reciprocating compressor increases the reliability, availability and decrease the downtime, maintenance cost of machine. Appropriate overhauling strategy reduces the chance of uncertainty in failure and extra maintenance cost.

REFERENCES:

[1] R.C.Patel & C.J.Karamchandani, Elements of Heat Engine Volume-I, pp 342.
[2] KLM Technology Group Practical Engineering Guidelines for Processing Plant Solutions, pp 6-7, 10-12.
[3] R.C.Wadbudhe, Akshay Diware, Praful kale, International Journal of Research In Science & Engineering, Volume: 3 Issue: 2 March-April 2017,pp 272-279.
[4] S. S.Verma, Global journal of Research in Engineering, Volume xiii, ISSN: 2249-4596, issue 1, year 2013, pp 15-23.
[5] Gaurav Kumar Tandan, International Journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 11, November 2015, ISSN: 2278 – 7798 pp 3770-3774
[6] Jitendra Kumar Sasmal, Amit Suhane, Geeta Agnihotri, International Journal of Science and Research, ISSN (Online): 2319-7064, Volume 4 Issue 6, June 2015,pp 2596-2601
[7] Ravi Shankar, Amit suhane, Manish vishwakarma,International Research Journal of Engineering and Technology, Volume: 03 Issue: 04,year 2016, e-ISSN: 2395 -0056,pp 653-664.
[8] Suraj Ghiwe, K.V. Srinivasan, Kiran Chaudhari, International Journal of Scientific Engineering and Applied Science,Volume-1, Issue-2, year 2015, ISSN: 2395-3470,pp297-302