A REVIEW ON IMPROVING PERFORMANCE AND DEVELOPMENT OF TWO STAGE RECIPROCATING AIR COMPRESSOR

Jayesh R. Patil[1], R.K. Bhagat, H.S. Patil [3]

[1]Student of Mechanical Design Engineering, VIT, Pune
[2]Asst. Prof. of Mechanical Engineering Department, VIT, Pune
[3]Sr. Manager at Kirloskar Pneumatic Company Ltd, Pune

Abstract - *The most effective part in the development of a reciprocating compressor depends strongly on improvement of its performance. For this purpose, a performance characteristic evaluation of a two stroke reciprocating air compressor is carried out in this paper. The aims were to improve compressor performance by illustrating the effects of various parameters such as clearance between head and piston, stroke length, friction losses, compressor running time, background working condition and air leakage. The effect of each parameter was compared with given performance condition and after it was demonstrated the most important parameter on the performance. The parameter was measured using three techniques. The experiment addressed some factors that led to the inefficient performance of the reciprocating compressor air system and cause energy losses. The results advocate the optimal time for starting time for starting each stage of the two–stage reciprocating compressor. The work in addition may give the insight for the development of the design of multi-stage compression and presents some key design parameter.*

***Key Words*: Volumetric Efficiency, Performance, FAD**

1. INTRODUCTION

Compressor is a device used to increase the pressure of compressible fluid, either gas or vapor, by reducing specific volume of the fluid during passage of the fluid through compressor. The compressors used to compressed the air are called air compressors. Compressors are invariably used for all applications which required pressurized air. One of basic aim of compressor usage is to compressed the fluid and then deliver it to a higher pressure than its original pressure. The inlet and outlet pressure level are varying, from a deep vacuum to a high positive pressure, depends on required process necessity. This inlet and outlet pressure is compared corresponding with the type of compressor and its configuration. Reciprocating compressors generally have piston-cylinder arrangement where displacement of piston in cylinder causes rise in pressure. Reciprocating compressors are capable to give large pressure ratios but the mass handling capacity is limited or small. Reciprocating compressors may also be single acting compressor or double acting compressor. Single acting compressor has one delivery stroke per revolution while in double acting there are two delivery strokes per revolution of crank shaft.

2. LITERATURE SURVEY

The method of evaluating the cooling capacity of reciprocating compressor tanks is proposed by P. Grolier [1] to do the calculation of the volumetric efficiency and the estimated the suction gas temperature in the suction plenum of the cylinder-head of compressor. The determination of considered thermodynamic properties required in the calculation. This thermodynamic properties are enthalpy difference between super-heat and sub-cooled points and suction gas density. The given paper proposes a method of evaluating the performance of reciprocating compressors. The simulation of the capacity and the compression work under various operating conditions can predict a good idea of the compressor performance. A method has been described to predict the given performance of reciprocating hermetic compressors for refrigeration. This paper gives analytical formulas of the volumetric efficiency and suction gas temperature was proposed. The given method present in the paper can help the designer to estimate the cooling capacity at early step of his design process.

According to Xiongpo Hou [2] energy efficiency and power factor were most essential performances for compressor unit driven by inverter-fed motors. The performances are simulated utilizing a parametric linear model under variable-frequency and variable conditions in this paper. The results shows that, at given rated frequency, both the performances would fall down with lighter load, if frequency was reduced from rated, energy efficiency would fall even lower, though power factor rise up slightly. By comparison, at beyond rated frequencies both the performances would go better. The results also shows that whether at infra-frquencies or ultra-frequencies, the motor overload capability was more restricted, so it could only be adopted in light-load conditions. This research could be helpful for optimization and energy saving of reciprocating compressor units running under variable frequencies and variable working conditions.

Numerical and experimental investigations was proposed by Adolf Burgstaller [3] to quantify the influence of main parameters of the suction valve on the overall performance of the compressor. The thermodynamic cycle calculation is performed by using software AVL BOOST & CFD. The calculation model shows the whole compressor domain between shell inlet and outlet. The dynamic valve displacement were calculated using an equivalent spring-damper mass system. The experiments are effected on a calorimetric test bench. A big influence of the flow coefficient is found during the study. The small change in flow coefficient leads to a higher valve lift and vice versa. Therefore the valve port geometry and the main valve parameters should be coordinated.

According to Robert B. Grisbrook [4] gap is provided between the recess and the space above the piston and cylinder head, increasing the initial pressure above the piston and causing greater pressure to be developed during the compression stroke. The result is an increase in the volumetric efficiency of the compressor. It is an object of the present invention to provide an improved reciprocating compressor which may be utilized for compressing air and other gases, such as, for example, air conditioning, heat pumps, pneumatic compression, and for various other gas compression purposes.

According to Takuma Tsuji [5] Calculations of the mechanical efficiency of a large reciprocating compressor are developed. The optimal combination parameters yielding the maximum mechanical efficiency could be determined, and then compared with the empirical combination used in the Mayekawa compressor. The mechanical efficiency was calculated for various combinations of piston diameter and stroke at operating speeds of 800, 1000 (rated) and 1200 rpm. The optimal combinations of the piston diameter and stroke were determined.

According to Xinye Zhang [6] the mechanical efficiency was calculated for various combinations of piston diameter and stroke at operating speeds of 800, 1000 (rated) and 1200 rpm. The optimal combinations of the piston diameter and stroke were determined. Several experimental measurements with different target pressures and run times have been conducted using $CO2$ as the working fluid. The following parameters have been recorded: pressures, temperatures, surface temperatures, and pressure ratios. Simulation model has been created to predict compressor performance and model predictions were validated through the use of the acquired test data.

According to R.C.Wadbudhe [7] 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

The given study introduced the use of side inlet ports proposed by S. A Parker [8] to improve volumetric efficiency. The author unexplored third use of the side inlet ports can be used for compressors in the high compression ratio range where additional lubrication of the piston ring as well as the suction and discharge valve is needed. By placing the inlet port at the near bottom dead center of the compression stroke, and by proper design where these inlets communicate to the crankcase an oil mist could be admitted into the cylinder chamber. Author conclude that find that the cylinder side inlet hole would give them even superior lubrication over a wider range of performance possibly at reduced costs.

3. SUMMARY

A two stage reciprocating compressor includes a casing. A first compressing unit is disposed in the casing and includes a first piston and a first cylinder. The first compressing unit can be drive by using reciprocating motor to linearly reciprocate the first piston in the first cylinder to suck in and compress gas. A second compressing unit will in the casing and includes 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 get gas in and compress gas. A vibration transfer member also called AVM 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 compressing unit to the second compressing unit. The first and second compressing units extend in parallel and face toward each other.

In designing a high-pressure compressor, the effect of various parameters, such as clearance volume, stroke length, etc., on the performance of the compressor must be well understood. Three compressor parameters-clearance volume (dead-end volume), wall temperature of cylinder head and stroke length-were varied systematically. The compressor efficiency were calculated through the calculation of the coefficient of performance, defined as the ratio of the cooling capacity to the power input. The compressor efficiency is consist of volumetric efficiency, compression efficiency, mechanical efficiency and motor efficiency.

4. CONCLUSION

In this Study authors shows some of the simulation model of variable speed air compressor which gives satisfactory performance study. The given studies also shows that volumetric efficiency, cylinder pressure, cylinder air temperature and FAD (Free Air Delivery) were changed with change in parameters like speed, cylinder diameter, pressure output and clearance volume.

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BIOGRAPHIES

Student of Mechanical Design Engineering, VIT, Pune

Asst. Prof. of Mechanical Engineering Department, VIT, Pune