



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VI **Month of publication:** June 2022

DOI: <https://doi.org/10.22214/ijraset.2022.43097>

www.ijraset.com

Call:  08813907089

E-mail ID: ijraset@gmail.com



The Survey on Reciprocating Gas Compressor: A Review

Hrishikesh Ganesh Jarang¹, Dr. R. S. Deshpande²

¹M.E. Scholar, ²Associate Professor, P.V.P.I.T. Bavdhan, Pune

Abstract— This paper represent the survey on reciprocating gas compressor and there effects on different location whether it is onshore or offshore. Reciprocating air compressors are the foremost ordinarily used compressor for domestic and industrial functions. These papers also investigate the improving volumetric efficiency of two stage reciprocating gas compressor by providing IC Tube bundle and cooling system. These surveys perform the experiments of a two-stage with double-cylinder reciprocating gas compressor system with gas and different cooling systems were performed. This study develops a higher understanding on the impact of honing within the cylinder that reduces the surface roughness within the cylinder and ends up in bigger air output. In these review paper there are various things that are considered for designing the cylinder for the purpose of compressing the gas in differential uses. In these review the effecton reciprocating is seen whether it is steady state or in a thermal state conditions, so to get this results they have done assessments on various conditions and for various purpose. The aim of these survey papers is to define the proper way of research done on reciprocating compressor i.e. the research paper data, methodology, verification and validation, the way of results and discussion of various assessments test, etc. These paper mainly focus on the positive displacement compressor and that of the sub part is reciprocating gas compressor and their design, modelling, analysis and development i.e. from raw stage to the final stage of reciprocating gas compressor. From these survey we also find the whole process of reciprocating gas compressor and there future scope.

Keywords— Reciprocating Gas Compressor, Honing, Two Stage Cylinder, Cooling, Volumetric efficiency

I. INTRODUCTION

As we know that the compressor is the most important topic in modern day industries. Reciprocating gas compressor unit among the leading used varieties of compressors. They play tremendous roles in guaranteeing that industrial processes and works area unit done. Compressors area unit mechanical devices that may compress a substance in gaseous state. Throughout the method of air compression, the inlet/intake pressure of the air is sometimes raised to the next exhaust pressure. Reciprocating compressors area unit key instrumentation most typically employed in oil extraction, gas production, oil purification, chemical industries, refrigeration and gas transmission. However, the particular demand is under the rated capability of the mechanical device to a modification within the production method or air source. In general, compressors area unit generally classified in line with their operating principles or principle of operations, in line with their actions and in line with their range of stages. It is more, supported the principle of operation, compressors area unit classified into "positive displacement" compressors and non- positive displacement or "dynamic compressors". In positive displacement compressors are classified into mutual and rotary compressors.

Reciprocating compressors could also be single or double acting, single stage or multi-stage. The inlet gas which enters the suction valves, then flows inside the compression cylinder wherever it gets compacted by a piston driven in a very reciprocating compression by a shaft, and after the compression the compressed gas gets discharged. Applications embrace "oil refinery", "gas pipelines", "oil and gas" "production drilling" and "well services", , offshore platforms, manufacturing, gas process plants, air con, and refrigeration plants. The "distance piece" could be a support connecting the mechanical device frame to the cylinder.

A single-acting mechanical device could be a sort of gas mechanical device that uses just single finish of the piston for the suction and compression purpose. In straightforward words, the primary stroke of piston sucks the gas within the mechanical device whereas the gas compression happens within the second stroke. A double-acting mechanical device could be a terribly known style of positive displacement mechanical device from the class of the reciprocating compressor. A reciprocating (air mechanical device compressor) that uses each side of the piston to suck and compress the air is termed a double-acting compressor. In straightforward words, the piston of a double- acting reciprocating mechanical device uses its each side for air or gas suction and compression. As the compression heat will increase, the double-acting reciprocating mechanical device is generally cool. Throughout the piston movement among the cylinder, the fluid should not leak through the house between the piston and also the cylinder wall. So, this compressor part covers with the seal. A little mechanical device doesn't want a seal. The house between the cylinder and therefore the piston also covers with oil to stop the



compressed refrigerant from getting into the housing. The rod includes within the most essential double-acting mechanical device elements. These makes a link between the rotating shaft and also the piston.

II. LITERATURE REVIEW

V.E.Shcherba et al., (2022), shows the numerical experiment which tends to resolve the physical properties of process within the machine absolute and relative flow rates of gas into the operating compression method. The performance quantity gets verified with the analysis which reducing the temperature of walls and diameter of cylinder improves[24].

Andrey Zanin et al., (2021), tells us about the compress gas into medium and high pressure in operation principles of machines could be primary compression in a very early stage of single acting reciprocating compressor. In this review it tells about the numerical analysis of degree of freedom of gas pressure and had impact on relative decrease[25].

C. Subramaniyan et al., (2021), these survey tells us about the heating effect of air compression process, on compressor and the effect of increase in temperature their reducing in or poor mechanical efficiency. The survey focus on energy consumption and conservation of law efficiency[19].

Xu Sun et al., (2021), in these paper it represents operational model of reciprocating compressor and their condition of capability running and integrates coupling impact on whole reciprocating system as well as valves. It also analyze of spring stiffness of piston, stroke length, valve effect, come back force, etc.[3].

Ernane Silva et al., (2021), in these paper it tells about the simulation model on unsteady flow of mass and energy conservation equations and the piston flight that gives natural potency for reciprocating gas compressor. It also focus on the extended time for compressor method relevantly by the crank-rod in reciprocating compressor[26].

Przemyslaw Mlynarczyk et al., (2021), in these paper it mainly focus on the suction and discharge manifolds vibrations in refrigerant compressor and the results of pressure in the form of pulsations and adding on the compressor generated vibration which gets transfer from the vibratory pipe[31].

Ekong Godwin I. et al., (2020), it mainly focus on the appliance of thermodynamically effects on piston while compression of gas as the temperature increases and mechanical efficiency decreases for single-acting reciprocating compressor. The main objective of these survey is to analyze the thermal effect while operating performance assessment, work done and equal potency in compressor [2].

Hoi Yin Sim et al., (2020), in these paper it tells us about valve trouble during the mid-stage of compressor where the gas gets compressed and little bit gets effect on valves. There should be performance base analysis has been done [20].

M. Mohsin Tanveer et al., (2020), these paper shows that it mainly focused on the exchange of current refrigerants with low warming potential. In these paper it compare numerous analysis and with the existing one to choose the modeling user interface for a wide range of study [29].

Dengji Zhou et al., (2020), in these paper it mainly focused on the vibration in pipe stress analysis. The stress analysis on piping just because of more vibration cause of leakage, air mass or air flow rate get reduces, flammability may causes, corrosion of gas. It also focused on the noise level in compressor when the flow of gas gets transfer from pipe [30].

Aadhithiyam Amutha Kulasekaran et al., (2019), it tells us about the material used for the reciprocating compressor, the hardness of material, chemical properties of material. For testing reciprocating compressor material it taken the hard chromium material these results shows saving in the annual power [16].

Ikpobari Amuele Nwakpang et al., (2019), these paper mainly focus on the performance assessment of two stage double acting reciprocating gas compressor. It has tested overall performance analysis of reciprocating compressor, the volumetric efficiency of compressor, the extraction and retraction speed of compressor piston, gas flow in both the valves i.e. suction valve and discharge valve [1].

Ibrahim A. Sultan et al., (2019), it tells us that for improving the performance of reciprocating compressor by changing their stroke length, but change in gas flow rate through overall process [11].

Harsha V Reddy et al., (2019), in these paper they said that it had made model just to know about real time operation of flow of gas and power generated through overall process [27].

Mustafa Ozsipahi et al., (2019), these paper tells us about the lubrication system in overall operating of reciprocating compressor, overall life span of compressor, the lubrication while the electric gets convert into mechanical operation, the time span wise effect of gas on shaft [29].

Liu Zhanz et al., (2018), they tells us the paper mainly focused on the energy consumption in developing countries with the increase of reducing artificial storage [7].

Issaco Stiaccini et al., (2017), in these paper we seen that the study on reciprocating compressor and their significant role in various field. One of the main field where they focused on refueling stations for natural gas car and while doing these how to



increase process efficiency while doing maintenance day by day and by the fluid dynamics properties [17].

Francesco Corvaro et al., (2017), the main objective of these analysis work is the assessment of reciprocating compressor plant designed and eventually compared critical analysis of elements of oil and gas trade which has endless increased in needs with the high quality of technology systems with the high aggressiveness of market has suppliers to implements management systems to their hands and productivity to fulfill these demands on time [22].

P. Balashanmugam et al., (2016), these paper shows the use of reciprocating compressor in a number of industries and business purpose. In these research we get the concept of triangular gas compressor cylinder. Which means that it contains 3 cylinders with an equal angle with common compression chamber with having their individual connecting rod, crank shaft, pistons and chain sprockets. It also focused on the time sequence and angle measurement from top dead centre to bottom dead centre and vice versa [5].

Jim Townsend et al., (2016), these paper shows about the alignment of connecting rod with crank case. The dynamically effect of electric motor on connecting rod which demonstrate that upgrade in law operating expenditure [10].

V.L.Yusha et al., (2016), these paper shows that the experimental analysis in operating condition of low air flow reciprocating compressor in which low gas flow rate is happens because of that the volumetric efficiency gets reduced. And the second point which explained about cooling system where they done experimental study on cooling stage conditions pressure and cycle time control [21].

J. Tuhovcak et al., (2016), these paper represents the mainly effect of thermal stress on reciprocating compressor, effectiveness of gas moving in reciprocating compressor and the second part is when the high temperature gas gets warm position the moisture get effects on whole operating system that effects study also mention in these paper [23].

Fernando M. Telloquendo et al., (2016), these paper compares the comparative study on the scroll reciprocating compressor and the vapor injection and a double stage reciprocating compressor. These paper shows the comparative analysis and the coefficient of performance which has higher potency [19].

Mahmood Farzaneh-Gord et al., (2015), these paper presents the modeling and work effects of the reciprocating compressor. It mainly tells about 1st law of thermodynamic i.e. mass flow rate, constant gas, suction and discharge pressure and working temperature. The results are mainly focused on clearance volume of reciprocating compressor and the angular speed of connecting rod [8].

Yusha V.L. et al., (2015), it says that the results of theoretical and procedure analysis of reciprocating gas compressor operating method of "long stroke" blast cooled compressor cylinder. It takes about the exchange process by the walls of operating chamber, the process of the gas flow by the spacing and valves. It also analyzed of thermal conditional effect on cooled "long stroke" reciprocating compressor [9].

Mohammad Malakoutirad et al., (2015), the core objective of these paper says that the analysis of dynamic and thermal stress on design of reciprocating natural gas compressor gets parts into automotive engine. It mainly depends on multi stage reciprocating compressor of tank to store pressurized gas. Highly pressurized compressed gas produced torques on the crankshaft, but not a unsteady rotational speed oscillations, according to the dynamic simulation data [18].

P.K.Jadhao et al., (2012), these paper tells about the trouble shooting in reciprocating compressor with the proper degree of freedom to produce the operational pressure demanding at intervals less the time taken by single operating system. By making themodeling and by doing analysis on modeling double fair results on compressor [4].

J. A. Becerra et al., (2011), in these paper there is an study on failure in premature or immature stage during the highly range of crankshafts. While performing analysis it examine the "shaft chemical composition" and "hardness analysis" and the impulsive method of system. The finite element analysis has been done on torsion dynamic effect on the connecting rod as well shaft [6].

In this literature survey it mainly focus on the overall performance of reciprocating compressor with the help of various case study and experimental setup. Many researchers focus the air flow through the inlet and outlet and the thermal effect while performing operation on cylinder. Most of the time as the gas flow rate increases the temperature gets increases and just because of that moisture gets started and it directly gets effects on volumetric efficiency of reciprocating compressor

III. CONCLUSIONS

The conclusion of the survey paper is to mainly focus on the effect of thermal effect inside the cylinder when the compressor in an operating condition. The objective of these review is to deep study on the whole process of reciprocating compressor whether it is pressure effect on piston, connecting rod, distance piece, etc. The effective study on compressor valves is also important; to select the compressor valve we have to know about operating pressure according to that we select rating and then flange.



REFERENCES

- [1] Performance Assessment of a Two-Stage Reciprocating Air Compressor-Ikpobari AmueleNwakpang, Barinaadaa Thaddeus Lebele- Alawa, and BarinyimaNkoi - European Journal of Engineering Research and Science, Vol 4, No.4, April 2019
- [2] Performance Analysis of a Single-acting Reciprocating Compressor Using Thermodynamic Concepts- Ekong, Godwin I., Ibibom, Emmanuel N. , Bassey, Isaiah U.- International Journal of Engineering Science Invention (IJESI) ISSN (Online): 2319-6734, ISSN (Print): 2319-6726 www.ijesi.org, Volume 9 Issue 5 Series I , May 2020 , PP 20-31
- [3] Optimization of capacity control of reciprocating compressor using multi-system coupling model-Xu Sun, Jinjie Zhang, Yao Wang, Junyan Wang, Zhen Qi.- Applied Thermal Engineering, Volume 195, August 2021, 117175
- [4] Design, Modeling and Analysis Of Double Acting Reciprocating Compressor Components– P.K.Jadhao , K.K. Jadhao, S. S. Bhagwat - International Journal of Scientific & Engineering Research Volume 3, Issue 4, April-2012 ISSN 2229-5518
- [5] Design and fabrication of multiengine air compressor- P.Balashanmugam, G.Balashanmugam - International Journal of Scientific and Engineering Research, Volume 3, Issue 4, April 2012
- [6] Failure analysis of reciprocating compressor crankshafts-J.A.Becerra, F.J.Jimenez, M.Torres, D.T.Sanchez, E.Carvajal - Engineering failure Analysis, Volume 18, Issue 2, March 2011, Pages 735-746
- [7] Improvement of one-dimensional gas dynamic model for pulsation prediction in reciprocating compressor systems-Liu Zhanz, Enle Xu, WenguangJia, Cao Xing - Energy Procedia, Volume 152, October 2018, pages 137-142
- [8] Thermodynamic analysis of natural gas reciprocating compressors based on real and ideal gas models- Mahmood Farzaneh-Gord, Amir Niazmand, Mahdi Deymi-Dashtebayaz, Hamid Reza Rahabari -International Journal of Refrigeration, Volume 56, August 2015, Pages 186-197
- [9] The Estimation of Thermal Conditions of Highly-cooled Long-stroke Stages in Reciprocating Compressors-Yusha V.L., Den'gin V.G. , Busarov S.S , Nedovenchanyi A.V. , Gromov A.Yu.- International Conference on Oil and Gas Engineering, OGE-2015, Procedia Engineering 113 (2015) 264-269
- [10] Updating temperature monitoring on reciprocating compressor connecting rods to improve reliability-Jim Townsend, M. Affan Badar, Julie Szekeres - Engineering Science and Technology, an International Journal, Volume 19, Issue 1, March 2016, Pages 566-573
- [11] Improving torque performance in reciprocating compressors via asymmetric stroke characteristics-Ibrahim A. Sultan, Truong H. Phung- Positive Displacement Machines, Modern Design Innovations and Tools, 2019, Pages 145-162
- [12] Design of Machine Elements – V.B.Bhandari, Studies on hard chrome plating in reciprocating air compressors - Aadhihiyan Amutha Kulasekaran, Anbarasu Subramanian - Proceedings of the ASME 2018, International Mechanical Engineering Congress and Exposition IMECE2018, November 9-15, 2018, Pittsburgh, PA, USA
- [13] Analysis of valve-retainer orientation influence on a reciprocating compressor for natural gas vehicle refueling stations – IssacoStiaccini, Giovanni Galoppi, Francesco Balduzzi, Marco Sacco, Sabrina Santoni, Giovanni Ferrara - Journal of Natural Gas Science and Engineering, Volume 38, February 2017, Pages 516-526
- [14] Design considerations for an engine-integral reciprocating natural gas compressor – Mohammad Malakoutirad, Thomas H. Bradley, Chris Hagen - Applied Energy, Volume 156, 15 October 2015, Pages 129-137
- [15] Second law analysis on performance of double stage reciprocating air compressor with inter cooler – C.Subramanian, B.Kalidasan,
- [16] N.Bhuvanesh, K.B.Prakash, A.Amarkartik
- [17] Detection and estimation of valve leakage losses in reciprocating compressor using acoustic emission technique – Hoi Yin Sim, RahizarRamli, Ahmed Saifzul, Ming Foong Soong - Measurement, Volume 152, February 2020, 107315
- [18] The Experimental Research of the Thermal Conditions in Slow Speed Stage of Air Reciprocating Compressor – V.L.Yusha, S.S.Busarov, R.Yu.Ghoshlya, A.V.Nedovenchanyi, B.S.Sazhin, M.A.Chizhikov,
- [19] I.S.Busarov - Procedia Engineering, Volume 152, 2016, Pages 297-302
- [20] Reliability, Availability, Maintainability (RAM) study, on reciprocating compressors API 618 – Francesco Corvaro, Giancarlo Giacchetta, Barbara Marchetti, Maurizio Recanati - Petroleum, Volume 3, Issue 2, June 2017, Pages 266-272
- [21] Comparison of heat transfer models for reciprocating compressor – J. Tuhovcak, J.Hejcik, M.Jicha - Applied Thermal Engineering, Volume 103, 25 June 2016, Pages 607-615
- [22] Approximation of the compression process to isothermal in a reciprocating compressor with a liquid piston - V.E.Shcherba, E.A.Pavlyuchenko, E.Yu.Nosov, I.Yu.Bulgakova - Applied Thermal Engineering, Volume 207, 5 May 2022, 118151
- [23] Numerical and experimental study on fluid compressibility in a two-stage reciprocating pump-compressor - Andrey Zanin, Evgeniy Pavlyuchenko, Victor Scherba - Applied Thermal Engineering, Volume 194, 25 July 2021, 117106
- [24] Piston trajectory optimization of a reciprocating compressor - Ernane Silva, Thiago Dhutra - International Journal of Refrigeration, Volume 121, January 2021, Pages 159-167
- [25] Towards energy-efficient LNG terminals: Modeling and simulation of reciprocating compressors - Harsha V Reddy, Vikas S Bisen, Harsha N Rao, Arnab Dutta, Sushant S Garud, Iftekhar A Karimi, Shamsuzzaman Farooq - Computers and Chemical Engineering, Volume 128, 2 September 2019, Pages 312-321
- [26] Evaluation of ionic liquids as replacements for the solid piston in conventional hydrogen reciprocating compressors: A review - NasrinArjomandKermani, Irina Petrushina, Marvin M. Rokni - International Journal of Hydrogen Energy, Volume 45, Issue 33, 24 June 2020, Pages 16337-16354
- [27] Performance characterization of small variable-capacity reciprocating compressors using a minimal dataset - Guilherme Z. Santos, Adriano F. Ronzoni, Christian J.L.Hermes - International Journal of Refrigeration, Volume 107, November 2019, Pages 191-201
- [28] Experimental and numerical investigation of lubrication system for reciprocating compressor - Mustafa Ozsipahi, Haluk Anil Kose, Sertec Cadirci, Husnu Keripici, Hasan Gunes - International Journal of Refrigeration, Volume 108, December 2019, Pages 224-233
- [29] Performance of a scroll compressor with vapor-injection and two-stage reciprocating compressor operating under extreme conditions - Fernando M. TelloOquendo, Emilio Navarro Peris, Jose GonzalezMacia, J.M.Corberan - International Journal of Refrigeration, Volume 63, March 2016, Pages 144-156
- [30] Quantitative and qualitative evaluation of various positive-displacement compressor modeling platforms – M.MohsinTanveer, Craig R. Bradshaw,



International Journal of Refrigeration, Volume 119, November 2020, Pages 48-63.

- [36] Vibration-based fault diagnosis of the natural gas compressor using adaptive stochastic resonance realized by Generative Adversarial Networks – Dengji Zhou, Dawen Huang, JiaruiHao, Yonglei Ren, Ping Jiang, XingyunJia- Engineering Failure Analysis, Volume 116, October 2020, 104759
- [37] Innovative hybrid device for the simultaneous damping of pressure pulsations and vibrations in positive displacement compressor manifolds- PrzemyslawMlynarczyk, Piotr Cyklis, Tomasz Ryancarz- International Journal of refrigeration, Volume 132, December 2021, Pages 109-118



International Journal for Research in Applied Science & Engineering Technology (IJRASET)

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538

Volume 10 Issue VI June 2022- Available at www.ijraset.com



10.22214/IJRASET



45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24*7 Support on Whatsapp)