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PERFORMANCE ANALYSIS OF TWO STAGE RECIPROCATING AIR COMPRESSOR

GANTA VANYA SREE

ASSISTANT PROFESSOR, MECHANICAL ENGINEERING DEPARTMENT, CVR COLLEGE OF ENGINEERING, MANGALPALLY, HYDERABAD.

Abstract - *Reciprocating compressor is also known as positive displacement compressor and is used to deliver high pressure. Air enters from intake manifold and enters into the cylinder and it gets compressed by reciprocating motion of the piston then high-pressure air delivers from exhaust manifold. These are used for various manufacturing industries such as chemical plants, refrigeration plants. This paper mainly presents the effects of control parameters on the performance of compressor. The analysis showed that there has some reduction in the volumetric efficiency, isothermal efficiency due to clogging and there are other parameters which affect the performance of compressor like ambient temperature. The results revealed that due to clogging there has decrease in the discharge pressure from the compressor.*

Key Words: *Air Compressor, Isothermal Efficiency, Volumetric Efficiency*

1. INTRODUCTION

Air compressor is a device used to convert power into potential energy by using an electric motor, diesel or gasoline engine. air compressor is different from pump because air compressor is used for gas or air but whereas pump is used for only liquids. In single stage reciprocating compressor one way valves are used to guide air into and out of a chamber. When piston is in downward stroke then air enters into the chamber. When piston is in upward stroke charge of air is forced out and is enters into the storage tank. When tank pressure reaches upper limit then pressure relief valve is used to decrease the tank pressure. Air compressors are generally of two types, single stage air compressor and two stage air compressors. Compared to single stage air compressor two stage compressors provide higher efficiency. Air compressors are used for variety of applications in industries.

1.1 EXPERIMENT ANALYSIS

A thermodynamic analysis of the compressor under study was done to evaluate its performance behaviour with regard to the problem of clogging with the use of the equations already deduced, collected data and the operating parameters of the compressor.

1.2 SPECIFICATIONS OF EQUIPMENT

TYPE	**RECIPROCATING TYPE**
STAGE	**SINGLE**
CYLINDER	**SINGLE CYLINDER**
MOTOR RATING	**2HP**
MOTOR SPEED	**1420 RPM**
COMPREESOR SPEED	**930 RPM**
TYPE OF COOLING	**AIR COOLED**

2. EXPERIMENTAL PROCEDURE

- Connect the power supply to compressor
- Close the outlet valve and start the compressor
- Let the receiver tank pressure rise up to around 1 $kg/cm^{2.}$ Now open the delivery valve slightly.
- Wait for some time and see that delivery pressure remains constant. Now note down that pressure.
- Note down the energy meter pulses, and temperature of air at inlet, the rpm of compressor.
- Repeat the same procedure for different pressures.

3. PERFORMANCE PARAMETERS AND CALCULATIONS

PRESSURE RATIO

Pressure ratio is the ratio of inlet pressure to discharge pressure

$r_p=P_2/P_1$

ISOTHERMAL COMPRESSION

Isothermal compression takes place at constant temperature

$W_i= P_1V_1 \ln r_p$

ADIABATIC COMPRESSION

Adiabatic compression takes place without any transfer of heat

$W_a=2\ \gamma/\ \gamma\text{-}1\ \ P_1V_1\ r_p\ (^{\gamma\text{-}1/2\ \gamma)}\ \text{-}1$

VOLUMETRIC EFFICIENCY = $1+C-C\ r_p^{1/n}$

It is the ratio of actual volume of air to the theoretical volume

ISOTHERMAL EFFICIENCY = W_i/W

It is the ratio of isothermal power to the indicated power

4. COMPARISIONS OF RESULTS

Table1. Calculated values of performance parameters

S.NO	INLET PRESSURE	DISCHARGE PRESSURE	VOLUMETRIC EFFICIENCY	INLET TEMPERATURE	ISOTHERMAL WORK	ISOTHERMAL EFFICIENCY
	1	6	68	298	186	89
	1.5	10	79	299	186.5	89.5
	2	12	85	299	187	90
	2.5	16	88	300	188	90.8

Table 2. Compressor operating data per day(clogging)

S.NO	DAYS	DISCHARGE PRESSURE	DISCHARGE TEMPERATURE	VOLUMETRIC FLOW	MASS FLOW RATE
1.	1	416	6.3	0.4	0.38
2.	2	416.3	6.2	0.398	0.379
3.	3	416.5	6.1	0.39	0.37
4.	4	417.1	5.96	0.39	0.37

Table3. Compressor operating data per day (without clogging)

S.NO	DAYS	DISCHARGE PRESSURE	DISCHARGE TEMPERATURE	VOLUMETRIC FLOW	MASS FLOW RATE
1.	1	416	6.3	0.4	0.38
2.	2	416.3	6.304	0.400	0.38
3.	3	416.9	6.31	0.39	0.38
4.	4	415.8	6.29	0.39	0.37

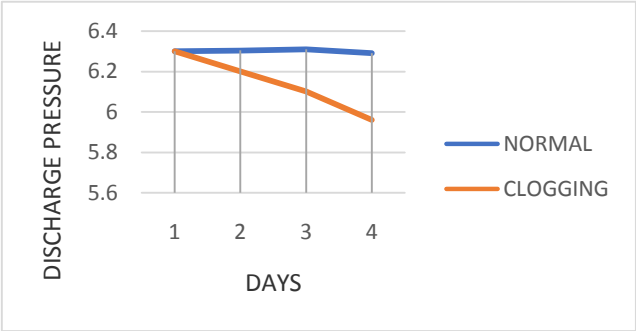

Fig. 1 Effect of clogging on discharge pressure

Fig.1 Shows the Effect of clogging on discharge pressure. From figure the discharge pressure decreases with the effect of clogging but where as in normal condition the discharge pressure does not experience any significant changes.

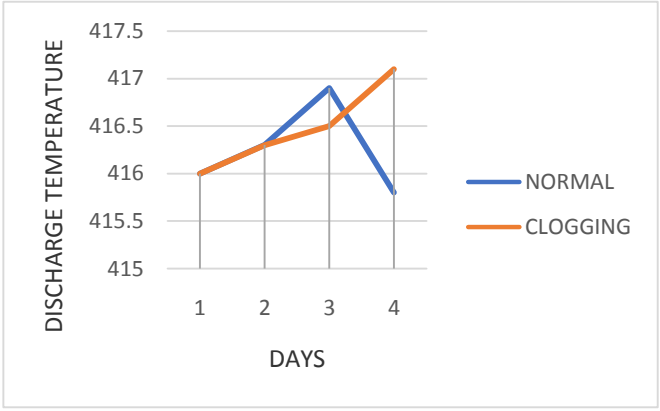

Fig.2 Effect of clogging on discharge temperature

Fig.2 Shows the effect of clogging on discharge temperature. From figure due to clogging there is a gradual increase in discharge temperature as the days went. Due to this gradual increase of temperature the complete breakdown of

compressor may takes place. But during the normal period the discharge temperature does not experience any significant change.

5. CONCLUSIONS

From analysis of air compressor, efficiency of air compressor mainly depends on clogging. Due to clogging efficiencies are decreasing. The clogging increases the performance of air compressor.

To reduce the problem of clogging for an improved performance of air compressor double filter installation method applied so that the unwanted element does not enter into the compressor. Periodic cleaning of cylinders can also help in minimising clogging effects.

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