Experimental Investigation of Screw Compressor

By

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Experimental Investigation of Screw Compressor

Major Project Report

Submitted in partial fulfillment of the requirements

For the Degree of

Master of Technology in Mechanical Engineering (Thermal Engineering)

By

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MAY 2016

Declaration

This is to certify that

1. The thesis comprises my original work towards the degree of Master of Technology in Thermal Engineering at Nirma University and has not been submitted elsewhere for a degree or diploma.

2. Due acknowledgement has been made in the text to all other material used.

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Abstract

This project work is divided in two parts. Part one is to design experimental setup to determine temperature and pressure distribution in the rotor profile of 37 kW oil injected screw compressor. Screw compressors are mechanical devices used for raising the pressure of gas. This design includes selection of various location for embedding the temperature and pressure transducer. Specification, suppliers, least count and cost of pressure transducer, temperature transducer, encoder, slip ring, data acquisition system, torque meter, rotational speed meter, oil flow meter, air flow meter and three phase induction motor are found using various sources. In part two experiments were carried out on 37 kW testing at M/s Ingersoll Rand Ltd. Part two is to determine performance of screw compressor to know adiabatic efficiency, volumetric efficiency and specific power by changing rotational speed, discharge pressure and oil flow rate. It was found that by increasing rotational speed and oil flow rate, volumetric efficiency and specific power increases whereas adiabatic effciency decreases. By increasing discharge pressure adiabatic efficiency and specific power increases but volumetric efficiency decreases.

Keywords: *Performance of Screw compressor, Design of Experimental Setup, Temperature distribution*

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Chapter 1

Introduction

Compressors are the devices that used to increase the pressure of gas . An air compressor is a specific type of gas compressor. Major type of compressors are screw, centrifugal, single screw, scroll, rotary vane and reciprocating. As the use of compression is large,the manufacture of compressor has a huge market.Compressor efficiency should be better at rate which can justify the cost of research and development to ensure improvement.

1.1 Types Of Compressors

There are Mainly two types of Compressors

1. Positive displacement type
   - Reciprocating compressor
   - Rotary compressor
2. Dynamic type
   - Centrifugal compressor
   - Axial ow type compressor

1.2 Rotary Compressor

They are the positive displacement compressors. Single stage or spiral lobe oil floded screw air compressor are the most common types.There are two rotors in casing which compress the air internally. These units are basically oil cooled (with air cooled or water cooled oil coolers) where the oil seals the internal clearances.

There will be never high temperatures inside the compressor because air or water type cooling will be provided in the compressor. On the type of medium used for cooling, air or water is used in the compressor for cooling purpose and it is one component in all. There are less wearing parts and easy design of screw compressor. It is the only reason for its easy operation and maintenance and easy installation. It is so easy to install on any kind of dead weight that can bear its weight.

Figure 1.1: Rotary Compressor[16]

1.2.1 Screw Compressor

To compress the gas, it uses twin meshing helical screw, known as rotors.The Connection between male and female rotor is done by timing gear. In screw compressor each rotor consist of helical groove affixed to the shaft, one of them is male rotor which is comparatively larger than other rotor called female rotor. The number of lobes in male rotor and number of flutes in female rotor are different for different compressors. Generally number of flutes is kept more compare to lobes on the male rotor for better efficiency. Male rotor is driven by either electric motor or an engine which inturn drives the female rotor. Screw compressor has two types.

(a) Oil free compressor

As the name suggested in oil free compressor compression space is free from oil. They can compress various gases required relatively low pressure ratio at constant volume flow rates. Application of this are in handling contaminated, particle-laden, polymerizing, or explosive gases.

(b) Oil Injected compressor

In this kind of compressor, oil which plays role of lubricant is filled into gas stream to absorb the heat of compression. Thus,pressure ration in single stage without intercooling is achevid and also provide protection against corrosive gases. No timing gears are required and male rotor usually drives the female rotor through the oil film between intermeshing profiles. Oil injected machines can be used as compressor or as expander. They operate on variety of fluids. They develop pressure higher then the centrifugal compressor at same tip speed.

1.3 Motivation of Recent Study

Oil injected screw compressors has a wide range of application as for pneumatic air, cooling and drying etc.Also compressors are power consuming machine. For this we need to study effect of parameters on the performance of the screw compressor. The CFD results and scientific model can not describe the real procedure of compression, and for this the test is necessary. For comprehension, the thermo-fuid procedures occurring inside the screw compressor, It is important to Measure temperature distribution in the rotors through investigations.

1.4 Objective of Present study

Objective of present study are:

- To design experimental setup along with specification for knowning temperature profile of screw compressor.
- To identify approparaiate equipments for measurement of various parameter.
- To determine the total cost involved in preparing experimental setup.
- To carry out performance analysis of oil injected screw compressor.

Chapter 2

Literature Review

Wu Huagen et al[1] studied P-V diagram of screw compressor. For this study as shown in figure 2.1, five small pressure transducer on casing were installed. Out of there five transducers as shown in figure 2.1, 2,3 and 4 are mounted on discharge side and 1 and 2 are on suction side. With this P-V diagram is generated and compared with mathematical model. Wu et al.[2] proposed a new mathematical model for simulating the P-V indicator diagram, Describing the thermodynamic working process inside twin screw refrigeration compressor, which was verified with the experimenttal data. In 2003, Wu et al[3] carried out study on the P-V diagram for full load and part load condition. These P-V diagram are prepared successfully by a small pressure sensor embedded in bottom of female rotor at discharge side. They also studied screw compressor performance theoratically & found theoritical study are in good agreement with experimentally measured data.

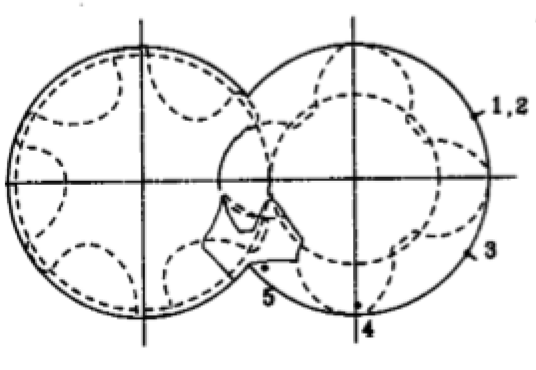

Figure 2.1: Principal location of pressure transducer[2]

Hugen vu et al[4] did study of influence of mid-pressure refrigerant gas superfed into the compression chamber from economizer on the performance of twin screw refrigeration compressor. Furthermore, on the basis of the experimental research on the p-V indicator diagrams, a sub-model describing the superfeed process within the working process of twin screw compressor is proposed., S H Hsieh1, Y C Shih1, W-H Hsieh1, F Y Lin, and M J Tsai[5] using numerical simulation and experimental investigations studied the theoretical model and computer program for calculating the pressure–volume diagram and the efficiency of an oil-injected screw compressor.

S.H. Hsieh et al[6] determined temperature distributions in the rotors of oil-injected screw compressors. The temperature and pressure are measured using thermocouple & pressure sensors installed on the rotor of screw compressor. These temperature and pressure sensor are inserted at various distance on rotors, Output of these sensors recorded by data acquation card through slip rings. Result of study shows that the heat generated in male screw is more then in female screw due to inserted bearing on male screw.

M. Fujiwara et al[7] woked on Performance analysis of an oil-injected screw compressor and its application.In which Performance predication is carried out with experiment by changing rotor speed,inlet temperature.It shows effect of effect of rotational speed and inlet temperature on efficiency of screw compressor.

N.Seshaiah et al[8] carried out theoretical and experimental studies on oil injected twin screw air compressor, Performance of screw compressor with effect of different gases(nitrogen, argon and helium gases apart from air) predicted and experimentally verified.

Z. Zhang et al[9] studied on the the performance of screw compressor by changing work conditions, analyzing the test results, investigating other air compressor basic parameters, analyzing various factors which affecting the performance of screw air compressor, several suggestion and reference about the auxiliary equipment design and choice of screw air compressor are presented in this paper.

Chapter 3

Experimental Setup

Present experimental work is divided in two task. Task one is to do preapare design of experimental setup and to prepare detailed specification & cost of measuring equipment for knowing temperature and pressure distribution on the rotors of screw compressor. Other task is to do performance study of screw compressor by varying rotational speed,discharge pressure and oil flow rate.

3.1 Design of experimental setup for knowning temperature and pressure distribution

For measuring P-V diagram & temperature distribution, pressure and temperature sensors are embeded axially & radially into the compressor.This sensord can be placed between the space of rotor casing or in the male & female rotor.Present research work suggests that the sensors should be embedded on the rotors for better results.

Figure 3.1 shows the schematic diagram of experiment setup. Screw compressor operate by a DC motor.For measuring rotational speed of shaft and input torque rotational speed meter and a torque meter should be installed. From inlet, air flows to the compressor and at the time of operation, oil is injected into the compressor from an injecting port. The air and oil are blended and packed inside the pressure chamber.. Then it goes to seperator, Where it separate the oil and air. The separated air and oil then ow through a cooler through separate pipes. then the air is dried by a water dryer. The dried air goes through a back pressure valve and an air ow meter. Then the air is discharged to the Area of operation. On the other hand, the cooled oil ows through an oil ow meter and is re-injected into the compressor.

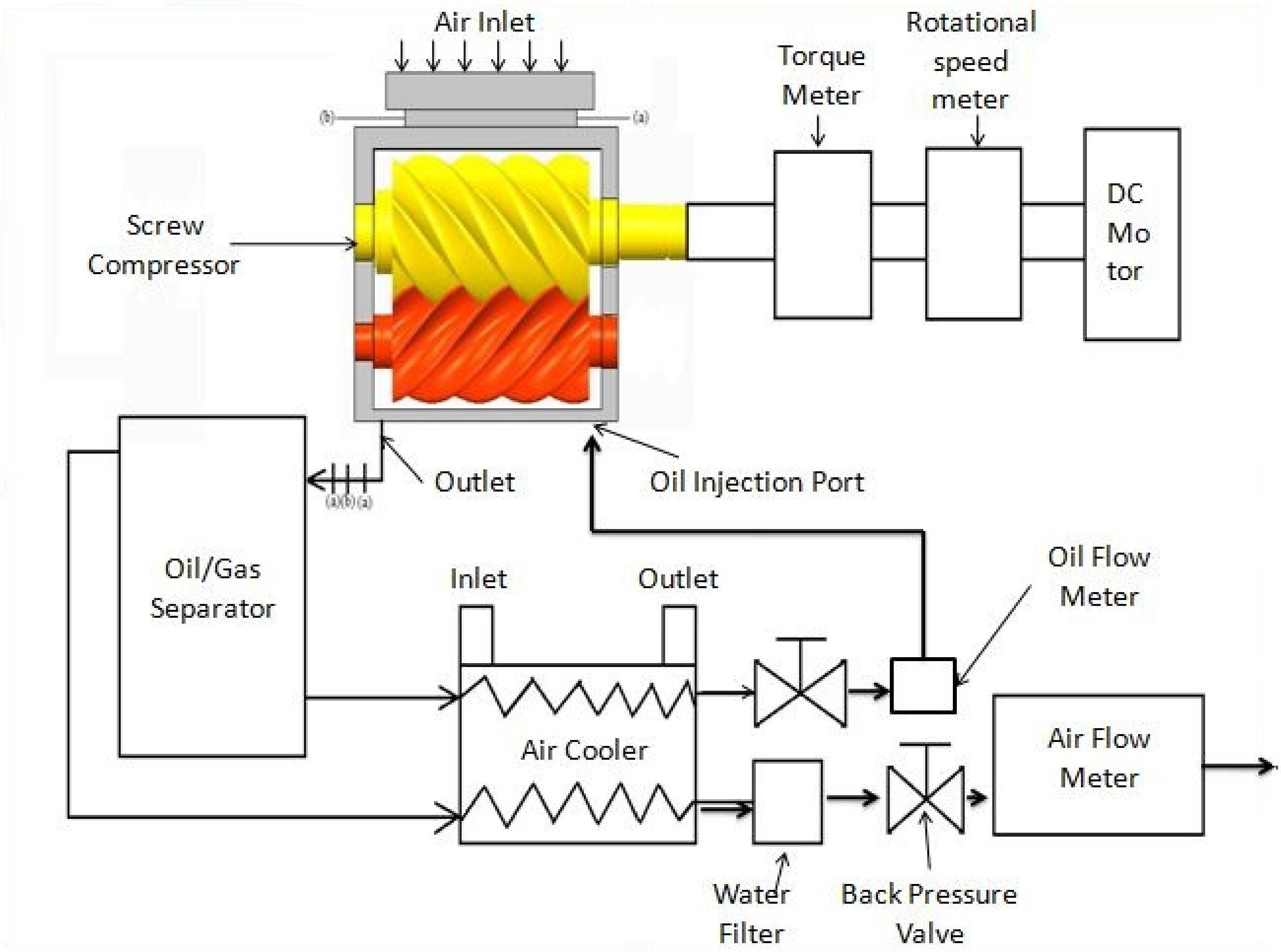

Figure 3.1: Experimental setup[6]

Figure 3.2 Shows detailed diagram regarding to location of pressure & temperature sensors and its recording methodology. Temperature sensors are located at the inlet,middle and output of male and female rotors, Whereas pressure sensors are located at the suction and discharge side.To prepare P-V diagram angle of rotation of male rotor needs to be measured.This can be possible by instaling encoader.

Table 3.1: Uncertainty of equipment

1	Pressure sensor	0.5%
2	Temperature sensor	0.55%
3	Data acqution system	0.072%
4	Rtd	0.08%
5	data acquisition apparatus	0.05%
6	Pressure gauge	0.125%

The outputs from both the pressure transducers and the temperature transducer are recorded, through two slip rings, by a data acquisition A/D card installed on a personal computer.Uncertainty of equipments required for better measurement are given in table 3.1. The leading wire of pressure and temperature sensor passes from the center hole of male and female rotor and is connected to a slip ring by coupling.Signals will be amplified by the signal amplifier and then it will be collected to the acquisition instrument, and finally will be processed and analysed by data process system.There temperature sensors and pressure sensors is located on each rotor.

There are two wires from each of temperature sensor and four wires from each of pressure sensor, so total ten wires should be passed from hole to data acquation system through slip rings.It was mentioned that sensors embedded on the male & female rotors provides better results, however instaling there sensors on the rotors are not at all an easy task.For this holes are to be generated in male and female rotors.

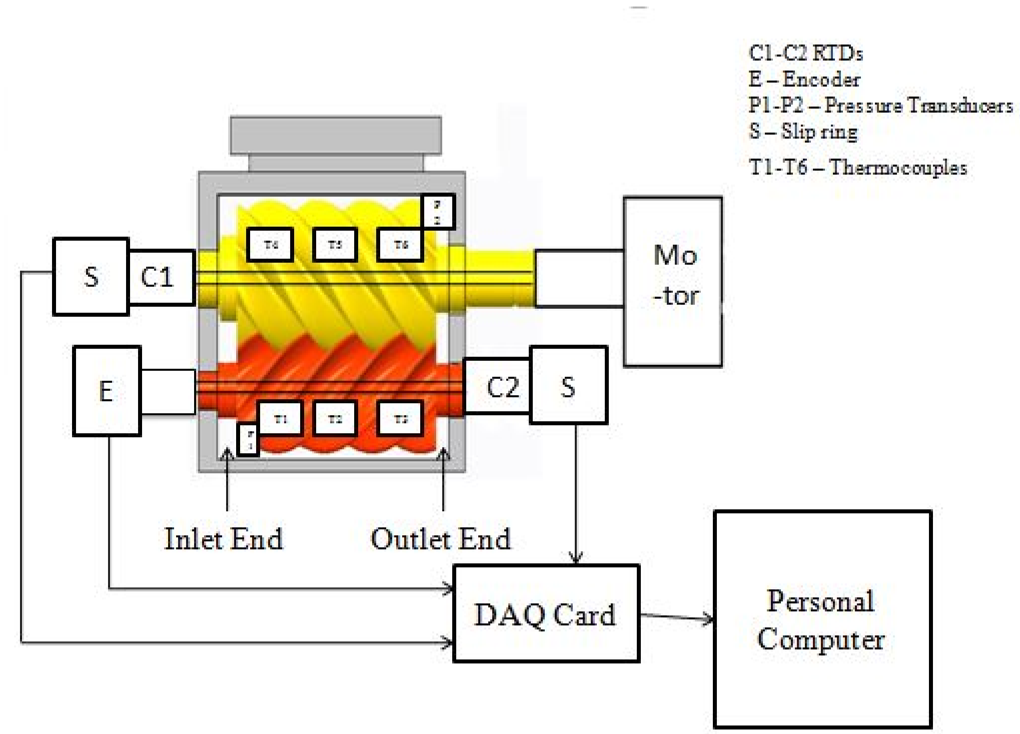

Figure 3.2: Temperature, pressure sensor and data acquisition system for experiment[6]

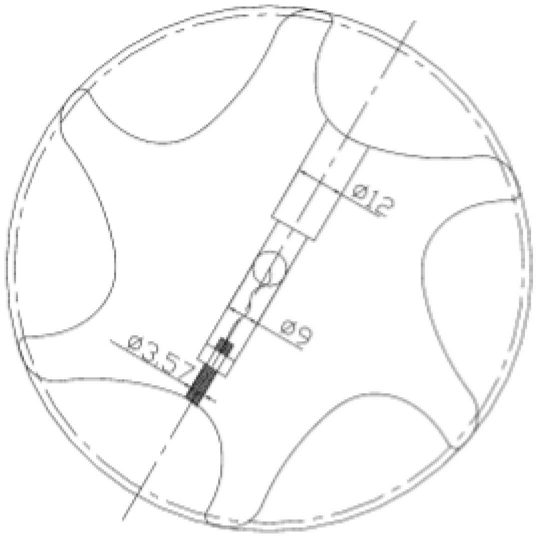

Figure 3.3: Location of pressure transducer[10]

3.1.1 Measuring Equipement Detais:

- **Pressure Transducer**

It is used for measuring pressure inside the rotor. Maximum pressure and temperature inside airend is 12 bar and 80°C respectively, So are needs to select pressure transducer accordingly Kulite group(Model number XTL-140), which is manfucturing pressure transducer as shown in figure 3.4. Which can work between -55 to 175 °C and having pressure range 0 to 17bar. As mentioned four cable connection are required to be passed through center hole to record pressure.

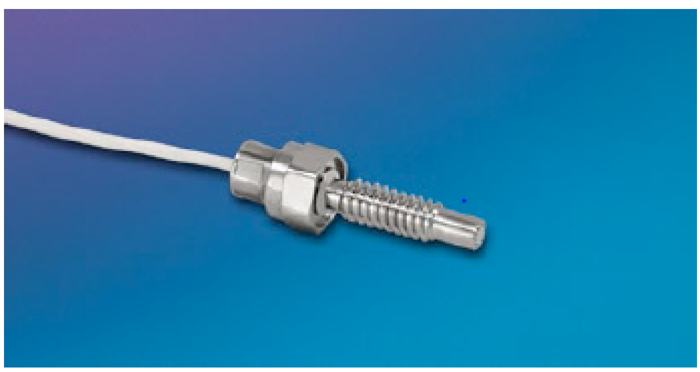

Figure 3.4: Pressure transducer[12]

- **Pressure Gauge**

Pressure of oil & air gas coming out from the discharge end of screw compressor depends upon the capacity of compressor. Maximum pressure is 12 bar, so is needs to select pressure gauge accordingly Pennwalt group(Model number 61A-1A-0050). Whose maximum pressure range is 35 bar and uncertainity is 0.066%.

- **Temperature Transducer**

Table 3.2: Temperature range of thermocouples.

Thermocouple type	maximum temperature(°C)
E	900
J	750
K,N	1250
T	350
B	1700
R,S	1450

It is used for Measuring Temperature . In airend maximum Temperature is 80°C. So we can use temperature transducer omega (model number-TT-E-36-72),whose temperature range is upto 220°C. .In the Table shows temperature ranges of different type of thermocouple. It is having uncertainity of 0.55%.

- **Encoader**

Encoaders are used to measure rotational angle of male rotor. Male rotor speed vary with capacity of compressor. Maximum rotor speed is generally 7000 to 8000 rpm.

Working of encoader

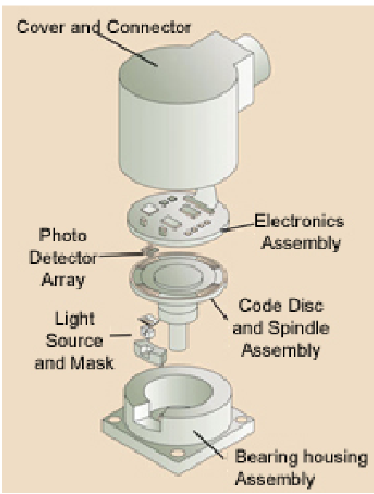

Figure 3.5: Working of an encoader

There are two types of encoaders.One of them is rotary encoders and another one is linear encoders. Optical rotary encoders are most commonly found in motion control systems while linear encoders are used more specifically for linear-positioning applications such as piston or actuator monitoring systems. A rotary encoder with optical sensor relates with the revolution of internal disc with opaque line pattern. When the disc is rotated in LED light then markings on disc will block and unblock the light. An photodetector inside it which senses the light beam and then electronics convert the pattern into an electrical signal. A signal will go into control system thus we can achieve the outputs from encoader which is measured in two ways. In first method we use PWM9 device. PWM9 is a universal measuring device for cheaking and adjusting HEIDENHAIN Encoaders.There are different modules are avaliable for cheaking different signals.The value can read on monitor and various keys provide for easy operation.

Figure 3.6: PWM 9 for Generating outputs from encoader[14]

The second method is to put chip(IK 215) connected with computer and it gives output of encoader. As DAQ system is to be used in the experimental setup the second method with chip is to be used for measuring data using encoader.

Figure 3.7: IK 215[14]

Slip Rings A slip ring can be used for the transmission of electrical signals from a stationary to a rotating mechanism. The performance is increased by use of slip ring and it simplify system operation and eliminate damageing of wires.

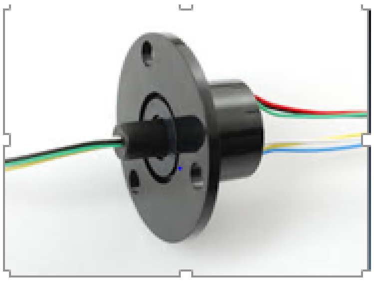

Figure 3.8: Slip Ring[15]

It can be used upto 10,000 rpm.

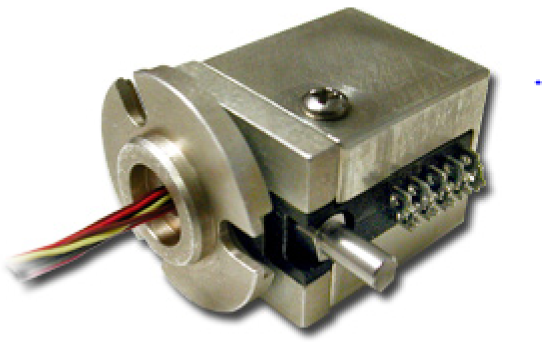

Figure 3.9: Mood EC3848 Slip ring[15]

Data acquation System: Data acquisition (DAQ) is the process measures the quantity like voltage, current, temperature, pressure, or sound with a computer. A DAQ system has sensors, DAQ measurement hardware, and a computer with programming software. compared to orthodox measuring system,computer based daq system far more effective in productivity, display, processing power and cost effective as well.In our experiment we can use Model number NI PCI-6255 can be used as a DAQ system. It is compatible with windows xp and having sampling rate of 1.25ms/s.

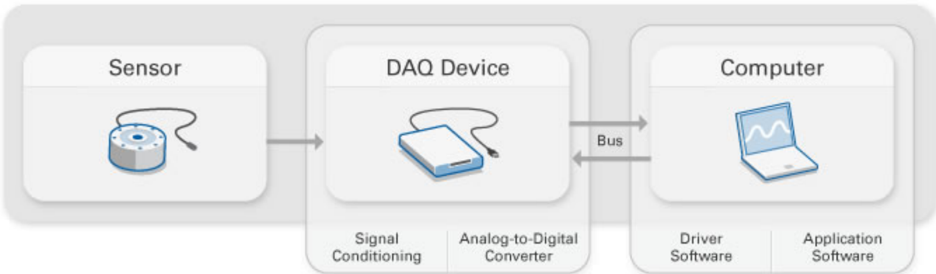

Figure 3.10: Data acquisition System

Over and above mentioned equipments are torque meter, rotational speed meter, air flow meter, oil flow meter are used to measure torque, speed, air flow rate and oil flow rate.

Torque meter Maximum torque capacity of compressor is 200 nm, so we need to select torque meter of capacity of 500 Nm. It has applicable revolution range upto 8,000 rpm. Accuracy is 0.5%

Rotational speed meter It can measure upto 99999 rpm. It has accuracy of 0.05%

Oil flow meter It can work on maximum pressure and temperature of 23 bar and 121řC. It has accuracy of 0.5%.

Air flow meter It can work on pulse input which is connected to DAQ system and output range of 4-20mA. It has accuracy of 0.015%

Accuracy:0.015%

Cost:$400

Three phase induction motor: It has Capacity of 0.5 kW to 90 kW and frequency of 0 to 50 hz.

3.1.2 Cost

Table 3.3: Cost of equipment

ITEM NAME	Manufacture Name	Model number	PRICE/PIECE($)	QUANTITY	Total price($)	Cost(Rs)
Pressure Tranducer	kulite	XTL-140	1000	2	2000	130000
temperature tranducer	omega	TT-E-36-72	100	6	600	39000
Data acquation Card	National instruments	NI-PCI-6255	3000	1	3000	195000
Slip ring	Mood	EC-3848	300	2	600	39000
Encoader	Heiderhain	ROD-486	434	1	434	28210
Pressure gauge	Pennwalt	61A-1A-0050	250	1	250	16250
Torque meter	ONO SOKKi	SS-501	900	1	900	58500
Rotational Speed meter	PCE	PCE-VT 204	750	1	750	48750
Air flow meter	omega	FS-fit-08	400	1	400	26000
oil flow meter	omega	FLC-H14	200	1	200	13000
3-phase ac motor	Kirloskar	KI 90S	6000	1	6000	390000
					Total Cost	983710

3.2 Experimental setup for Performance of screw compressor

Fig 3.11 shows the experimental setup for measuring the performance of screw compressor. Power source is connected to VFD to run the compressor at fluctuating conditions. Power analyser is connected to VFD for measuring the actual input power to the screw compressor. Nozzle is connected to the discharge of compressor where pressure and temperature of discharge air is measured by pressure sensor and thermo-couple respectively. In thermo-couple, cold junction is in DAQ where it is controlled. Pressure and temperature readings of air in the nozzle can be read at computer connected to the Test Rig. Pressure control valve is used to regulate the discharge pressure and humidity sensor is located in test rig for measuring the humidity of atmospheric air. By varying different key parameters of screw parameters such as rotational speed, discharge pressure, oil flow rate, performance can be calculated in terms of adiabatic efficiency, volumetric efficiency.

Figure 3.11: Experimental setup for performance of screw compressor

3.2.1 Selection of equipment for performance of screw compressor

Power analyser Model number of power analysis is YOKOGAWA WT230. It is used for measuring actual input power. It has current accuracy of 0.1% and its range is from 0.5 to 100 khz. The display update rate is 0.1, 0.25, 0.5, 1, 2, or 5s. It can display digit upto 5 digits.

Figure 3.12: power analyser

DAQ system It is located at test rig for measuring air flow rate and various data. It has 21 mix and match plug in modules for measuring pressure and temperature. It can scan upto 1000 ch/sec. It i0s compitible to USB 2.0. Model number:Agilent 34980A

Figure 3.13: DAQ System

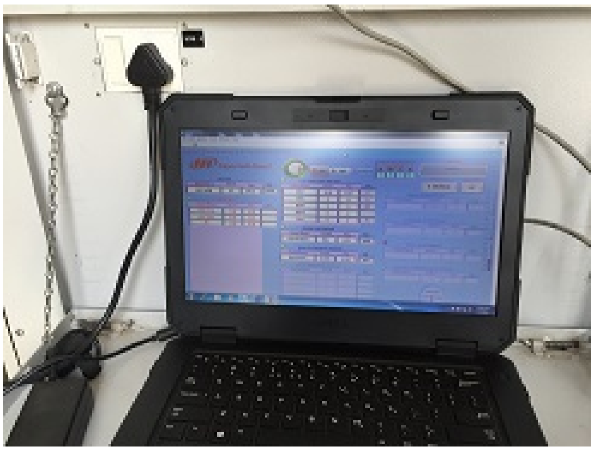

Figure 3.14: DAQ system

Thermocouple:OMEGA TQSS-18U-12 It is located at the nozzle for measuring temperature of discharge air. It has temperature range from 29řC to 180řC. It has accuracy of 0.2%

Figure 3.15: Thermocouple

Pressure measurement Model number of pressure measurement device is Mensor Cpg2400. It is used For measuring pressure of discharge air. One end of pressure sensor is located at test rig and another end is located at the nozzle. Its pressure measuring range is 0.2 to 345 bar. Its accuracy is 0.01.

Figure 3.16: Pressure measurement

VFD(variable frequency drive) Model number of VFD is VLT automation drive 301. It is used for running the compressor at fluctuating conditions by changing the rotational speed. It can run upto 50 Hz.

Figure 3.17: VFD

Pressure control valve It is used for maintaining the discharge pressure at nozzle.

Figure 3.18: Pressure Control valve

3.3 Efficiency

volumetric efficiency: The volumetric efficiency can be defined either in terms of volume flow rate or in terms of mass flow rate to yield the same value.

= (Volume of gas delivered at suction condition for a pair of rotor cavities)/ (volume of meshed male and female rotor cavities)

= (Mass delivered for a pair of rotor cavities) / (Theoretical mass of gas contain for the same volume at suction condition)

$$\eta_v = m/V_{th} \tag{3.1}$$

$$V_{th} = (0.5 * L/D * D^3 * N) * Co \tag{3.2}$$

Where,

m=real volume,

V_{th}=Theoritical volume

L=length of a rotor

D=diameter of rotor

N=rpm of male rotor

Co=Air circulating co-efficient

Adiabatic efficiency: Adiabatic efficiency is defined in terms of system power, which can be measured reasonably accurately by an energy meter. The system power is the power required for an entire compression system and is the sum of the shaft power and several additional power requirements due to the presence of controllers and other peripheral systems. Based on the experimental shaft power.

$$\eta_a = P_i/P \tag{3.3}$$

$$Pi = P_1 * V_1 * 3.5((P_c - 1)/36)) \tag{3.4}$$

$$P_c = (P_2/P_1)^c \tag{3.5}$$

where,
P_i=Isentropic Power
P=Actual Input Power
P_1=Suction Pressure
V_1=Scution Volume
P_c=Pressure Coeffecient

Specific power specific power is power required to deliver a unit quantity of mass of the gas.it is the ratio of the compressor power and mass flow rate.

$$S = P/m \tag{3.6}$$

Where,
S=specific power
P=actual input power
m=mass flow rate

Chapter 4

Results & Discussion

4.1 Performance of screw compressor

Performance of screw compressor have been cheaked with various operatiing condition such as rotational speed and discharge pressure and oil flow rate. Obsevation and results were presented on table 4.1

Table 4.1: Performance of screw compressor by changing rotational speed

N(RPM)	2988	3486	4482	4980
Ps(psi)	14.521	14.523	14.521	14.522
Ts(řC)	33.32	33.31	33.33	33.31
Pd(psi)	101	101	101	101
Td(řC)	80	82	90	93
m(cfm)	143.38	167.15	213.11	236.41
P(kW)	26.9	31.98	42.45	48
η_a(%)	73.6	72.13	69.99	67.45
η_v(%)	50.14	58.60	74.72	82.89
S(kW/m3/min)	6.73	6.83	7.11	7.27

Effect of Rotational speed As shown in table 4.1 and figures 4.1 to 4.5, with the increase in the rotational speed of rotors volumetric efficiency, specific power, air flow rate and discharge temperture increases. With the increase in the speed of rotation it is obvious that air flow rate increases. This increase in air flow rate with increase in speed also leads to increase in the volumertic efficiency as theoretal volume remains same but actual volume handled increases. With increase in the speed of roation, power supplied to compressor increase and ideal power also increases due to increase in air flow rate. As increase in actual input power is more compared to increase in air flow rate with the increase in rotational speed, adiabatic efficiency decreases. Similarly for specific power increases with the rotation speed as power comusmption increases and air flow rate also increases however percentage increase in power consumption is more than increase in air flow rate. With the increase in rotational speed discharge tempeature increasses due to more friction

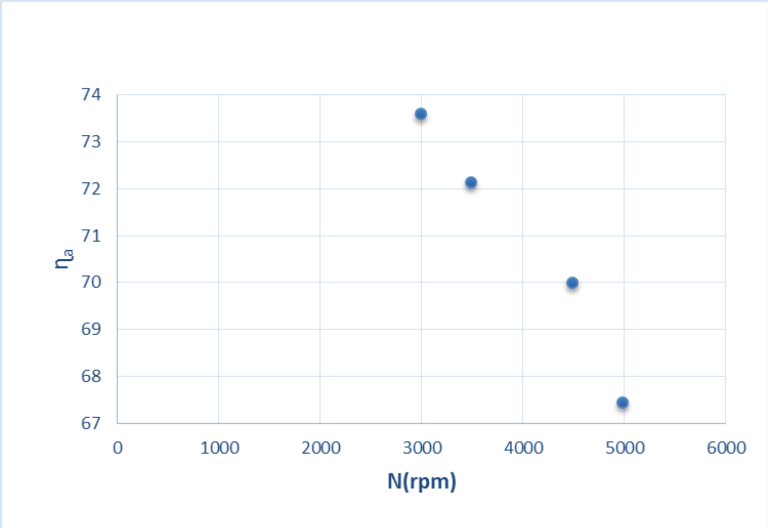

Figure 4.1: Effect of Rotational speed on adiabatic efficiency

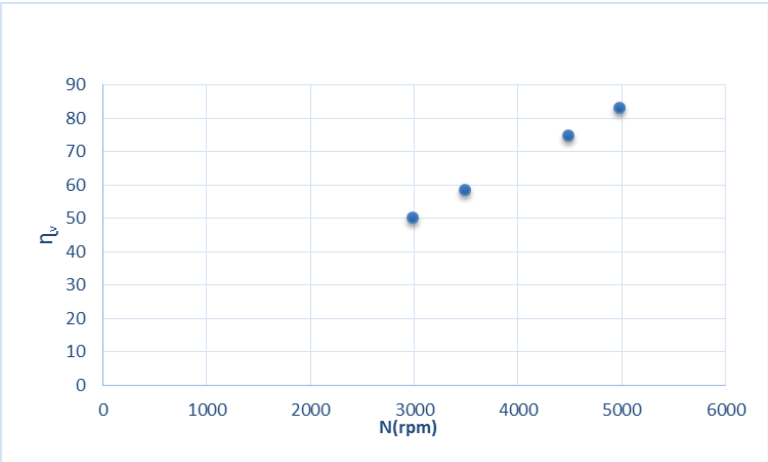

Figure 4.2: Effect of Rotational speed on volumetric efficiency

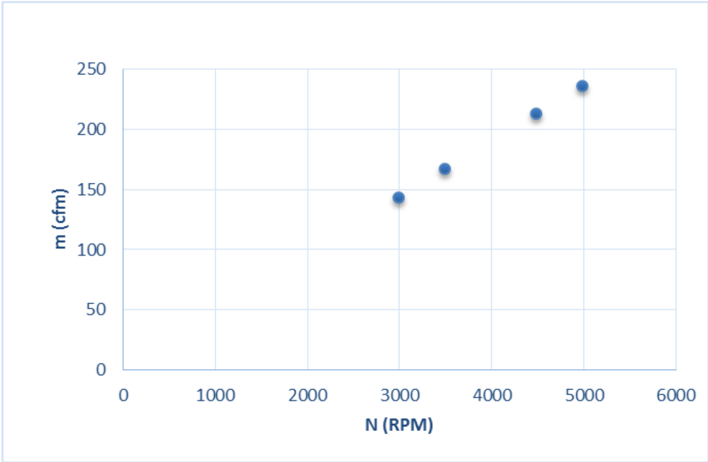

Figure 4.3: Effect of Rotational speed on air flow rate

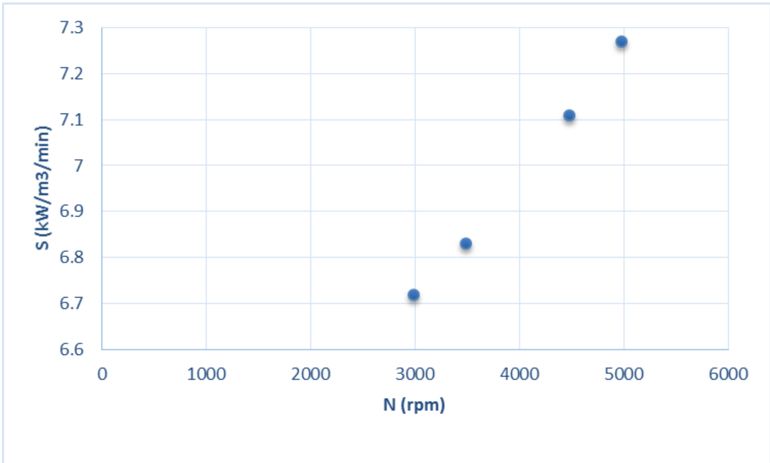

Figure 4.4: Effect of Rotational speed on specific power

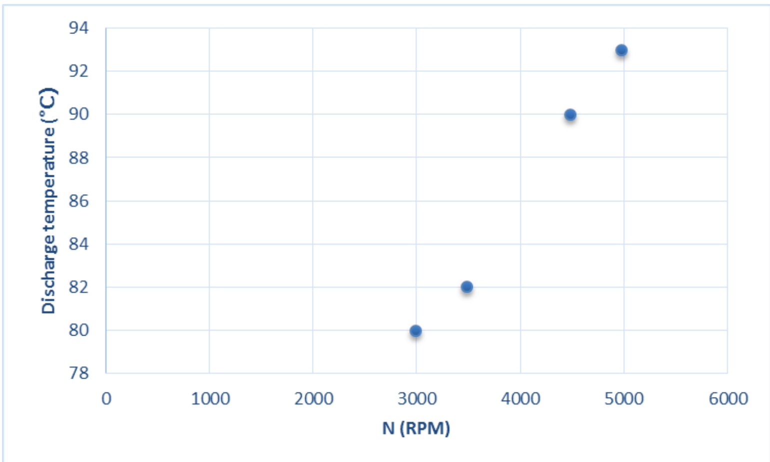

Figure 4.5: Effect of rotational speed on discharge temperature

Table 4.2: Performance of screw compressor by changing discharge pressure

N(RPM)	4980	4980	4980
Ps(psi)	14.623	14.623	14.623
Ts(řC)	33.32	34.03	34.53
Pd(psi)	101	116	137
Td(řC)	93	98	102
m(cfm)	236.15	231.66	234
P(kW)	48.08	50.06	54.03
η_a(%)	65.41	65.97	62.44
η_v(%)	82.80	81.22	82.04
S(kW/m3/min)	7.27	7.71	8.24

Effect of changing pressure ratio As seem in table 4.2,Based on thermodynamic priciple as pressure ratio increases discharge temperature of gas increases. As pressure ratio increases, discharge pressure increases while inlet pressure remains same. Due to increse in discraage pressure losses from lekages increases which leads to decrease in air flow rate. With the increase in pressure ratio, air flow rate decreases where as theoretical volume of screw remains same, thus volumetric efficiency decreases. Specific power increases with the increase in pressure ratio due to increase in power consumption and decrease in air flow rate. With the increase in pressure ratio ideal power and actual power increases but increase in ideal power is more compare to actual power so adiabatic efficiency increases. This experiment needs to verify for one more time.

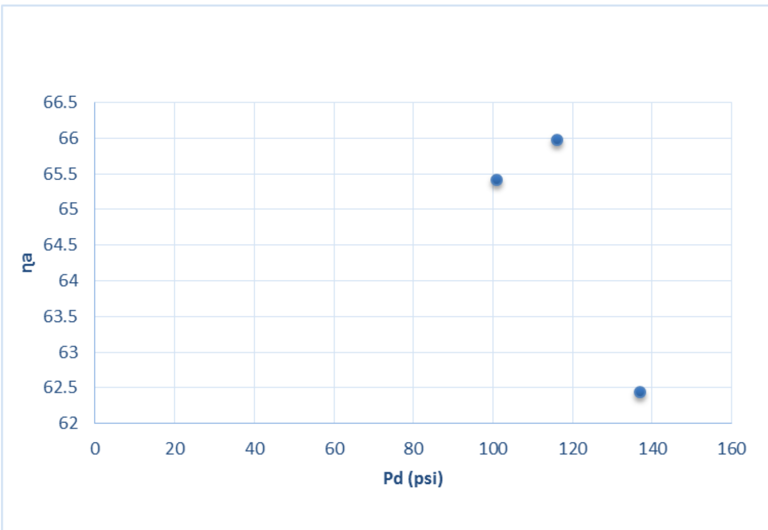

Figure 4.6: Effect of Discharge pressure on Adiabatic efficiency

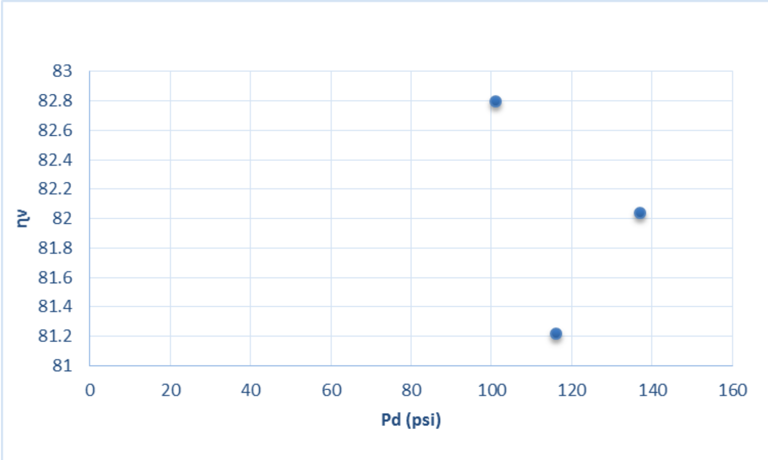

Figure 4.7: Effect of Discharge pressure on volumetric efficiency

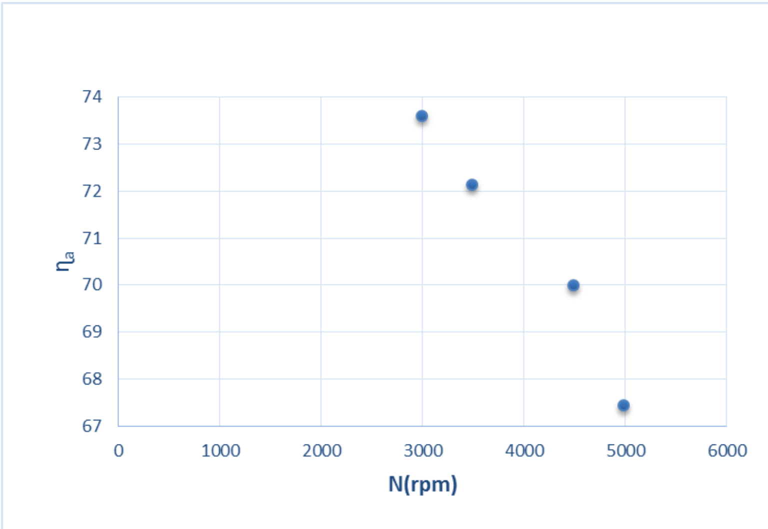

Figure 4.8: Effect of Discharge pressure on air flow rate

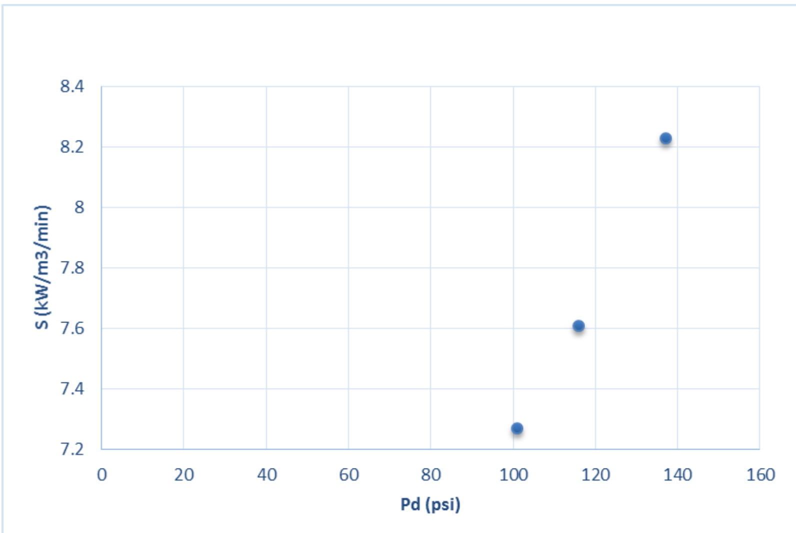

Figure 4.9: Effect of Discharge pressure on specific power

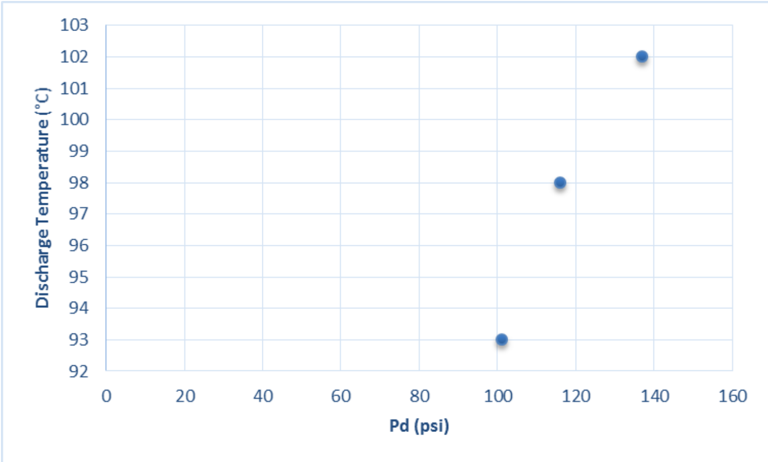

Figure 4.10: Effect of discharge pressure on discharge temperature

Table 4.3: Performance of screw compressor by changing oil flow rate

oil flow rate(Lpm)	48	58	67.15
m(cfm)	182	225	250
P(kW)	52	47.09	42.25
$\eta_a(\%)$	48.30	65.94	81.86
$\eta_v(\%)$	63.81	78.89	87.65
S(kW/m3/hr)	5.09	6.3	7

Effect of changing oil flow rate As shown in table 4.3 and figures 4.11 to 4.14, with the increase in the oil flow rate adiabatic, volumetric efficiency, specific power, air flow rate increases. With the increase in the oil flow rate, more oil is avialable to take heat out of the air, these there is better cooling is achevide with high flow rate. With decrease in power consuption adiabatic efficiency increases. With the increase in oil flow rate better sealing is achieved which results in less leakages and improves volumetric efficiency.

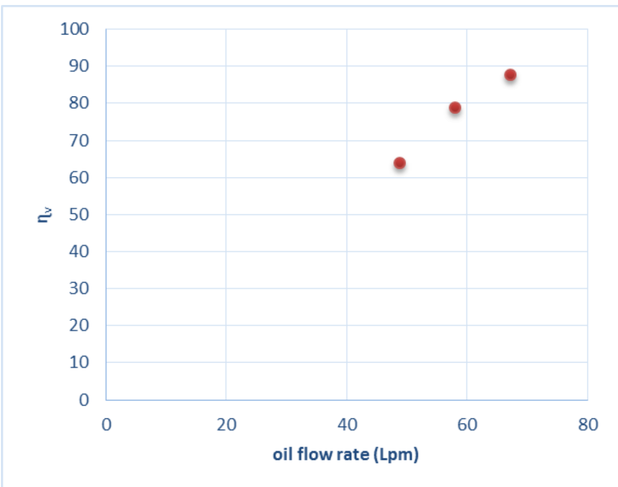

Figure 4.11: Effect of Oil flow rate on volumetric efficiency

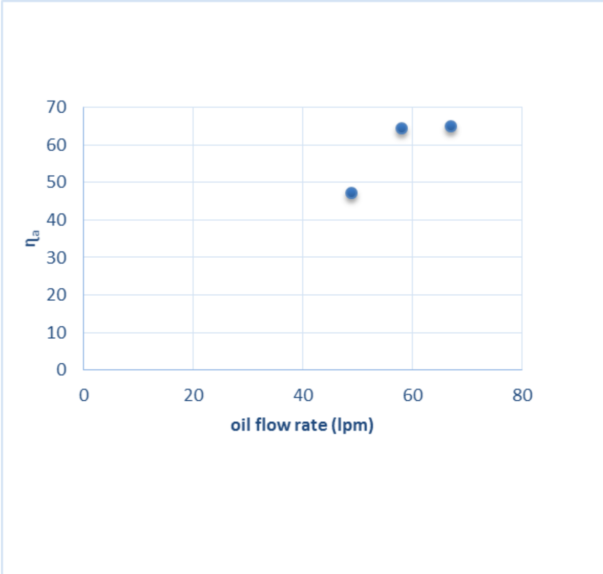

Figure 4.12: Effect of oil flow rate on adiabatic efficiency

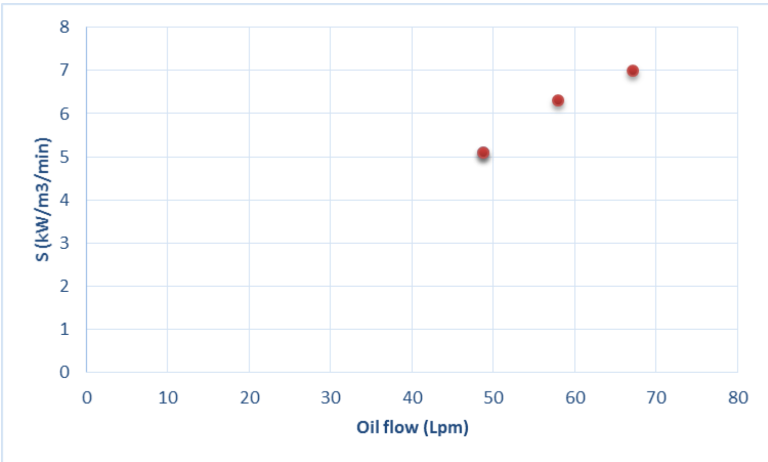

Figure 4.13: Effect of Oil flow rate on specific power

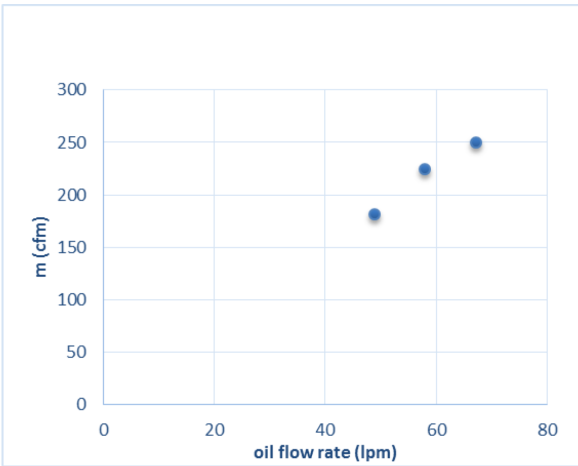

Figure 4.14: Effect of Oil flow rate on air flow rate

Table 4.4: Performance of screw compressor by changing oil flow rate

oil flow rate(Lpm)	26	27	28	33
m(cfm)	123.26	124.26	125.74	127.26
P(kW)	24	25	26	28
η_a(%)	65.38	66.39	67.18	68.32
η_v(%)	78	79	80	81
S(kW/m3/hr)	7.19	7.20	7.28	7.82

As shown in table 4.4 and figures 4.15 to 4.18, performance of screw compressor(22 kW) measured by changing oil flow rate. With the increase in the oil flow rate adiabatic, volumetric efficiency, specific power, air flow rate increases. With the increase in the oil flow rate, more oil is avialable to take heat out of the air, these there is better cooling is achevide with high flow rate. With decrease in power consuption adiabatic efficiency increases. With the increase in oil flow rate better sealing is achieved which results in less leakages and improves volumetric efficiency.

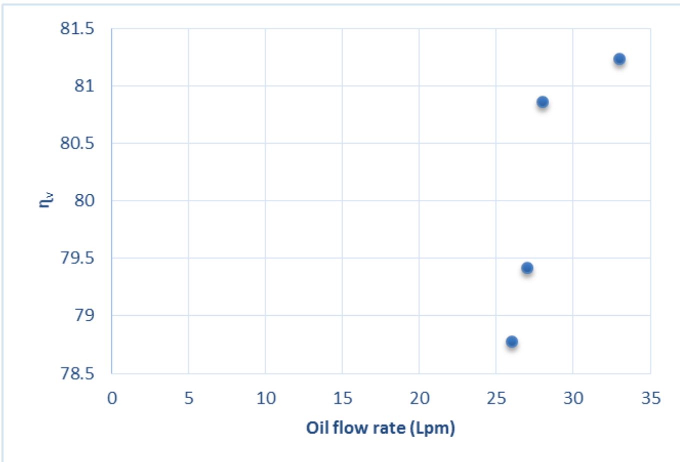

Figure 4.15: Effect of oil flow rate on volumetric efficiency

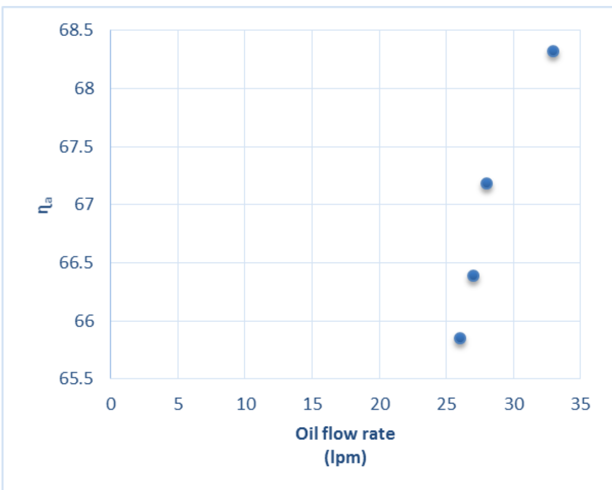

Figure 4.16: Effect of oil flow rate on adiabatic efficiency

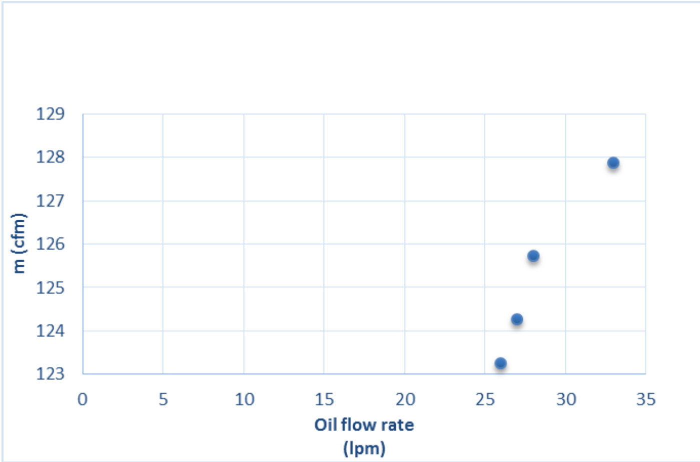

Figure 4.17: Effect of oil flow rate on air flow rate

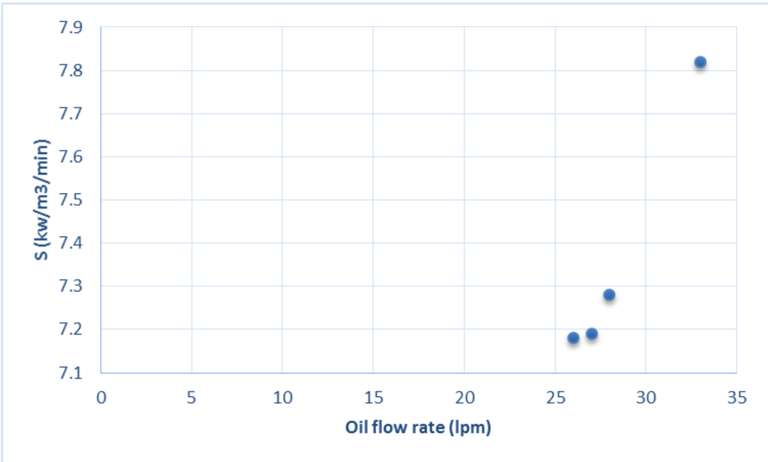

Figure 4.18: Effect of Oil flow rate on specific power

Chapter 5

Conclusions And Scope of Future Work

5.1 Conclusions

- The objective of this project work is to determine temperature distribution in the rotor along radial and axial directions. To fulfill this requirement, design of experimental setup is carried out. The measuring instruments are identified along with its specification, supplier and cost. P-V diagram of designed experimental setup can be plotted.
- Parametric study for performance improvement of screw compressor shows effects of rotational speed, discharge pressure and oil flow rate on adiabatic efficiency, volumetric efficiency and specific power. Volumetric efficiency increases with increase in rotational speed and oil flow rate where it decreases with increase in pressure ratio. Adiabatic efficiency decreases with increase in rotational speed and increases with increase in pressure ratio and oil flow rate. Specific power increase with increase in rotational speed, pressure ratio and oil flow rate.
- With increase in discharge pressure from 101 psi to 116 psi, adiabatic efficiency increases by 0.56% which is different from therotical studies. Similarly, volumetric efficiency rises by 0.82% when discharge pressure is changed from 116 psi to 137 psi.

5.2 Scope for Future Work

- To prepare experimental set up to determine performance of the screw compressors of different capacity.

- To conduct experiments to know the temperature and pressure distribution along radial and axial direction on the screw compressor's rotors.
- To prepare P-V diagram of the screw compressor.

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