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Study of Time Reduction in Manufacturing of Screws Used in Twin Screw Pump

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ABSTRACT: *This paper gives the characteristics of Time reduction in manufacturing of screws for Twin screw pumps. Screws are playing a vital role in the performance of pumps, because pumps give the fluids transfer rate with the help of screws. There is a gap in screws which shows its positiveness. This indicates that we are studying about positive displacements pumps. Positive displacements pumps having no point of contact between screws, because of that there will be no any friction formation. Automation is best for development of product to reduce time in manufacturing of any product. In this paper we also tried to explain this feature of Automation to help reduction of time to manufacture of product to increase productivity.*

Keywords: *Screws formation, Pressure flow system, Automation, Knowledge based engineering.*

I. INTRODUCTION

1.1 Background

On facing of low productivity of screw gives the ideas to develop screws with the help of Automation. With working of conventional machine named Holroyd make machine; there is time used to make 10 hours per screws, this process gives low productivity to submission of pump to customers. That's why we want an alternate to this problem.

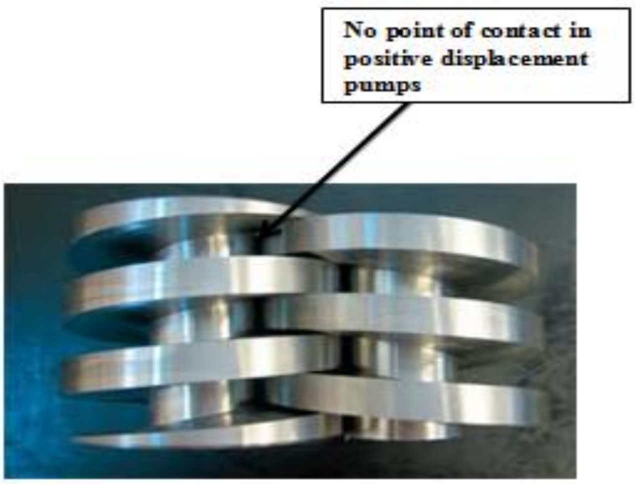


Fig 1.1 No point of contact between screws

1.2 Solution of problem

Working with HMC (Horizontal Machine Centre), which having 4-axis of rotation, gives idea to develop the screws. With the help of VMC programmer, made 3-D model and studied tooling and programming same as screw made with conventional machine. HMC machine gave us working environment without removing or disturbing features to our job.

1.3 Process followed

Steps to manufacture a screw from raw material to final product are as follows: -

- Rod cutting: Rod of SS 431 is used as raw material to develop the blank size of screw.
- Blank formation: Process of turning and facing done on CNC machine.
- Screw formation: programming and setting done on HMC machine. Cutting fluid is used to protect heat up the component.

1.4 Working Principle

The operating principle of twin screw pumps Inside the pump housing rotates the pair of rotors, pushing fluid located around the screw respectively screws step size. Liquid is supplied very uniformly and without pulsations and along the axis (not circumferentially as in centrifugal pumps).

The liquids sensitive to mixing in cross section or turbulent mixing, subject to a small load during pumping:due to the absence of pulsations, low speed, the minimum number of centrifugal rotation and lack of contact between the screws on the pumped product is not subject to changes in volume, texture, characteristics and properties. Due to the low inertia of the rotary parts, screw pumps can operate at higher speeds than other positive displacement pumps, or equivalent volumetric chamber.

1.5 Parameters for Selecting of pump

In order to select the most suitable pump for your application, you must consider a number of key parameters. First and foremost, you must determine the type of installation of the pump and the manner in which the pump will be used in the system. In addition, it is important to take into account the feed rate of the pumped fluid flow (l / min or m^3 / hr.); the total pressure feed rate of pressure (bar), and the index of the liquid column height below the pump suction pipe (NPSN). To the list of the key parameters to be considered when selecting a pump also relates nature of the pumped material (chemical composition, density, viscosity, pH, temperature), and the level contained suspended solids and degree of abrasiveness. Moreover, one should consider the level of the supply voltage and line frequency for connecting the motor and the type of the transmission mechanism between the motor and the pump.

1.6Performance under different conditions such as

- Flow rate
- Viscosity
- Power consumption

1.6.1 Flow Rate

1. Chamber Size + number of screw
2. Speed
3. Differential Pressure
4. Viscosity
5. Gap design (screws, liner/casing)

Flow rate =Volumetric Flow – Backflow

$Q_{total} = Q_{volumetric} – Q_{backflow}$

1.6.2 Viscosity

1. Chamber Size + number of screw
2. Speed
3. Differential Pressure
4. Viscosity,
5. Gas Content
6. Gap Design (screws, liner/casing)

Less Backflow with higher fluid Viscosity

Less Backflow with Gas.

1.6.3 Power Consumption

1. Speed
2. Differential Pressure
3. Viscosity

Shaft Power = Hydraulic Power + Friction

Pshaft = Phydraulic + Pfriction

Flow Rate is directly proportional to speed.
Power Consumption depends on speed and differential pressure

II. EXPERIMENTAL SET UP

Pump casing

Pump casing is a casing used to passes liquid through that which is made up of cast steel or cast iron of casing made.

Suction as Inlet port used to give inside liquid pressure in pump and discharge as outlet port used to give outside pressure to transfer liquid through that casing.

There are also two ports used in pump casing for shaft intake and outtake.

Valve Casing Assembly

Valve casing assembly is used to store fluid which come high pressure; there is relief valve through that valve casing can bear extra force of fluid.

Gear casing

Gear casing is used to cover the gears, gear used on the shaft to help transmit energy to move shaft assembly. Gear casing is used on both ends as drive and non-drive end of shaft.

Bearing and Mechanical Seals

Bearings are used to movement of shaft assembly, and Mechanical Seal is used to protect back pressure of liquid pressure from the pump casing.

Pressure gauges

Pressure gauges is used to measure the pressure of outgoing liquid, timing of transfer liquid is depend on the regulation control by the pressure gauge.

Electrical Motor

Motor is used to start the pump; electrical energy is converted into mechanical energy.

Coupling

Coupling is used between electrical motor and pump casing attached to drive end of shaft assembly.

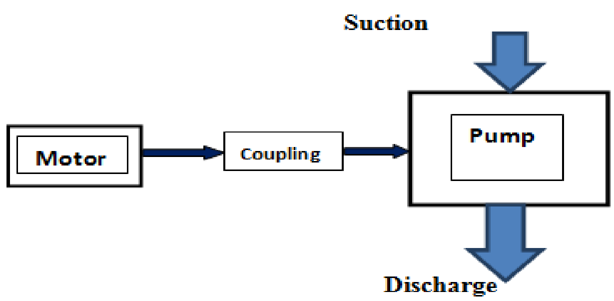
Base frame

Base frame is uses as foundation of screw pump assembly. There is vibration damper also used. It is made of mild steel, channels and sheets.

Foundation bolts & vibration damper

Foundation bolts are used to fix the base frame; base frame is stand on vibration damper to fix the vibration on running condition of pumps.

2.2 Block diagram



III. RESULT OF EXPERIMENT

Quality Assurance Report:

Holroyd made screw sets data:

Table: 3.1 Pump input data

Viscosity (cst)		Discharge pr. (bar)	Speed (rpm)	Capacity (m3/hr.)	Power Absorbed (kw)
2	20	2.84	1450	100	
1.119	2.87				

Table: 3.2 On Process Test Result

Q_{th}	Suction Pr.	Diff. Pressure	Speed	For capacity		For Power			
				litre	time	amp	volt	PF	without eff. Power

131.40	0	0.00	1450	117	3.60	26.4	378	0.70	12.10
	0	1.00	1450	110	3.60	31.4	378	0.72	14.80
	0	2.00	1450	104	3.60	38.4	378	0.72	18.10
	0	3.00	1449	98	3.60	45.0	378	0.74	21.74
	0	4.00	1449	92	3.60	51.4	377	0.74	24.90
	0	5.00	1449	87	3.60	59.1	376	0.76	29.40
	0	6.00	1449	83	3.60	65.1	368	0.78	32.53
	0	7.00	1449	78	3.60	79.5	368	0.81	40.79
	0	8.00	1448	74	3.60	89.9	368	0.81	46.53
	0	9.00	1448	71	3.60	100.0	369	0.83	53.95
	0	10.00	1448	67	3.60	107.0	366	0.84	56.84

Table: 3.3 Result of input Data

Test condition			Diff. Pressure	Speed	capacity with viscosity		curve data	%
water	35.0 C	1 cst	0.00	1450	117	117.53	126	92.86
			1.00	1450	110	110.79	122.5	89.8
			2.00	1450	104	105.01	119	87.39
			3.00	1449	98	99.32	115	85.22
			4.00	1449	92	93.54	112	82.14
			5.00	1449	87	88.72	109	79.82
			6.00	1449	83	84.87	107	77.57
			7.00	1449	78	80.05	104	75
			8.00	1448	74	76.29	102	72.55
			9.00	1448	71	73.40	99	71.72
			10.00	1448	67	69.54	98	68.37

Table: 3.4 Technical sheets

Barometric Pressure A	9.96
Vapour Pressure of Liqiud at 35℃ B	0.66
Suction Pressure C	9.30
Flow velocity corresponding to pipe size & Flow V	1.40
Velocity Head D= V2/2g where V=Q/a, a=(π/4 d2)	0.10

Suction Pressure			Discharge Pressure (kg/cm2)	Diff. Pressure (kg/cm2)	Capacity (m3/Hr.	NPSH
mm Hg	Bar	mWc				
-	0.3	3	4.7	5	91	6.4
-	0.5	5	4.5	5	91	4.4
-	0.7	7	4.3	5	91	2.4
-	0.8	8	4.2	5	90	1.4
-	0.9	9	4.1	5	87	0.4

Hmcmade screw sets data:

Table: 3.5 Pump input data

Viscosity (cst)		Discharge pr. (bar)	Speed (rpm)	Capacity (m3/hr.)	Power Absorbed (kw)
2	20	2.84	1450	100	
1.119	2.87				

Table: 3.6 On Process Test Result

Qth	Suction Pr.	Diff. Pres-sure	Speed	For capacity		For Power			
				litre	time	amp	volt	PF	without eff. Power
131.40	0	0.00	1452	121	3.60	20.9	362	0.92	40
	0	1.00	1451	116	3.60	29	362	0.74	40
	0	2.00	1451	109	3.60	36	364	0.75	40
	0	3.00	1451	102	3.60	43.2	363	0.78	40
	0	4.00	1452	96	3.60	50	363	0.79	40
	0	5.00	1451	90	3.60	58	362	0.8	50
	0	6.00	1451	85	3.60	66.7	362	0.87	50
	0	7.00	1450	81	3.60	71.1	361	0.82	60

	0	8.00	1450	77	3.60	78.9	359	0.83	65
	0	9.00	1450	73	3.60	92.7	359	0.85	70
	0	10.00	1449	70	3.60	108.0	358	0.87	80

Table: 3.7 Result Technical Data

Test condition			Diff. Pressure	Speed	capacity with viscosity		curve data	%
water	35.0 C	1 cst	0.00	1452	121	121.21	126	96.03
			1.00	1451	116	116.48	122.5	94.69
			2.00	1451	109	109.74	119	91.6
			3.00	1451	102	102.99	115	88.7
			4.00	1452	96	97.13	112	85.71
			5.00	1451	90	91.44	109	82.57
			6.00	1451	85	86.62	107	79.44
			7.00	1450	81	82.85	104	77.88
			8.00	1450	77	79	102	75.49
			9.00	1450	73	75.15	99	73.74
			10.00	1449	70	72.35	98	71.43

Table: 3.8 Technical sheets

Barometric Pressure A	9.96
Vapour Pressure of Liqiud at 35 ℃ B	0.66
Suction Pressure C	9.30
Flow velocity corresponding to pipe size & Flow V	1.57
Velocity Head D= V2/2g where V=Q/a, a=(π/4 d2)	0.13

Suction Pressure			Discharge Pressure (kg/cm2)	Diff. Pressure (kg/cm2)	Capacity (m3/Hr.	NPSH
mm Hg	Bar	mWc				
	0.3	3	2.5	2.8	100	6.43
	0.5	5	2.3	2.8	101	4.43
	0.7	7	2.1	2.8	101	2.43
	0.8	8	2	2.8	99.5	1.43
	0.9	9	1.9	2.8	96	0.43

IV. CONCLUSION

By doing this type of Experiment we save:

1. 20 hours of manufacturing time,
2. 20 hours of Electricity Bills,
3. 20 hours of Machine maintenance cost.

During this period we can fulfill other customer requirements.

5.1 Future scopes: To reduce manufacturing time by using alternate method of automation is in progress.

1. Single screw pumps; rotors can make
2. Triple screw pumps; middle and side screw is in progress
3. High pressure pumps parts such as connecting rods, plungers is in designing process for development.

2. APPENDIX

Properties used

Viscosity	1.002 mPa at 20°c water temperature
Density	1000 kg/m3
Atmospheric pressure	14.66 psi
Vapour pressure	38.7° c
Velocity	m3/sec
Velocity Head	meter

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