International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 07 | July-2016 www.irjet.net p-ISSN: 2395-0072

Design and development of petrol tank neck forming machine

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Abstract - *Petrol tank neck forming machine is an apparatus or machine by which a neck of a petrol tank are shaped, the petrol tank neck is pressed and shaping of it is done. The component is shaping is done by applying force on the neck part of the petrol tank, here high pressured hydraulics which is powered by hydro pneumatic intensifier is used. This SPM comprise of a punch and a die, as these punch and die are used for forming in a petrol tank neck forming machine.*

Basically earlier operation was tedious and time consuming they usually subjected to neck forming operation to skilled hammering from the labor which were time consuming hence the thought for the alternate solution started.
Concluding the project with the design will be safe with a help of the solver and analytical calculation for the load and factor of safety.

Key Words: **hydro pneumatic intensifier, petrol tank neck forming, special purpose machine, pneumatics, hydraulics, punch and die. etc**

1.INTRODUCTION

It is very useful to have the customer feedback and there inference on the special purpose machine concept hence involving them in the concept stages is important and helpful as their inputs will reduce the burden of the designers. All these parameters help in building a successful special purpose machines. The main challenge of special purpose machines are here the old conventional designs methods and ideas cannot be used these old conventional ideas becomes obsolete hence they are used in such a way that they are improvised to great extent to achieve the required improvements in the designs. Hence the customer data about the requirement are noted and are induced in the machine designing. There is a huge demand for increasing the quality of production, quantity of production, reducing the cost of production etc. Hence special purpose machine which capable of performing good in the above segments. That special purpose machine will be appreciated. Special purpose machine make it quite easy to perform well in above mentioned segments. In this huge world of competition in the market results in the requirement of quality, quantity, cost, time plays important role. It is required to act accordingly. These elements can be satisfied by using special purpose machines they give higher productivity rate. These special purpose machines can be later used incorporating automation in the process reduces human error caused due to fatigue. Basically it reduces human fatigue in carrying out repetitive action and frequently. As a result it insure the quality since does not incorporate any shortcuts in the methods. These special purpose machines basically made by using cams or hydraulics machines, pneumatic or combined all together. Many times a programmable logic controlled device are installed and positional sensors are used here they are all used to give commands actuating sometimes the special motors used as actuating element. After these efforts the productivity of 3 to 10 times can be achieved. 3 to 10times of productivity increment over the present rate of production is a huge margin and big number

1.1 Problem statement

To the present trend of automobile manufacturing using of sheet metal plays vital role this metal thickness varies from 0.5mm to 4mm thickness. These sheet metals are later bend to required shapes to achieve the required looks and shapes of required dimension. These sheet metal helps in reduction total kerb weight of vehicle. The bike tank is manufactured using sheet metal of 0.8 mm thickness while manufacturing. There are two separate sheet of 0.8 mm thickness each these two sheets are seam welded to obtain the required shape. The above sheet metals must bent back so fouling of the tank neck on the bike chassis could eliminated. Now the requirement is to make the process of tank make semi automatic neck forming machine. The reason behind manufacturing the machine is to make assembly process quicker, to eliminate the fouling, reduce the time involved in neck forming machining hence these factors above mentioned are directly proportional to the total manufacturing time of the automobile. Hence the time of manufacturing and assembly of bike is lessened significantly

1.2 Methodology of design

The basic need is the fixture for that concept is done. Here we more concentrate on the firm holding of the tank and its important when pressure is applied on the neck region of the tank; hence fixture is built to hold off the tank. After fixture is designed then comes the part of hydraulic intensifier, pneumatic, hydraulic cylinders there design and placement.

Later here resting of the tank plays a vital role as it would hence providing the firm resting position is important Stand should be built to withstand the weight and the pressure applied, hence designing a stand should be done with lot care. Guide of the punch should be firmly placed and fool proofing is achieved. Pneumatics and hydraulics cylinder there specification are calculated as per the requirements. Pneumatic circuits are built based on the concept. This circuit will help make in the connection to pneumatic hydraulics and the intensifier

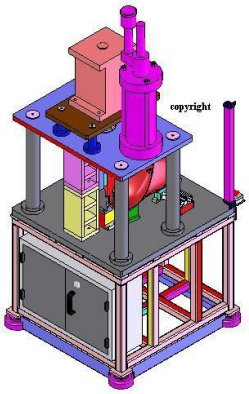

Fig -1: overall machine isometric view without guards

The petrol tank is placed in the neck forming machine as shown in the figure below. Then clamping device is switched on and is subjected to the power. These clamping devices are pneumatic cylinders. These clamp on the petrol tank rigidly. After clamping of a petrol tank a sensor is provided in such a way that it acts as a poka-yoke which only recognize the presence of the component that is placed at the right direction. Hence after firmly placed component neck forming operation takes place Here basically the die and punch are designed by offsetting the profile of the petrol tank surface. The sensor which detects presence of the component in the right place then only circuit allows switching on the machining sequence process done in as per the machining sequential order. These punch and dies are heat treated to withstand the shocks during process of neck forming. This profile cut punch and dies later subjected hardening process. These profile cuts done on CNC milling operations. Dove tail guide which is provide basically acts as guiding for punch which results in the avoiding minute deviation during the pressing condition

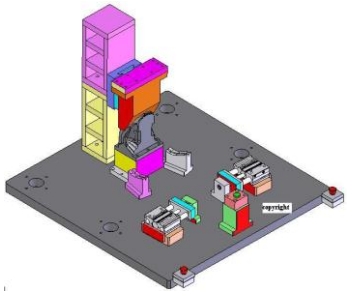

Fig -1: Isometric view of fixture

2. Forming force required

P = 3.125 d t s ((D/d)-c)

P = forming force in kg
D = radii of neck of the tank
t = thickness of the metal in mm
s = yield strength of the component metal in kgf/mm^2
c = constant (take 0.6)
P = 3.125 x d x t x s ((R/r)-c)
P = 3.125 x 107.86 x 0.8 x 25 (0.4051)
P = 4392.60 kg
P = 4 tons
The Factor of safety is to be assumed and taken = 1.25
Therefore force (P) = 4 x1.25= 5ton

Die block dimension

Diameter is semi circular profile cut by CNC milling operation
Material for die block should be of OHNS(oil hardened non-shrinking)Heat treatment = die block should be toughened up to 55 to 60 HRc
Die height = 189.35mm

Top plate

Top plate dimensions = 30x590x790
The thickness of the top plate should be around 30 to 35mm so take 30mm

Bottom plate

Bottom plate dimensions = 40x900x931

The Thickness of the bottom plate should be around 35 to 40mm so take 40mm

Punch height

Height for punch should be around = 152.35mm

Hydraulic cylinders

Cylinder diameter = 80mm

Rod diameter = 36mm

Piston area calculation

Ap = 0.7854 Dp^2
= 0.7845 (36)^2

Ap = 5026.56 mm^2
Ap = 50.3 cm^2

Action force in kgf for P = 100kg/ cm^2

P = F/A
F=P x A
F = 100 x 50.3
F = 5030 kgf

Rod area (cylinder)

Ar = 0.7854 $(Dr)^2$
Ar = rod area
Dr = rod diameter
Ar = 0.7845$(36)^2$
Ar = 1017.87 mm^2
Ar = 10.178 cm^2

Effective area

Ae = Ap – Ar
Ae = 50.3-10.17
Ae = 40.12 cm^2

Volume of the cylinder

V = A x S
V = 40.12 x 200
V = 8024.24 mm^3 = 80.24 cm^3

Pneumatics calculations

Cylinder thrust

Here the cylinder thrust is function of the pneumatic cylinder

F= 0.785 x D^2 x P

F= cylinder thrust is in kgf/cm^2

D = dia of the piston rod in cm

P = operational air pressure in kgf/cm^2

F = 0.785 x D^2 x P

F = 0.785 x 3.2^2 x 0.0612

F = 49.18kgf/ cm^2

Air consumption

Here the air consumption rate which has been calculated for cylinder that is required to estimate a compressor capacity which will be built n used for specific machine

Free air utilization in that of a forward stroke are calculated by the

Free air consumption = piston area x (operating pressure + 1.013) x stroke

C = (0.785 x D^2 x (p+1) x L) /1000

D=diameter of the piston in cm

d = piston rod diameter

c= stroke in cm

p=air pressure in bar

C = (0.785 x D^2 x (p+1) x L) /1000

C= (0.785 x 3.2^2 x (6 + 1) x 50) / 1000

C = (0.785 x 0.24 x 350)

C = 2.1834 litres

Free air consumption for return stroke

C = (0.785 x $(D-d)^2$ x (p+1) x L) /1000

C= (0.785 x $(3.2-1.5)^2$ x (6 + 1) x 50) / 1000

C= (0.785 x 2.89 x (6 + 1) x 50) / 1000

C= (0.785 x 2.89 x (6 + 1) x 50) / 1000

C = 0.7 litres

Hence for a completion of 1 cycle of operation for the above cylinder, required free air consumption are calculated and tabulated below

2.183+0.8 =3 litres

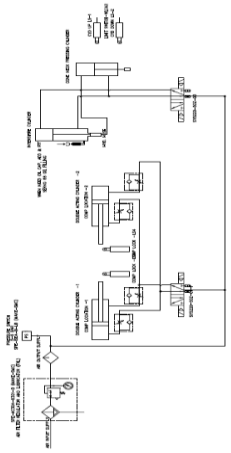

Fig -3: hydraulic pneumatic circuit

Hydro pneumatic intensifier

A hydro pneumatic intensifier is basically used on the conventional machines, in which the hydraulic powering part is not available. Double acting cylinders are generally used with that of the hydro pneumatic intensifiers. This is a hydro pneumatic intensifier it comprises of a twofold acting pneumatic barrel and high powered hydraulic chamber here cylinder bar of pneumatic barrel which is constrained into the fluid driven chamber which results in high pressurized oil removal. In the vast majority of the hydro pneumatic powered apparatus utilized, the typical weight of 80 to 100-psi is more adequate to work at certain spool valves and different instruments. To take into account the requirement for a high weight necessity for a nearly brief timeframe, pumps and adornments are unquestionably not the arrangement. Be that as it may, the substitute can be hydro pneumatic intensifiers. There are diverse sorts in view of the medium of fluid driven liquids utilized and the quantity of strokes used to increase to the weight. They are single-stroke, differential chamber intensifiers, oil-oil intensifiers, air-air intensifiers, and oil-air intensifiers. Late improvements are vast to the point that immense weights are accomplished by utilizing blends of the above sorts hydro pneumatic intensifier helps in intensification of the fluid. When the air allowed in a intensifier region by a directional control valve, the oil on the other hand in the hydraulic side they are pressurized and are forced out at high pressure this type of intensification of the pressure by using pneumatic cylinder is the most economic way of obtaining the pressure from the hydraulic without using the hydraulic pressure. The oil output will do the job of punching in this case of machine. Hence after the position changing takes place in the directional control valve because of the return air pressure, the piston will return to and the punch comes out , hence the oil is pushed back to the intensifier by the spring action of the cylinder. A pressure driven intensifier is a gadget which is utilized to expand the force of weight of any pressure driven liquid, with the assistance of the fluid powered vitality accessible from a colossal amount of fluid or pressure driven liquid at a low weight.

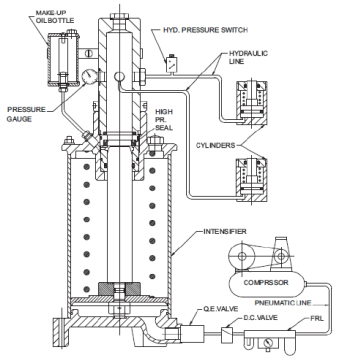

Fig -4: hydro pneumatic intensifier

Analysis of punch and die for analytical load

Application of force in newton after meshing this is the analytical value obtained by applying the formulas, and as well as company specified force is 5ton in analytical calculation force specified is cross checked hence these forces are used. Here the maximum force applied is found to be 5 ton hence force applied to be very negligible on the material hence the stress concentration on the die at critical places can are ignored here the maximum stress is found to 17N/mm^2 on die and 12 N/mm^2 hence the factor of safety is found to be very high

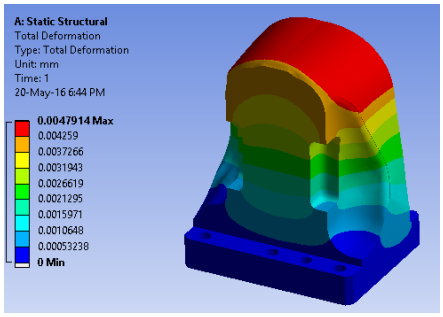

Fig -5: max stress induced on the die

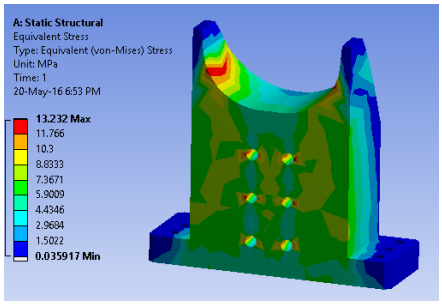

Fig -6: max stress induced on punch

Approximate sum total cost of the neck forming machine

Total charge= sum total cost on raw material + sum total cost on machining + sum total cost on hole drilling+ Hardening charges+ Blackening charges+ hydraulic and pneumatic standard parts cost +Assembly charges

Totalcharge=
60000+85000+27635+5000+5000+70000+4000

Total charge=262895Rs

Time estimation cost justification

Table -1: Cost and time justification of petrol tank neck forming SPM

Descriptions	Conventional process	SPM
Total time required for forming neck region of tank	Ranging from 8 to 12min (consider 8min)	2min
Job/hour	8 job / hour	30 job / hour
Job/day for 8 hours workshift	64 job / day	240 job / day
Job/month	1920 job / month	7200 job / month
Job/year	23040 job / year	86400 job / year
No. of operators required	1	1
Aesthetic look	poor	Good
Component damage risk	high	Low
Human fatigue	high	Low

More jobs per year is 86400 – 23040 = 63360 jobs

The above table gives the complete information on the time estimation and the cost justification or the time comparisons from conventional machining process and special purpose machine here these above table gives the clear cut view of components manufacture in a given stipulated time

3. CONCLUSIONS

As we mentioned above this petrol tank neck forming machine manufacturing criteria is to save the time. Manufacturing time is definitely saved by following the above designed machine. As the requirement of the customer is full filled the customer is happy about the design here the machine ergonomical importance is appreciated and well accepted the usage of these ergonomical colors, dimension, ambience matters a lot and helps the worker to reduce the stress level while operating the machine time saving in just a process which helped it to increase the jobs is remarkable achievement more over the time saved in the production will give the breather time to cope up with the demand. Here these design cross checked or the safety in all the level Ansys are used to check the stress concentration on the punch and die. Here since the stress concentration is found to be negligible hence the design would be safe in terms of the failure due to wear. Here extensive production cost calculation has been done. These calculations are precise and accurate to the present market trend here these cost estimation will help to justify the machine cost and that cost justification has been done extensively to prove worth of the petrol tank neck forming machine. A company's most successful and most profitable product or the component is being manufactured at higher faster rate by using the petrol tank neck forming machine is always a good sign for the company and because profits are bound to dribble like a rain

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