

MANUFACTURING OF METALLIC BELLOW USING HYDRAULIC BELLOW FORMING MACHINE

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ABSTRACT

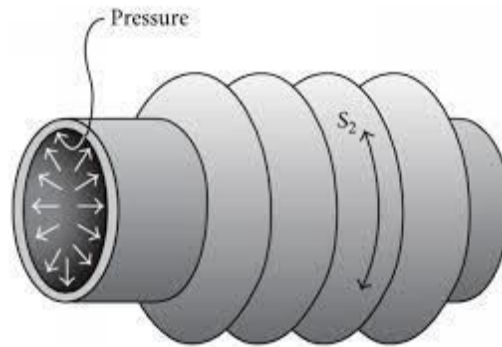
Metallic BellowForming Machine Was developed to obtain uniform and accurate bellows with an completely automated process. The main of this project is to replacing the existing rubber tool which were used in the hydraulic forming machine. By replacing the split tool instead of rubber tool were employed in order to give the uniform rate of bellow productions. According to this certain changes and some modifications may be made in the machine which would be studied in this project. By replacing the rubber tool into split tool we can able to achieve time consumption during manufacturing process, elimination of wastages, reduces the breakdown time and reduces the tool replacement cost.

Keywords:Bellows, Manufacturing process, Rubber tool, Split tool

I . INTRODUCTION:

Metal bellows are elastic vessels that can be compressed when pressure is applied to the outside of the vessel or extend under vaccum, When the pressure or vaccumis released the bellows will return to its original shape. Bellows are one of the most energy efficient absorbing elements for engineering system.bellows have a function to absorb regular or irregular expansion and contraction in piping system. [6] discussed about a disclosure which is made regarding a gear blocking gear cover for the four wheeler vehicle where the protective cover has been with touch sensors and biometric sensors. Here in case of theft even if the car is started without a key the gear system is locked using biometric locks which can read the palm of the user to unlock the gear system thus protecting the vehicle against any form of theft. This device can be attached to any type of four wheeler vehicle.It is widely used as the element of expansion point in various piping system, aerospace, micro electromechanical and industrial system.

II . DESIGN CALCULATIONS:



N - No of convolutions

n - No of ply

t - Thickness

OD - Outer diameter

ID - Inner diameter

Dm - Mean diameter

LB - Bellow diameter

Q – Pitch

W - Depth

NL – Nominal Length

Oc – Outer circumference

N = 6

OD = 366mm

ID = 324mm

n = 2

t = 0.3mm

LB = 60mm

I . DETERMINATION OF PITCH :

$$W = \frac{OD - ID - (n*t)}{2}$$

$$= \frac{366 - 324 - (2*0.3)}{2}$$

$$W = 20.4\text{mm}$$

II . DETERMINATION OF NOMINAL

LENGTH:

$$NL = (2W) + (0.571*Q) *N$$

$$= (2*20.4) + (0.571*10)*6$$

$$= (40.8 + 5.71) * 6$$

$$NL = 280\text{mm}$$

III . DETERMINATION OF PITCH:

$$Q = LB/N$$

$$= 60/6$$

$$Q = 10\text{mm}$$

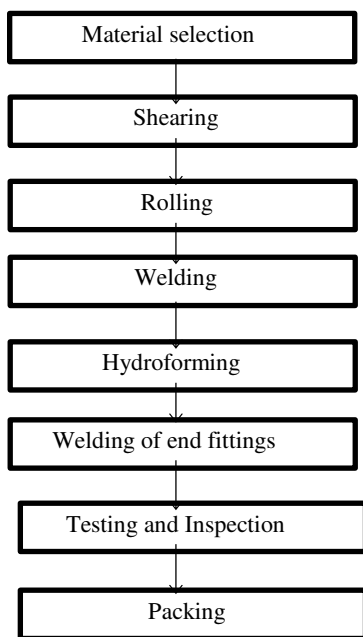
IV . DETERMINATION OF MEAN DIAMETER:

$$Db = OD+ID/2$$

$$= 366+324/2$$

$$Db = 345\text{mm}$$

III . MANUFACTURING PROCESS:



3.1 MATERIAL SELECTION :

- Austenitic, Inconel, titanium, titanium alloys, non – ferrous materials like copper, brass, phosphor, bronze etc..., are the materials used in the manufacturing of bellows.
- Usually stainless steel with the various grade are selected for the manufacturing process.
- For aerospace applications 304L grade stainless steel is used.
- For chemical purpose industries 316L grade stainless steel is used
- For normal applications 321 grade stainless steel is used

3.2 SHEARING :

- Shearing is a process of metal cutting without the formation of chips.
- A shear force is applied that will cut off the part of a sheet.

3.3 ROLLING :

- A rolling machine is used for roll different kinds of metal sheet in to round or conical shape.

3.4 WELDING :

- Welding is a fabrication process that joints materials or thermoplastics, by causing fusion which is distinct from lower temperature metal joining techniques such as brazing and soldering which do not melt the base metal. The long seam welding is used to weld the rolled materials.

3.5 HYDRO FORMING PROCESS :

- First check the water level inside the tank.
(based on the ID . OD the suitable die is selected and the die is fitted in to the pipe.)
- Suitable split tool is selected, based on the convolution thickness.
- Set the die and split tool in the machine
- Once the required pitch is set, then all the convolutions can be made.
- After all setting is over, insert the tube in the machine.
- The forward and backward movements of the dies can be controlled using the switches.
- The die movement is based on the hydraulic pressure passing through pipe.
- Based to the forward and backward movements the split tool is expanded and contracted.
- Due to the expansion and contraction of the split tool, the convolutions can be formed.
- Form the bellow continuously and check the outer diameter of the bellow.
- After finishing the bellows finally move to the house and switch off the machine.



Fig 3.1 Hydroforming machine

3.5.1 MODIFICATIONS :

- the rubber tool is replaced in to split tool.
- Because tool is not much suitable for mass production of bellows.
- Split tool is made up of mild steel which is available in cheap.
- Using the split tool many convolutions can be mad without any damaging.
- The possibilities of bending in split tool at the time of applying high pressure but it cannot be damaged and bending is eliminated and rectified easily.



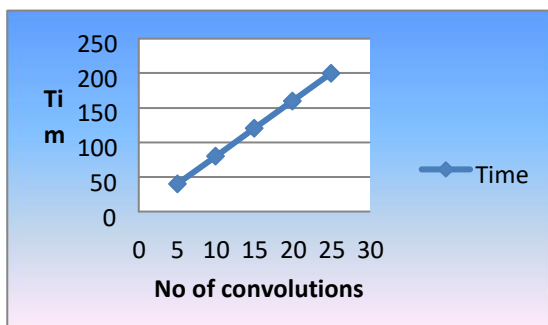
Fig 3.2 Rubber tool



Fig 3.3 Split tool

3.5.2 CONVOLUTION vs TIME

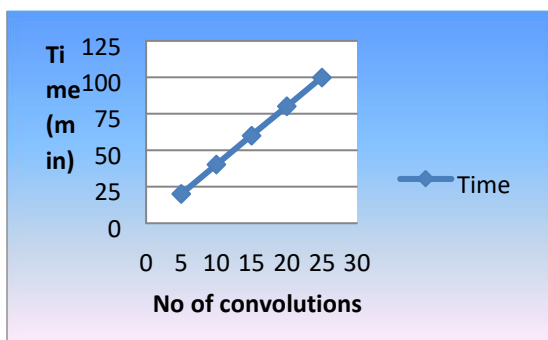
- ForRubber tool**



It takes 8 minutes for making one convolution in the work piece. No. of convolutions is taken along the x – axis and the time taken along the y axis. [3] discussed about a disclosure which is made regarding a driving alert system which is designed in the form of a neck cushion which has the capability to sense the posture of the drivers neck position so as to identify whether the driver is alert and if he is dozing of. The system is made intelligent to obtain data from the movement so as to produce triggers to alert the user and to keep him/her awake to avoid accidents. The system is also linked to a mobile computing device so as to provide a report of the analysis done. The drivers location can also be tracked using the same.

The graph is plotted between these two.

ii) For Split tool



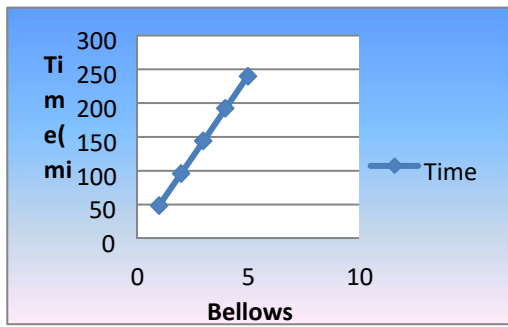
It takes 4 minutes for making one convolution in the work piece. No of convolutions is taken along the x – axis and the time is taken along the y – axis.

The graph is plotted between these two.

3.5.3 BELLOWS vs TIME

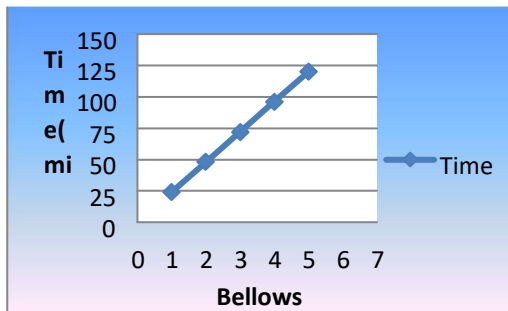
No of convolution is 6

i) For rubber tool



It takes 48 minutes for making one bellow in the forming machine. No of bellows is taken along the x – axis and the time taken along the y – axis. The graph is plotted between these two.

ii) For split tool

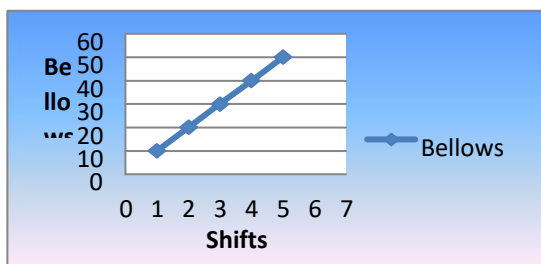


It takes 24 minutes for making one bellow in the forming machine. No of bellows is taken along the x – axis and the time taken along the y – axis. The graph is plotted between these two.

3.5.4 BELLOWS vs SHIFTS

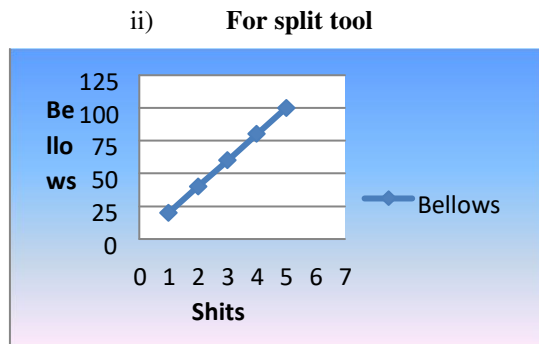
1 shift = 8 hours

i) For rubber tool



For one shift 9 – 10 bellows are manufactured in the forming machine. No of shift is taken along the x – axis and the number of bellows is taken along the y – axis.

The graph is plotted between these two



For one shift 18 – 20 bellows are manufactured in the forming machine. No of shift is taken along the x – axis and the No of bellows is taken along the y – axis

The graph is plotted between these two

IV. RESULT & DISCUSSION

As we already stated that this project mainly focuses on changing rubber tool into split tool. Hence the following result were achieved.

V. CONCLUSION :

Thus, the complete process of manufacturing of bellows using hydraulic bellows forming machine was explained in detailed manner. Manufacturing process and the Testing procedures are also clearly viewed. In manufacturing process, the replacement of split tool instead of using rubber tool and their advantages, disadvantages, performances are discussed completely in the report because of this replacement time consumption in manufacturing process of a bellow can be reduced from 30mins to 15mins

NO	PARAMETERS	RUBBER TOOL	SPLIT TOOL
1	convolution	6 to 12	More than 12
2	Thickness of crest	Reduced	Nearly equal to the root
3	Instability in deformation	Unstable deformation	Stable deformation
4	Advantages & disadvantages in design	Simple, less flexible	Complex, more flexible
5	Torsion	Less flexible	More flexible

6	Fatigue	short	Longer
7	No of jobs produced per hour	2	4
8	No of tool required to manufacturing one job	More than 4	Only 1
9	No of jobs eliminated per hour	3	Nil
10	Time consumption per job	30 mins	15 mins
11	Accuracy of an product	low	high
12	No of plies	Bellows having only one ply can be manufactured	More than 2 plies can be manufactured

VI. REFERANCES

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