Advancement In Die Design of Leaf Plate Making Machine

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Abstract- *Generally, the cups are made in plastics. The plastics are harmful and it has many disadvantages to us especially the earth pollution. We are encouraging lot of instant products which are made of plastics because of lower cost and requirements. These plastic products not degradable in earth. The disposable plates which are made of thermocol and materials such as plastics, ceramics are land pollutant materials, they will not decompose into the earth. By naturally we get leaves, papers by using this we can make cups and plates .It is do not affected by any chemical effect. The paper cup and plate is made by a hydraulic machine. The machine is operated by the hydraulic system and by using this we can produce cup and plate at high production rate. By using different shape die we can produce different shape and size plates and cups. The machine size is comfortable to suit anywhere. The automatic approach for manufacturing of the cups is found very suitable and also decreases the cost of the manufacturing. The leaves plates and cups are also found sustainable for the environment safety.*

Areca nut tree, which has leaves of big size and confine that leaf into desired shape by using the die equipment. Design of machine was done in SOLIDWORKS software and fabrication was done by using different joining methods like welding and bolt & nuts. Real time testing was carried out at different temperatures.

Keywords- Arecanut leaf, heating coil, dies, pneumatic press, pneumatic cylinder.

I. INTRODUCTION

Leaf cups and plates are Generally made by hand in Indian Villages. These are commonly used for serving food at marriages, Parties, religions and social functions the laborious craft can now be converted into a machine operation to make these containers in elegant shapes and sizes. Such cups and plates are made out of plant leaves of beautia, areca nut sheath, banana etc. These Plates and cup have good dimensional stability and are cheap in nature, hygienic and biodegradable in earth.

Paper plates and cups are widely used in domestic applications in replace of metal plates.. Making plastic plates and cups is a small business and one can easily afford it with the minimum Money. So we made two die system which produce leaves plate and cup at a same time at minimum investment

II. HISTORY –ARECA LEAF PLATE

In India 4 lakhs hectors of areca crop has been cultivated. Near about 5,400 million areca leaves are shredded and treated as an agro waste.

One Areca leaf plate manufacturing unit need 70,000 leaves per year. In this scenario nearly about 80,000 plates manufacturing units can be established all over India. 3 lakhs fresh employments can be given in 80,000 units. This project can create "A Rural Employment Revolution" in India.

At Present only 3,000 units are established all over India, in this 2,000 units are established by Eco Green unit for self-help groups, small entrepreneurs and farmers in India.

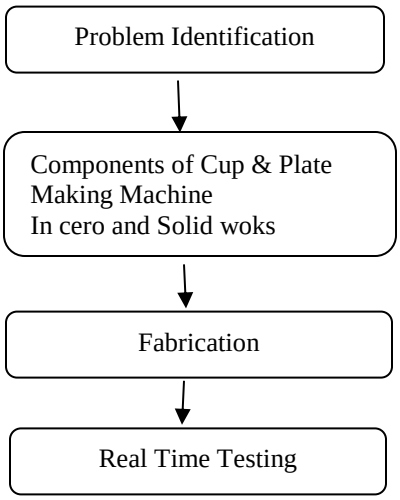
Due to plastic pollution and awareness of this kind of Eco friendly Bio degradable items there is a growing demand for leaf plates and cups in global level

III. PROBLEM DEFINATION

In our daily life we may find a lot of problems related to the pollution. We are encouraging lot of instant products which are made of plastics which are made of plastics because of lower cost and requirements. • These plastic products not degradable in earth. The disposable plates which are made of thermocol and materials such as plastics, ceramics are land pollutant materials, they will not decompose into the earth.

- To avoid the above said problem need to use natural type raw materials which easily decompose. Areca nut tree, which has leaves of big size and confine that leaf into desired shape by using the die equipment.

IV. METHODOLOGY



V. MATERIAL SELECTION

5.1 Design of Lower Dies

5.1.1. Design of plate die:

It is shown in the figure. Dies are often made of various types of metals to make sure the die can resist to corrosion. Our plate die is made of high quality mild steel and it also has a high resistance to breakage. Mild steel as opposed to higher carbon steel is quite malleable even when cold. This means it has high Impact and Tensile strength. Higher carbon steel usually shatter or crack under stress, while mild steel bends or deforms.

Upper Diameter =180mm

Lower Diameter=100 mm

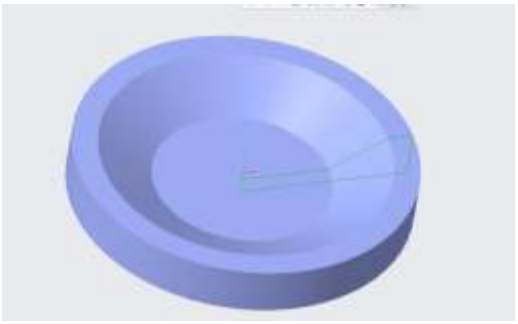


Fig.1.Design of plate lower die

5.1.2. Design of cup die:

The die is mounted on the inner frame and surrounded by heating coils these coils are used to heat the leafs and absorb the moisture present in the leafs. So heating the leaf gets stiffness. The die is made of mild steel material.

Upper Diameter =110mm

Lower Diameter=60mm

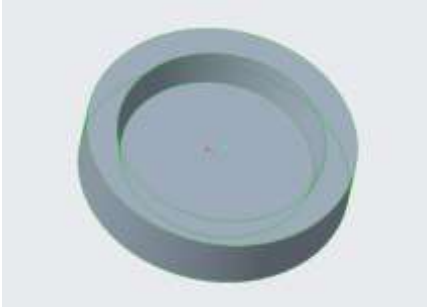


Fig.2.Design of cup lower die

5.2. Design of Punch for plate and cup

The Punch is a Male portion of Cutting Die. There punches i.e. for cup and plate is welded to piston of cylinder. It is usually upper movable member Welded to the piston rod. The design of the punch depends up on area to be pierced or blanked, and the pressure required penetrating the work piece material. The method of mounting a punch also depends up on the area to be pierced or blanked. The punch is made up on MS material

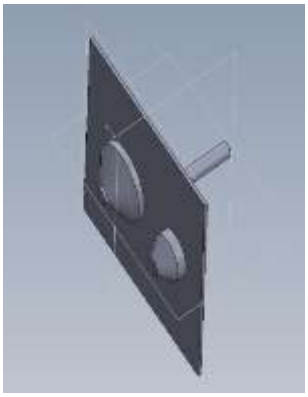


Fig.3. Punches

5.3 Frame

The frame is made up of mild steel. Outer frame is made of 25*25 L shape frame and inner frame is made of 25*25 square shape. It can be easily cut and drilled with correct equipment although it is possible to cut the smaller sizes with the good quality hacksaw blade. Welding properties are good and good results can be achieved. Frame Dimensions:-

Length (L) = 380mm

Breadth (B) = 200mm

Width (W) = 540mm

Fig.4 Frame

5.4. Pneumatic Cylinder

The cylinder is a double acting cylinder one, which means that the air Pressure operates alternatively Such that forward and backward. Then the compressed air is passed through the directional control valve for Supplying the air alternatively to either sides of the cylinder. Two hoses take the Output of the directional Control valve and they are attached to two ends of the Cylinder by means of connectors. One of the outputs from the directional control Valve is taken to the cylinder. By using Connectors, hoses are attached to the Pneumatic system. Cylinder has bore of 32mm and stroke 75mm respectively.

Fig.4. Pneumatic Cylinder

5.5. 5/2 Direction control valve

To control the to and fro motion of cylinder, the Pneumatic energy has to be regulated, controlled and reversed with a predetermined sequence in a pneumatic system

Fig.5. 5/2 DCV

5.6. HEATING COIL

The heating coil is of 2000 watts. The working of the heating coil is based on the heating effect of electric current. When current is passed through a resistance it produces the heat.

To produce the heat, the electric energy consumed by resistance is given by,

$E= I^2Rt$ (Joules)

Fig.6. Heating Coil

5.7 Connectors and Hoses

In our pneumatic system one types of connectors used; is the hose connector. Hose connectors normally comprise an adapter (connector) hose nipple and cap nut. These types of connectors are made up of brass or Al or hardened steel.

Hoses used in this pneumatic system are made up of PVC. These hoses can with stand at a maximum pressure level of 10 bar. Diameter of hoses is 8mm.

Fig.7 Connectors and Hoses

VI. DESIGN CALCULATIONS

6.1. For plate

Volume of Die =

$= (\frac{\pi}{4}*180^2*30) - \frac{1}{3}*\pi*(100^2+100*150+150^2) *18$

$=537568.538mm^3$

$=5.375* 10^{-4}m^3$

Punch Clearance =

=0.003*Thickness of Mtl.*Shear strength of Mtl

= 0.003*2*330

=2 mm

Volume of punch =

$=\frac{\pi}{4}*160^2*12 + \frac{1}{3}*\pi*(146^2+146*150+96^2)*18$

$= 451201.81mm^3$

$= 4.518*10^{-4}m^3$

Weight of Die =

=Volume of Die * Density of Material

$= 5.375*10^{-4}*7850$

= 4.23Kg

Weight of Die =

=Volume of Punch * Density of Material

$= 4.51*10^{-4}*7850$

= 3.54Kg

Punching Force Required=

=length of cut * Thickness of Mtl. * Shear Strength of Mtl.

$= 2*\pi*150*330$

= 311.01 KN

Stripping Force required=

=15% of Punching force

= 46.65 KN

6.2. For Cup

Volume of Die =

$= (\frac{\pi}{4}*90^2*30) - \frac{1}{4}*\pi*60^2*20$

$=134303.0859mm^3$

$=1.34* 10^{-4}m^3$

Punch Clearance =

=0.003*Thickness of Mtl.*Shear strength of Mtl

= 0.003*2*330

=2 mm

Volume of punch =

$=\frac{\pi}{4}*56^2*20 + \frac{1}{4}*\pi*70^2*10$

$= 87744.68mm^3$

$= 8.77*10^{-5}m^3$

Weight of Die =

=Volume of Die * Density of Material

$= 1.34*10^{-4}*7850$

= 1.05Kg

Weight of Die =

=Volume of Punch * Density of Material

$= 8.77*10^{-5}*7850$

= 0.75Kg

Punching Force Required=

=length of cut * Thickness of Mtl. * Shear Strength of Mtl.

$= 2*\pi*60*330$

= 124.40KN

Stripping Force required=

=15% of Punching force

= 18.86 KN

VII. FABRICATION AND TESTING

7.1 Fabrication

The fabrication of the machine begins with the fabrication of die and punch. The die and punch is made up of mild steel. The table frame is made up of mild steel 'L' shape angle and square shape angles. The various links are joined together using welding.

Operations Performed In Fabrications

The fabrications is done by the processes that are involved in are:

- Lathe Operations
- Welding
- Grinder
- Drilling

As per the design raw material for frame is purchased. The plate die has a dimensions of 150 mm upper diameter and 100mm lower diameters shown in the figure 1. The plate die consist of taper pattern which allows leaves to be compact under extreme pressure. proper clearance between die and punch is provided so that punch will be exactly fit into the die and the plate and cup will be made of desired shape.

For fabrication of outer and inner frame we purchased a long mild steel L shape angle and square shape angled frame of length 1500 mm and 1000 mm respectively. First we fabricated outer frame of dimension 380mm*200mm*540mm and then by using square shaped angled frame the plate and the die cavity is welded on square shaped frame and it is placed at a distance of 180mm from the bottom.

On the upper side of the outer frame double acting cylinder is placed at the centre. And at the bottom of the piston of the cylinder the plate and cup punch is welded with the help of rod. The heating coil is placed at the bottom below the square shaped frame below the plate and cup die for heating the die which in turn heats the leaves to be punched.

Fig.8 Fabricated Prototype

7.2 Working Principle

Working of leaf plate making machine is very easiest just we have to start a compressor and take the output of compressor to 5/2 DCV the valve is manually operated which activate the pneumatic cylinder which operates the die as the deer operates the leaf get compressed heating coil heat die due to heating process the leaf plates Gate it's share after the releasing of push button valve again piston from BDC course towards TDC this whole procedure is been repeated again and again for 8 hours in a day we can take one leaf around in 3 seconds so in a day we can produce around thousands of plates from one machine by while the efforts required for this machine is very negligible this machine has low maintenance low initial cost , cost effective easy friendly.

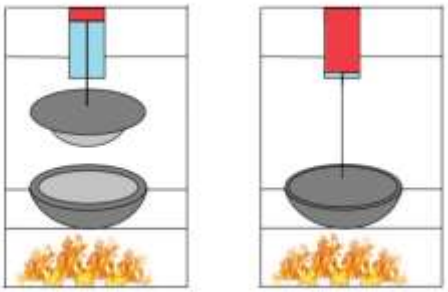


Fig.9 Working Principle

7.3 EXPERIMENTATION

The raw material is fed into the Die pattern and then Punch will press it against the die, producing huge pressure and due to heating coil high temperature, under the right condition is achieved. The material take shape of die cavity and final product is formed.

VIII. RESULTS AND DISCUSSION

This chapter deals with the testing and fabrication of leaf plate and cup making machine. The various testing of machines which includes time and temperature, production time cost analysis by using various techniques. At appropriate holding time, pressure and temperature desired shape of plate and cup can be achieved.

IX. EMPLOYMENT OPPORTUNITIES

Due to this many employment opportunity are created such as

1. Areca Nut farmers (An Extra Income through wasted leaves).
2. Leaf collection labourer
3. Transporters
4. Entrepreneurs
5. Consumers

Each leaf plate manufacturing industries provides direct employment to 3-4 persons. Rural areas is also selected to create employment.

X. WASTE DISPOSAL

Fig.10 Chart depicting the process of manufacture of Areca leaf Plate

XI. CONCLUSION

The leaf plate and cups can be manufactured with this machine at a very high rate. Normally machines available in the markets can produce either plate or cup at a time which leads to low production rate so to overcome this difficulty we modified the existing design which can produce cups and plates simultaneously.

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