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THOMSON REUTERS

[Bhat* *et al.*, 6(4): April, 2017]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

DESIGN AND FABRICATION OF FOOT OPERATED BOWL MAKING MACHINE

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DOI: 10.5281/zenodo.556372

ABSTRACT

Paper describes the development and design and fabrication of bowl making machine The principle of operation of the machine is based on the movement of slider crank mechanism. After a short description of the basics of machine, this paper presents the analysis of the structure. The aim of the foot operated bowl making machine is to make the bowl and fabricate the machine within minimum cost.

KEYWORDS: Die, Heater, Crank Slider Mechanism.

INTRODUCTION

In the world of automation, everyone needs less work but it is required high initial investment which is not possible to common man. So it has been try to make something that is affordable to common man and they can start their own business in their home with minimum investment. This proposal evaluates the technical feasibility and financial viability in setting up of a small –scale enterprise to do the activity on manufacturing and sale paper plate in small district and all over rural areas. Pedal power is the transfer of energy from a human source through the use of a foot pedal and crank system. As a consequence of the brainstorming exercise, it has been apparent that the primary function of pedal power one specific product is particularly useful. **Disposable food packaging** comprises disposable items often found in fast food restaurants, takeout restaurants and kiosks, and catering establishments. Food serving items for picnics and parties is very similar. Typical disposable foodservice products are plates, bowls, cups. These products can be made from a number of materials including plastics, paper, bio-resin and bamboo disposable foodservice packaging can be made from a number of materials each with its own uses and benefits. By reducing the need for equipment and additional labor, disposable foodservice packaging is an economical alternative to multiuse items and eliminates the need for dishwashers and other support equipment (racks, carts, dollies, shelving, bins) It can save money on water and energy used by dishwashers and can eliminates the need to replace reuse that are broken, damaged, stolen or accidentally discarded

MATERIALS AND METHODS

PROBLEM DEFINITION

The machine manufactured is enable to use in domestic as well as in small scale industrial purpose. In the market there are various types of machine available for bowl manufacturing. The bowl manufacturing machine is very costly in market .The cost of each bowl is between 0.80-1.25paisa per piece and also the manufacturing machine is very expensive. So here we are trying to reduce the cost of bowl as well as of the manufacturing machine, this machine can be used as startup business for poor people.

Market Potential

These products have an urban as well as rural market. These products are mostly used during social functions, religious gatherings, parties, marriages, outings, in sweet shops, by caterers etc. The products have many advantages and are hence preferred as compared to standard utensils/crockery for serving eatables. They can easily be disposed off after use and hence save a lot of labor as far as cleaning/drying of utensils are concerned. These are easily transportable and easy to handle. In our country people are religious and organize functions throughout the year all such occasions call for social gathering and celebrations with meals, snacks sweets being served. Further, our vast population organizes marriages,

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Celebrates birthdays and other family functions on a regular basis. Sweet shops and small eateries can be found at every street corner and all such joints use these disposable plates and bowls. Thus keeping in view the culture of the people and the habits there is a vast market for the products not only in urban areas but also in rural areas.

Need of bowls in day to day life

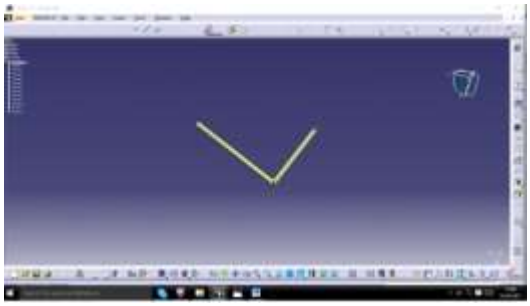
These products are conveniently used for serving eatables during family functions, eating chats and snacks, fruits, sweets etc. Most of the sweet shops use it for serving their customers with dry as well as wet sweets/namkeens. The caterers utilize it during parties and social functions. These are a convenient replacement for crockery and utensils. These have many advantages over conventional crockery/ steel utensils. Whereas conventional utensils need care in handling, have to be cleaned before and after use need lot of space for storage and are difficult to handle these products are light in weight, are disposable after use, cheaper and can be stored easily. These are very cheap as compared to convention utensils. The paper plates and bowl are made by fusing two layers of good quality paper with a sheet of polythene. The product can be in any desired shape and size depending upon the die employed for manufacture. The quality of paper used is generally of importance as it should be firm enough to maintain the shape and hold the weight of the eatable served in it.

Project Layout

Project layoout

Lower die

Welded joint



Upper die

Frame

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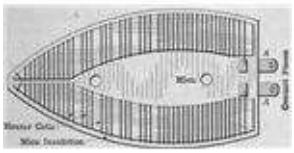
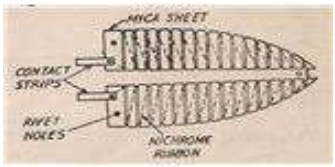
Components of Machine

- **Heater-**





Heating coil

The heating element consists of nichrome wire wound around a sheet of mica. The two ends of the nichrome wire are connected to the contact strips. The contact strips are connected to the terminals of the iron. There are two reasons for which mica is chosen in the heating material. Mica is a very good insulating material. Besides that mica can also withstand very high temperatures. The entire assembly of mica sheet, nichrome wire and contact strips are riveted together resulting in a mechanically sound and robust construction. There is an asbestos sheet, which separates and thermally insulates the top plate from the heating element.[3]

- **Frame**

Frame

Frame is used to withstand the die and operating mechanism. Frame is made of mild steel rod which are easily available in market in low cost and also we can use scrap material for the frame.

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- **Nut & Bolt**

Nut & Bolt

A **nut** is a type of fastener with a threaded hole. Nuts are almost always used in conjunction with a mating bolt to fasten two or more parts together. The two partners are kept together by a combination of their threads' friction (with slight elastic deformation), a slight stretching of the bolt, and compression of the parts to be held together.

The most common shape today is hexagonal, for similar reasons as the bolt head: six sides give a good granularity of angles for a tool to approach from (good in tight spots), but more (and smaller) corners would be vulnerable to being rounded off. It takes only one sixth of a rotation to obtain the next side of the hexagon and grip is optimal. However, polygons with more than six sides do not give the requisite grip and polygons with fewer than six sides take more time to be given a complete rotation.

A **bolt** is a form of threaded fastener with an external male thread. Bolts are thus closely related to, and often confused with, screws.

Welding of the parts

Welding can be defined as a process of joining metallic parts by heating to a suitable temperature with or without the application of pressure. Welding is an economical and efficient method for obtaining a permanent joint of metallic parts. Welding joins solidifies the two parts fuse into a single unit. Here we use ELECTRIC ARC WELDING in which the fusion is generated by an electric arc between the parts to be joined and an electrode. This electrode can be made of filler metal. Welded joints are divided into two groups-butt joints and fillet joints. A BUTT JOINT can be defined as a joint between two components lying approximately in the same plane. And FILLET JOINT also called as lap joint, is a joint between two overlapping components. So for crank-slider mechanism we use here butt joint, the edges of two plates form a v shape. Therefore, the joint is called V- joint.

E. Die

Die is specialized tool used to cut or shape material mostly using a press dies are generally customize to the item they are used to create product made with dies range from simple paper plate to complex piece. Die may be defined as the female part of the complete tool for producing work in press. The die of foot operated machine including two mating part one of the female die and another is male die. The male die is stationary and female die moves up & down with help of slider crank mechanism. The die is made up of harden steel material. The punching operation will takes place as the material on lower die touches upper die, the material will subjected to compressive stress.

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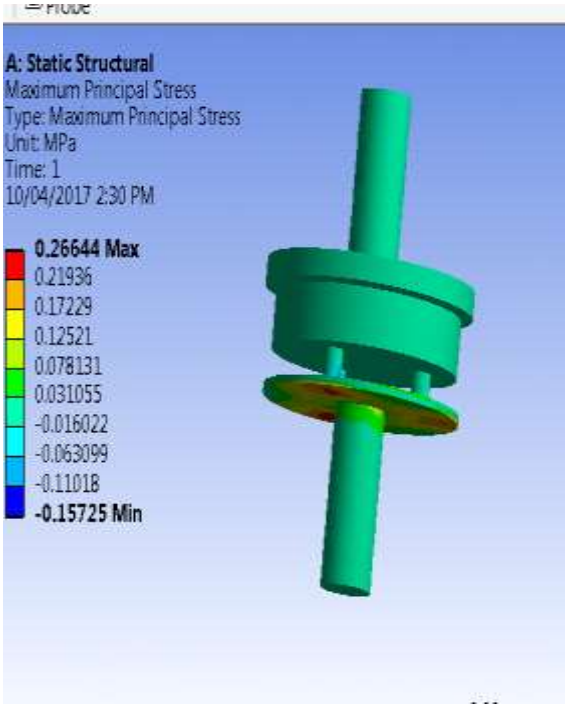
Die

5.5 Analysis of component

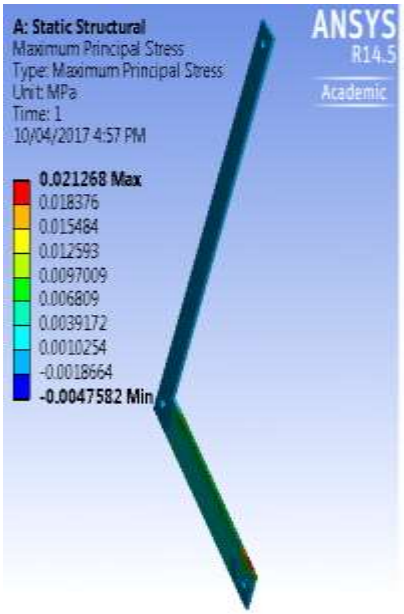
1. Die

Maximum Principal stress



2. Weld

Maximum Principal stress



METHODOLOGY /EXPERIMENTAL SETUP

1. Establishing objectives
2. Problem Statement
3. Scope of Project
4. Collection Data
5. Basic structure of the model and drawing
6. Design the required component of the model

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7. Collection of components

8. Fabrication of model as per drawing

9. Testing of model

10. Plotting of result

The project work deals with mechanically operated mechanism the project setup is mounted on a frame which is rectangular in shape. This pedal is at the middle of the frame further the pedal is connected to the shaft through crank slider mechanism and spring. The die pair is mounted on the shaft by rectangular plate in the die pair there is one fixed die which is fixed at movable die.

As we press the pedal the pressure is apply on it& due to the pressure the crank slider mechanism consists of V-shaped shaft in which lower shaft moves downward and upper shaft moves upward the spring connected to upper shaft get extended and shaft moves upward due to the spring extension as the shaft moves upward movable die get attached to the fixed die and product takes shape.

Ca**lculation of the Design**

Design of a Spring

Given: p=30 N δ=10mm C=6 Sut=1090n/mm2 G=81370 N\mm2

Ʈ=0.5Sut

Step : 01 wire diameter(d)

The permissible shear stress is given by,

Ʈ=0.5Sut

=0.5*1090

=545N\mm2

K= ([4C-1)/(4C-4)+(0.615\6)]

= 1.2525

Ʈ=K(8Pc\∏d2)

545=1.2525[8*30*6\∏*d2]

d =1.02 =1mm

step: 02 mean coil diameter

D=Cd

=6*1

=6mm

Step :03 number of active coils

δ =8PD3N\Gd4

10= (8*30*63*N)\81370*14

N =15.69=16 coils

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Step :04 total no. of coils

It is assumed that the spring has square and ground end .

The number of inactive coil is 2

Therefore Nt =N+2=16+2=18 coils

Step :05 free length of spring

The actual deflection of the spring is given by

$\delta = (8*P*D3*N)/(G*d4)$

$= (8*30*63*16)/(81370*14)$

=10.19mm

Solid length of spring = Nt*d

=18*1

=18 mm

It is assumed that there will be a gap of 1mm between consecutive coils when the spring is subjected to maximum force.

The total no. of coils is 18

The total axial gap between the coils will be

(18-1)*1=17mm

Free length =solid length+ total axial gap +δ

=18+17+10.19

Free length=45.19=46mm

Step: 06 pitch of the coil

Pitch of coil = (free length)/(Nt-1)

= (45.19)/(18-1)

=2.65mm

Step : 07 actual spring rate

$K = (Gd4)/(8*d3*N)$

=294 N/mm2

Step: 08 the force p acting at the end of the bracket induces torsional shear stress in the bar .

The torsional moment m1= (pD/2)=(30*6/2)

=90 N\mm2

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The torsional shear stress in the bar is given by,(Ʈ1)

=16mt/∏*d3

=16*90/∏*13

=458.36N/mm2

Direct shear stress (Ʈ2)

= (0.5*d)/D

=(0.5*1)/6)

=0.083N/mm2

Ʈ=Ʈ1+Ʈ2

=458.44N/mm2

The shear stress (ks)

Ks =(1+0.5d/D)

= (1+0.5d/D)

Ks=0.916

Design of Welding butt weld

P=30N

H=2.3Cm

FOS=2

1) Endurance limit

Se'=0.5Sut=225N/mm2

2) Length of weld σt =(P/l*L)

37.17= [30/l (2.5*10)]

L =0.03mm

Design of Die

PUNCH FORCE NEEDED

P=tLτ

Where L=length of cut

t = Thickness of Die

σyt =Yield Stress

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P=3.5*17*45

=2.67kN

Stripping Force

SF=0.02L.t

Where SF= Stripping Force

L= length of cut

t = Thickness of Die

SF=0.02*3.5*17

=1.19k N

PUNCH SIZE=Diameter-2clearance

=60-2*5

=50 mm

Specification :

- Total Weight of Machine: 25kg
- Power: 430 Watts
- Current Supply:0.9583 Amp
- Voltage:240 v
- Resistance:250.43 Ohm
- Rated Production: 7000-12000pieces Per Day
- Suitable Paper Weight: 80gsm-500gsm
- Paper Plate Size: 3inch-12inch

Final Design

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Results

SR.NO.	Applied Force	Quality of bowl
1	15N	NOT FORMED
2	20N	LOW
3	30N	BETTER
4	50N	GOOD
5	60N	BEST
6	90N	CRACKS IN BOWL

RESULT

Table shows the formation of bowl after applying various forces on pedal. Therefore it is observed from the above calculations, that bowl can form better after applying moderate pressure. As the pressure increases the bowl quality gets better but after certain limit the cracks will form due to high force. The result is obtained at the150° C of heating coil.

Future scope

In our machine most of the parts are detachable hence the replacement of the parts can be done easily. Also the die of bowl can be replaced by other type of die. The manual system can be replaced by hydraulic or pneumatic system.

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CONCLUSION

- A bowl making machine has been designed, fabricated and tested.
- A pedal force of 60N creates the best bowl.
- The bowl making process has been carried out at the temperature of 150˚C and it has been maintained throughout the process.
- This machine is user friendly, low cost, maintenance cost is negligible,it can be used as startup business and also for village industry.

ACKNOWLEDGEMENTS

We express our deep sense of gratitude to our respected guides, Dr. A.K. BHAT for their valuable help and guidance, we are also thankful to Prof. Sachin Vanjari sir HOD mechanical dept. for permitting us to utilize all the necessary facilities of the institution. Last but not the least all our classmates for supporting us in every manner. We express our deep sense of gratitude to our respected and learned guides, **Dr. A.K. BHAT** for their valuable help and guidance, we are thankful to them for the encouragement they have given us in completing the project. We are also thankful to respected **Prof. Sachin Vanjari** and to our respected principal **Dr. A.K. Bhatt, SSPM's COE Kankavli** for permitting us to utilize all the necessary facilities of the institution Last but not the least all our classmates for supporting us in every manner.

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