DESIGN AND FABRICATION OF PAPER BOWL & PLATE MAKING MACHINE

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ABSTRACT

The increasing global concern regarding environmental sustainability and the adverse effects of single-use plastic products have driven the demand for eco-friendly alternatives. In response, this study presents the design and fabrication of a paper bowls and plates making machine aimed at providing a sustainable solution for food service industries. The conceptual designs for the machine is developed. The machine incorporates various components, these are carefully designed and integrated to ensure a seamless production process, capable of manufacturing paper bowls and plates of different sizes and shapes. Fabrication of the machine involves a combination of mechanical, electrical, and control system engineering techniques. The selection of suitable materials and components is crucial to ensure durability and efficiency. Manufacturing processes such as machining, welding, and assembly are employed to construct the machine according to the design specifications. The design and fabrication of the paper bowls and plates making machine contribute to the development of environmentally friendly alternatives to plastic food containers. By enabling the mass production of paper-based food service products, the machine offers a sustainable solution for businesses seeking to reduce their ecological footprint. The study emphasizes the importance of integrating engineering principles and sustainable design practices to address global environmental challenges.

Keywords: paper bowls, paper plates, machine design, fabrication, sustainable manufacturing, eco-friendly alternatives.

I. INTRODUCTION

1.1 History

The history of paper cups and plates can be traced back to ancient times when various civilizations used materials like leaves, bark, and other natural substances as disposable food containers. However, the specific invention and development of paper cups and plates as we know them today have a more recent history. Here is an overview of their evolution.

1. Early Developments
2. Late 19th Century
3. 20th Century
4. 21st Century

Throughout their history, paper cups and plates have evolved to meet the demands of convenience, hygiene, and environmental sustainability. Today, they remain widely used for various occasions, from everyday meals to special events, while efforts are ongoing to minimize their environmental footprint. There are hierarchy of machine evolution in successfully order as:

1. Early Manual Methods
2. Introduction of Semi-Automatic Machines
3. Development of Fully Automatic Machines
    1. Feeding System
    2. Molding System
    3. Cutting and Trimming
    4. Stacking and Counting
    5. Heating and Drying
4. Technological Advancements
    1. Computerized Control
    2. High-Speed Production
    3. Eco-Friendly Features
    4. Customization Options

1.2 Application

A paper plate and bowl making machine is a versatile piece of equipment used in the manufacturing process of disposable paper plates and bowls. These machines automate the production process, making it faster, more efficient, and cost-effective. Here are some applications of paper plate and bowl making machines:

1. Food service industry
2. Events and parties
3. Takeaway and delivery services:
4. Institutions and canteens
5. Retail and wholesale distribution
6. Eco-friendly

Overall, paper plate and bowl making machines have a wide range of applications across various industries, providing a convenient, cost-effective, and eco-friendly solution for food packaging and serving needs.

1.3 Types of Machines

Here are some common types of paper plate and bowl making machines:

1. Hydraulic Paper Plate/Bowl Making Machine
2. Automatic Paper Plate/Bowl Making Machine
3. Semi-Automatic Paper Plate/Bowl Making Machine
4. Single Die Paper Plate/Bowl Making Machine
5. Double Die Paper Plate/Bowl Making Machine
6. Multi-Layer Paper Plate/Bowl Making Machine
7. Pulp Molding Machine

II. METHODOLOGY

2.1 General Theory of machine

A paper plate and bowl making machine is a mechanical device designed to automate the production process of paper plates and bowls[1]. The machine typically consists of several components and operates through a series of steps to convert raw materials into finished paper plates and bowls. While specific designs may vary, here is a general theory about how such a machine works:

1. Raw Material Loading
2. Heating and Shaping
3. Forming and Cutting
4. Edge Trimming
5. Stacking and Packaging
6. Quality Control
7. Optional Additional Processes

2.1.1 Input Parameters

There are various input parameters that can be changed to different values to obtain perfect results such input parameters are as follows:

The input parameters for a paper plate and bowl making machine can vary depending on the specific machine design and requirements. However, here are some common input parameters that may be involved:

1. Raw Material
2. Paper Sheet Size
3. Paper Sheet Thickness
4. Heating and Molding Parameters
5. Coating or Printing Materials (optional)
6. Power Supply

2.1.2 Laws and Mechanism

The laws and mechanisms used in paper plate and bowl making machines can vary based on the specific design and functionality of the machine. However, here are some common laws and mechanisms that may be involved:

1. Mechanical Laws: Paper plate and bowl making machines operate based on various mechanical principles and laws. These include laws of motion, such as Newton's laws, which govern the movement and forces involved in the machine's components. Other mechanical principles, such as leverage, friction, and momentum, may also come into play.

2. Heating Mechanism: Paper plate and bowl making machines often incorporate a heating mechanism to soften the paper and allow it to be molded into the desired shape. This heating mechanism can involve electrical heating elements, infrared radiation, or steam application, depending on the machine design.
3. Pressure Application: To ensure proper shaping and forming of the paper sheets, the machines use pressure application mechanisms. These can involve hydraulic systems, pneumatic cylinders, or mechanical presses to apply controlled pressure on the paper sheets, allowing them to take the desired shape.
4. Forming Drum or Mold: Paper plate and bowl making machines use a forming drum or mold where the paper sheets are shaped into the final product. The drum or mold is designed with cavities corresponding to the shape of the plates or bowls. As the paper sheets are pressed against the cavities, they conform to the shape of the mold and solidify.
5. Cutting Mechanism: After the shaping process, the excess paper material around the edges of the plates or bowls needs to be trimmed off. This is typically achieved through a cutting mechanism, which can involve rotary cutters, blades, or laser cutting technology, depending on the machine design.
6. Control Systems: Paper plate and bowl making machines often incorporate control systems to monitor and regulate various parameters. These control systems can include sensors, actuators, and programmable logic controllers (PLCs) to ensure precise operation and maintain consistency in production.
7. Safety Mechanisms: To ensure safe operation, paper plate and bowl making machines may include safety mechanisms such as emergency stop buttons, safety interlocks, and guards to prevent accidents or injuries during operation.
8. Major Mechanism:
There are various minor as well as major laws that are applicable on this machine and their mechanism is very important for result and analysis of machine and it may play a very important role in manufacturing the product and these mechanisms are:

- Crank Slider Mechanism
- Punch and Press Mechanism

2.1.2.1 Crank Slider Mechanism

The crank slider mechanism, also known as the slider-crank mechanism, is a mechanical linkage that converts rotary motion into reciprocating linear motion (or vice versa). It consists of three main components:
1. Crank
2. Connecting Rod
3. Slider
The crank slider mechanism operates as follows:
1. Rotary Motion: The crank rotates continuously due to the power input. As the crank rotates, it causes the connecting rod to move back and forth.
2. Linear Motion: The motion of the connecting rod is transmitted to the slider. When the connecting rod moves, it pushes or pulls the slider along the straight path. The slider's motion is linear and reciprocating.
Here are three common inversions:
1. Oscillating Cylinder Engine
2. Scotch Yoke Mechanism
3. Whitworth Quick Return Mechanism
These are just a few examples of the inversions of the crank mechanism. Each inversion has its own advantages and applications, depending on the specific requirements of the system.
Different mechanism by fixing different link of slider crank chain are as follows
First inversion: This inversion is obtained when link 1 (ground body) is fixed[2].
Application- Reciprocating engine, Reciprocating compressor etc...
Second inversion: This inversion is obtained when link 2 (crank) is fixed[3].
Application- Whitworth quick return mechanism, Rotary engine, etc...
Third inversion: This inversion is obtained when link 3 (connecting rod) is fixed.
Applications - Slotted crank mechanism, Oscillatory engine etc.,
Fourth inversion: This inversion is obtained when link 4 (slider) is fixed[4].
Application- Hand pump, pendulum pump or Bull engine, etc.
We uses-4th Inversion: If link 4 of the slider – crank mechanism is fixed the fourth inversion is obtained. Link 3 can oscillate about the fixed pivot B on link 4. This makes end A of link2 to oscillate about B and end o to reciprocate along the axis of the fixed link .

2.1.2.2 Punch and Press Mechanism

A punch and press mechanism are a mechanical system used for punching holes, shaping materials, or performing other operations in manufacturing processes. It typically consists of a punch, a die, and a press.

Here's a simplified description of how a punch and press mechanism works:

1. Setup: The workpiece is placed on the die, which is securely mounted on the press bed. The punch is aligned above the desired location on the workpiece.

2. Lowering the punch: The press is activated, causing the punch to move downward towards the workpiece. The press applies a controlled force to the punch, ensuring precision and accuracy.

3. Punching operation: As the punch contacts the workpiece, it deforms or removes material according to its shape. This can involve shearing, bending, or perforating the workpiece, depending on the specific application.

4. Retraction: After the desired operation is completed, the press retracts the punch back to its original position.

2.1.3 Output Parameters:

There are various output parameters that produce perfect results based on input parameters are as follows. The output parameters in a paper plate and bowl making machine refer to the characteristics and specifications of the produced paper plates and bowls. Here are some common output parameters:

1. Size and Dimensions
2. Thickness and Weight
3. Shape and Design
4. Rim and Edge Quality
5. Stacking and Packaging Requirements
6. Quantity and Production Rate
7. Quality Control Parameters

It is important to note that the specific output parameters may vary depending on the machine's design, capabilities, and customization options. Manufacturers of paper plate and bowl making machines will provide detailed specifications outlining the specific output parameters that their machines can achieve.

2.1.4 Components:

In the design and fabrication of the paper bowls and plates making machine, the following components have been utilized:

1. Motor: The motor is responsible for providing the power and rotational motion required for the machine's operation.

2. Motor shaft: The motor shaft connects the motor to other components of the machine, transmitting rotational energy.

3. Shaft: The shaft serves as a central axis for various rotating parts and transfers motion and torque between different components.

4. Pulley: Pulleys are used for power transmission and speed regulation. The machine incorporates multiple pulleys, including those attached to the motor, shaft, and crankshaft, to ensure proper power distribution.

5. Belts: Belts connect the pulleys, transmitting power from one component to another. They facilitate the movement and synchronization of different parts of the machine.

6. Bearings: Bearings support rotating components and reduce friction. The machine employs both small and large bearings to provide smooth movement and stability for the motor, shaft, and crankshaft.

7. Crankshaft: The crankshaft converts the rotary motion of the motor into reciprocating motion, enabling the forming process of the paper bowls and plates.

8. Connecting Rod: The connecting rod connects the crankshaft to the punch and die mechanism, translating the reciprocating motion into the desired movement for shaping the paper.

9. Bush bearing: Bush bearings are used to support and guide rotating shafts, ensuring smooth and low-friction movement. The machine incorporates bush bearings along the shaft for improved stability and reduced wear.

10. Shaft of bush bearing: The shaft of the bush bearing is responsible for transmitting the motion from the connecting rod to the punch and die mechanism.

11. Channel Combination in H shape: This H-shaped channel combination provides structural support and rigidity to the machine frame, ensuring stability during operation.

12. Punch & Die: The punch and die mechanism is responsible for shaping the paper into bowls and plates. It consists of a punch (male component) and a die (female component) that work together to form the desired shape.

13. Frame: The frame provides the structural support and stability for the entire machine, housing and connecting all the components.

14. Bolts: Bolts are used for assembling and securing various parts of the machine. In this project, bolts are utilized to attach the big and small bearings, motor, and other components to the frame.

These components collectively contribute to the functionality and efficiency of the paper bowls and plates making machine, enabling the production of eco-friendly food service products.

III. MODELING AND ANALYSIS

3.1 Specification of Components

Table 1.0 Components Specifications

Name of Components	Specifications
Motor	Power: - 0.5 HP, Rpm: - 1440
Motor shaft	Diameter: 30.53 mm, Length: 440 mm
Shaft	Diameter: 30.53 mm, Length: 440 mm
Pulley	**Motor Shaft Pulley** Inner Diameter: 10.00 mm Outer Diameter: 54.50 mm Length: 60 mm L Key: 2 mm cross-section of 60 mm **Single Groove Pulley** Inner Diameter: 25.40 mm Outer Diameter: 406.40 mm Length: 12.70 mm **Shaft Pulley**: Inner Diameter: 25.00 mm Outer Diameter: 120.00 mm Length: 30 mm **Crankshaft Pulley:** Inner Diameter: 50.80 mm Outer Diameter: 406.40 mm Length: 30.51 mm
Belts	**BELT1** Dimension: Length: 1866.30 mm **BELT2** Dimension: Length: 1682.24 mm
Bearing	**Specifications for the small bearings:** Quantity: 2 Inner Diameter: 30.53 mm **Specifications for the big bearings:** Quantity: 2 Inner Diameter: 50.80 mm
Crankshaft	Diameter: 50.80 mm Length: 1160 mm Stroke Length: 85.40 mm L-key Cut: 5 mm of 250 mm in length
Connecting Rod	Rod Bearing Diameter: 50.80 mm Beam Length: 288.1 mm Rod Small End Diameter: 25.40 mm
Bush bearing	Inner Diameter: 25.40 mm Length: 60 mm

Shaft of bush bearing	Inner Diameter: 25.40 mm Length: 300 mm
Channel Combination in H shape	**Shaft:** Diameter: 25.4 mm Length: 477 mm **Channel:** Quantity: 2 Length: 230 mm (L*B*H=70*40*40 mm) **Long Channel:** Quantity: 1 Length: 681 mm (Same dimension as the above channel) **Hollow Block:** Quantity: 2 Dimension: 45.4*70 mm with a 2 mm offset
Punch & die	Size: 4 Inch
Frame	Dimensions: Outer Frame: Length x Breadth x Height: 1220 mm x 760 mm x 1350 mm Parts: Channel: Quantity: 8 6 Parts of (40 mm x 70 mm x 40 mm, 2 mm): Length: 756 mm (4 parts) 2 Parts of (Length: 681 mm) Angle: Quantity: 9 2 Parts of (Length: 1290 mm) 7 Parts of (30 mm x 30 mm x 30 mm, 2 mm): Length: 756 mm
Bolts	**Nuts:** Type: Hexagonal Diameter: 6.8 mm Length: 40 mm **Washer:** Type: Circular Inner Diameter: 13.57 mm Outer Diameter: 25.40 mm Length: 2.8 mm **Bolt:** Type: Threaded Inner Diameter: 8.00 mm Outer Diameter: 13.00 mm Length: 45 mm

3.2 Machine Modelling

Machine modelling refers to the process of creating a representation or simulation of a machine system using mathematical and computational techniques. It involves capturing the physical characteristics, behaviour, and interactions of the machine components to analyse and predict its performance.

1. System Identification
2. Mathematical Modelling
3. Parameters Estimation
4. Model Validation
5. Computer-Aided Design (CAD
6. Simulation
7. Analysis and Optimization

3.3.1 Selection Design Criteria

Here are some commonly considered selection design criteria:

1. Performance
2. Functionality
3. Reliability
4. Safety
5. Cost-effectiveness
6. Size and Weight
7. Environmental Impact
8. Compatibility and Integration
9. Regulatory and Standards Compliance
10. Customer Requirements

3.3.2 Design Procedure

The design procedure refers to the systematic process followed by engineers and designers to develop and create a new product, system, or component. While the specific steps and details may vary depending on the nature of the design project, here is a general outline of a typical design procedure:

1. Identify the Design Problem
2. Conceptualization
3. Preliminary Design
4. Analysis and Evaluation
5. Detailed Design
6. Prototype Development
7. Testing and Verification
8. Iterative Design
9. Finalize Design
10. Production and Implementation
11. Post-Design Evaluation

3.1 Drawing of Major Components

There are various components and in those some major components are:

Pulley
Bearing
Crankshaft
Connecting Rod

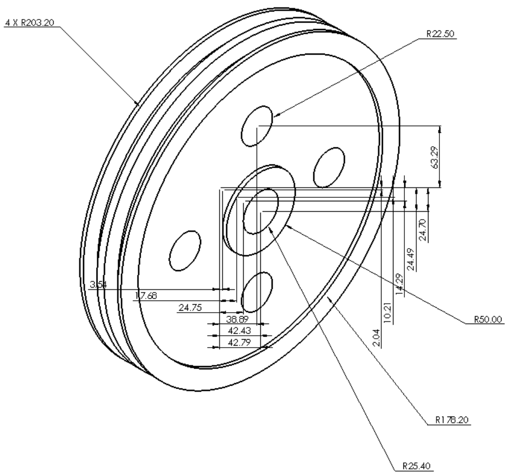

Fig 1.0 SolidWorks drawing of Pulley

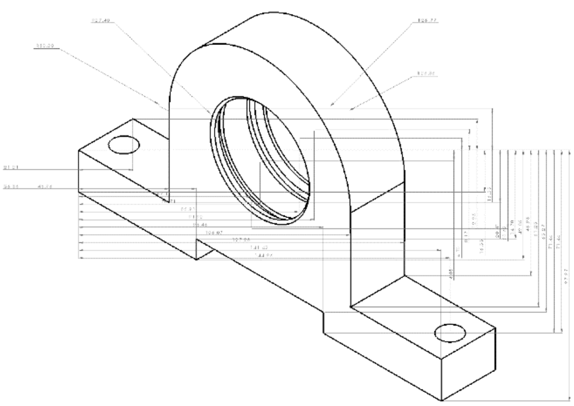

Fig 2.0 SolidWorks drawing of Bearing

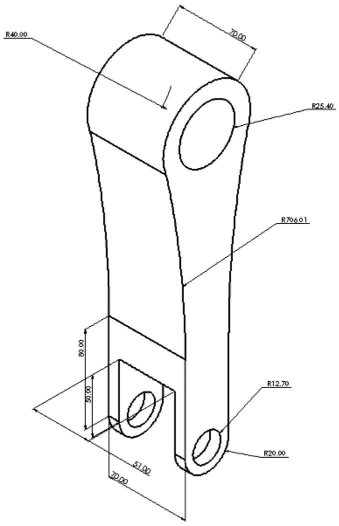

Fig 3.0 SolidWorks drawing of Connecting Rod

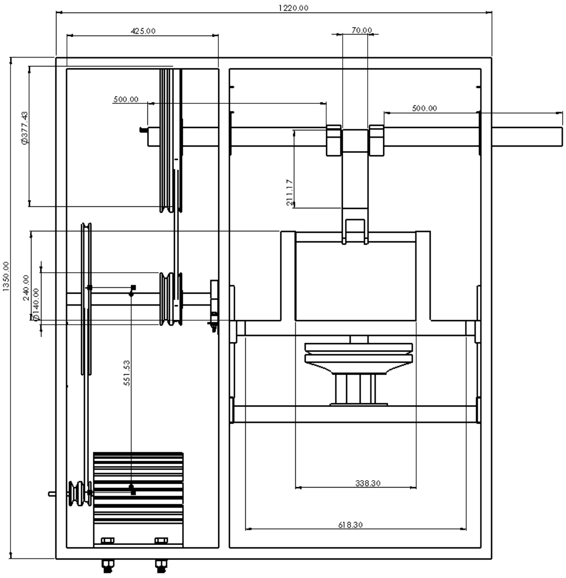

Fig 4.0 Front View of Machine

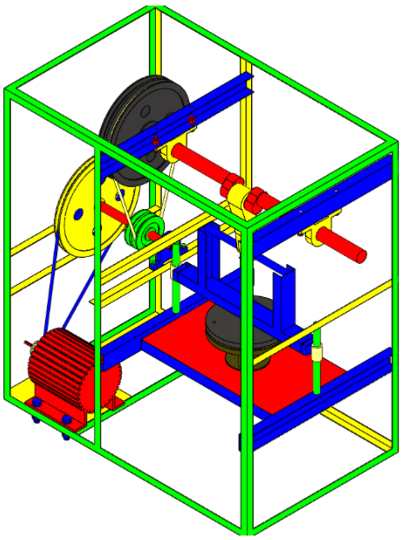

Fig 5.0 SolidWorks Modelling of Machine

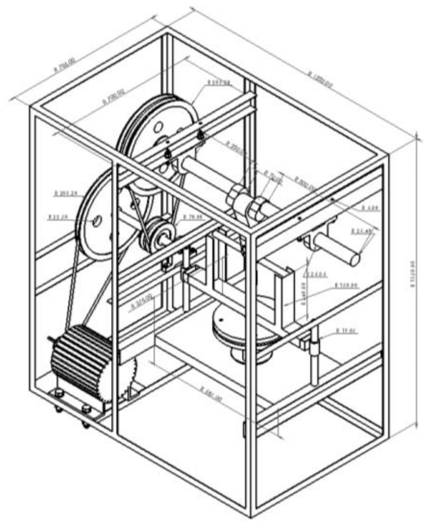

Fig 6.0 SolidWorks drawing of Machine

3.3 Mathematical Modelling

Motor Rpm: 1440 rpm

There are some notations that are as given:

Diameter of Motor Pulley = D_1

Diameter of Single Groove shaft Pulley= D_2

Rpm of Motor Pulley = N_1

Rpm of Single Groove shaft Pulley= N_2

Diameter of Shaft Small Pulley = D_3

Diameter of Crankshaft Pulley = D_4

Rpm of Shaft Small Pulley = N_4

Rpm of Crankshaft Pulley= N_5

1 Reciprocating Motion Length

The length that reciprocates in between Punch & Die = Stroke Length of Crankshaft

Stroke length: Maximum Distance-85.40mm
Minimum Distance-17.30mm
Centre Distance-30.00mm

Min distance will be used to press punch and die to give required shape to specimen and Max distance will be used to separate the punch and die
Combination of centre and max distance will be used to cut the edges and required pattern on specimen

2 RPM at Both stage

Stage 1 Shaft at which Two pulley are mounted which is of 25.4 mm in dia.

RPM at Stage 1-
D_1=54.50mm
D_2=406.40mm
N_1=1440rpm

$$Speed\ ratio = \frac{D_1}{D_2} = \frac{54.50}{406.40} = 0.1341$$

N_2=Speed ratio*N_1

=0.1341*1440
= 193 rpm

Stage2 Crankshaft at which Pulley is mounted and connecting rod is connected.
D_3=120.00mm
D_4=406.40mm
N_4=193rpm

$$Speed\ ratio = \frac{D_3}{D_4} = \frac{120.0}{406.40} = 0.29528$$

N_5= Speed ratio* N_4

=0.29528*193
= 56 rpm

After Neglecting some losses as – Belt friction loss, Component friction losses and after considering connecting rod weight and various other parts
Die and punch rpm=20 to 30 RPM (i.e., There will be production of 20-30 bowl in one min)

3.4 Cost Estimation

Table 2.0 Estimated Cost of Machine

S.NO	Components	Quantity	Per unit price	Price
1.	Crankshaft	1	2600	2600
2.	V-Belt	3	800	2400
3.	Die and Punch	1	1500	1500
4.	Pulley	4	750	3000
5	Connecting Rod	1	700	700
6	Shaft	1	450	450
7	Bush Bearing	2	200	400
8	Bush Bearing Shaft	2	150	300

9	Sheet	1	400	400
10	Motor	1	2600	2600
11	Bearing	4	500	2000
12	Frame	1	3000	3000
13	Nuts & Bolts	16	15	240
14	Miscellaneous		3000	3000
	TOTAL			**22,590/-**

IV. RESULTS AND DISCUSSION

4.1 Raw Material Research and Analysis

To ensure the production of high-quality products, we conducted thorough research and analysis on the raw materials used. Here are the key areas we focused on:

1. Material Properties: We studied the properties of the raw material, such as its strength, durability, corrosion resistance, and other relevant characteristics. This helped us select materials that meet the required specifications and ensure product longevity.

2. Availability and Cost: We assessed the availability and cost of the raw materials, considering factors such as sourcing, transportation, and market fluctuations. It was important to select materials that are readily available and cost-effective without compromising quality.

3. Environmental Impact: We considered the environmental impact of the raw materials used. This involved evaluating factors such as their sustainability, recyclability, and eco-friendliness. We aimed to minimize the ecological footprint of our production process.

4. Quality Assurance: We implemented stringent quality control measures to ensure that the raw materials meet the desired standards. This included conducting material testing, inspections, and certifications to guarantee consistent quality and performance.

5. Supplier Assessment: We conducted a thorough evaluation of potential suppliers to ensure their reliability, reputation, and ability to provide consistent and high-quality raw materials. Building strong relationships with trusted suppliers is crucial for a reliable supply chain.

By conducting comprehensive research and analysis in both machine and raw material aspects, we have aimed to optimize our production process, enhance product quality, and ensure customer satisfaction.

4.2 Machine Research and Analysis

In our research and analysis on the machine, we focused on various aspects to ensure its efficiency, performance, and suitability for the intended purpose. Here are some key areas we explored:

1. Functionality: We thoroughly examined the machine's intended function and its ability to perform the desired tasks. We assessed its features, specifications, and operational capabilities to ensure it meets the required production requirements.

2. Performance: We conducted performance tests and simulations to evaluate the machine's speed, accuracy, and output quality. This involved assessing factors such as production rate, cycle time, precision, and reliability to determine its overall performance.

3. Reliability and Durability: We analyzed the machine's build quality, materials used, and engineering design to assess its reliability and durability. We considered factors such as maintenance requirements, expected lifespan, and robustness to ensure long-term operation without frequent breakdowns[5].

4. Safety: Safety is a critical aspect of any machine. We conducted a thorough analysis of the machine's safety features, including emergency stop mechanisms, safety guards, and operator protection measures. We assessed its compliance with relevant safety standards and regulations.

5. User-Friendliness: We evaluated the machine's user interface, controls, and ease of operation. We considered factors such as intuitiveness, accessibility, and training requirements to ensure that operators can efficiently use the machine with minimal errors or difficulties.

6. Maintenance and Serviceability: We assessed the machine's maintenance requirements, availability of spare parts, and ease of servicing. We considered factors such as accessibility for repairs, availability of technical support, and overall cost of maintenance.

7. Cost Analysis: We conducted a comprehensive cost analysis, considering factors such as initial investment, operational costs, energy consumption, and potential cost savings. This helped us evaluate the machine's cost-effectiveness and return on investment.

8. Environmental Impact: We also considered the machine's environmental impact, such as energy efficiency, emissions, and use of eco-friendly materials. We aimed to minimize the machine's carbon footprint and promote sustainable manufacturing practices.

By conducting in-depth research and analysis on the machine, we aimed to select a reliable, efficient, and cost-effective solution that meets our production needs while ensuring safety and environmental sustainability.

4.3 Mathematical Research and Analysis on Machine

We increases and decreases the length between die and punch to obtain various result, this length is increased by various means as: -

Increases/ decreases orientation of Punch and die: - In this we use different values to obtain different shape

Research: -When we decrease the distance between two

Result: - Edges starts tearing due to high pressure/ forces

Research: -When we increase the distance between two

Result: - The punch does not produces required force to cut the edges as required

Final Result: -The distance between punch and die should be such that edges of punch should connect with edges of die and spring should be compressed approx. 10mm

In this machine we utilise stoke length in between 85.4 mm to 17.3 mm

Spring compression: - It should be compressed nearly 10mm because only in that condition we get perfect shape in that condition punch and die gets connected effectively to each other

4.4 Mathematical Research and analysis on Raw material

We use various input parameters associated with raw materials to obtain perfect result and they are as follows:

1: -Thickness of Raw Material: -We uses Punch paper or A5 paper as raw material whose thickness is120 GSM

Research: - We increases slightly the thickness of raw material by adding more sheets of punch paper. We increase it from 1 sheet to 5 sheet

Result: - At two sheet we get perfect shape but after two sheet there are some problems occurring like last sheet does not cut correctly.

Final Result: - 120-240 GSM is best thickness to get perfect shape

2: -Other factors of Raw Material: -

Certainly! In addition to the previously mentioned aspects, here are some other factors we considered during our research and analysis on the raw material:

1. Availability: We evaluated the availability of the raw material in the market to ensure a consistent supply. It is important to select a material that can be readily sourced without significant delays or supply chain issues.

2. Manufacturing Process: We examined the feasibility and compatibility of the raw material with the manufacturing processes involved in producing the machine. This includes considerations such as machinability, formability, and weldability of the material.

3. Cost: Apart from cost-effectiveness, we also assessed the overall cost of the raw material, including factors such as initial procurement cost, transportation costs, and any additional processing or treatment costs required.

4. Quality and Consistency: We focused on the quality and consistency of the raw material, ensuring that it meets the necessary standards and specifications. This involves evaluating factors such as material certifications, batch-to-batch consistency, and potential variations in material properties.

5. Environmental Impact: We considered the environmental impact of the raw material, including factors such as its sustainability, recyclability, and potential ecological footprint. Selecting materials that align with environmentally friendly practices is crucial in promoting sustainability.

6. Regulatory Compliance: We ensured that the selected raw material complies with relevant regulations and standards set by regulatory bodies or industry-specific requirements.

7. Supplier Assessment: We assessed the reputation and reliability of potential suppliers of the raw material. This involved conducting supplier evaluations, considering factors such as their track record, delivery capabilities, and customer satisfaction.

By considering these factors in our research and analysis on the raw material, we aimed to select a material that not only meets the technical requirements of the machine but also aligns with cost, availability, quality, environmental impact, and regulatory considerations.

We must produce hygienic product so we must have to use products that are not banned or are good with food material

Ex: - Silver Laminated roll, Polythene coated roll, Leaves pattern roll
There are other factors such as Recyclability, Patterns, Colours, etc

V. CONCLUSION

Paper plates can be manufactured at high rate with the available machines. Manufacturing normally requires hydraulic press machines to operate at a very high speed. But the problem is that they are used for making one or two plates simultaneously, which shows a less production rate[6]. Therefore, there may be the chances of increase in production rate by simultaneously punching the number of sheets in a single pass.

It is necessary to recognize that in a globalize economic environment the business outlook for any paper product will depend on the global demand supply balance for that product For Paper Cups there is production less capacity at a global level which was built up over the last decade or so in response to a boom in global growth[7] and increased levels of awareness of eco- friendly products. The growth of the manufacturing sector will be largely influenced by the growth consumption.

- Paper plates can be manufactured at high rate with the available machines[8].
- Manufacturing normally requires hydraulic press machines to operate at a very high speed. But the problem is that they are used for making one or two plates simultaneously, which shows a less production rate. Therefore there may be the chances of increase in production rate by simultaneously punching the number of sheets in a single pass.

There are various raw materials that are available in the market and they can be used to obtain various other results and one can also use some binding agent to discover new material that may be much helpful in future. One can use

- Thickness of raw material
- Pattern of raw material
- Machine automation

To improve the results most effectively

We have done that analysis that give that material can be perfect by hardness and force of punchy and die and it can be improved in future.

Based on our research and analysis on the design and fabrication of the paper plate and bowl making machine, we have drawn the following conclusions:

1. Machine Design
2. Material Selection
3. Functionality
4. Environmental Considerations
5. Cost-effectiveness
6. Ease of Use
7. Quality Assurance

In conclusion, the design and fabrication of the paper plate and bowl making machine aim to provide a cost-effective, efficient, and user-friendly solution for the production of paper plates and bowls[9]. The incorporation of environmentally friendly practices and careful material selection further enhances the sustainability of the machine.

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VI. REFERENCES

[1] https://www.etsy.com/uk/market/paper_plates_and_bowls
[2] https://b2b.partcommunity.com/community/knowledge/en/detail/8571/Slider-crank+linkage
[3] https://everything.explained.today/Slider-crank_linkage/
[4] https://testbook.com/question-answer/no-of-inversions-in-a-slider-crank-mechanism-is--61b8587bcf0f1447ef8d99f9
[5] https://www.linkedin.com/advice/1/how-do-you-evaluate-cost-effectiveness-return-2f
[6] https://www.academia.edu/5541537/REVIEW_ON_PAPER_PLATE_MAKING_MACHINES
[7] https://www.slideshare.net/PankajSharma1488/project-report-for-paper-cup-machine
[8] https://www.ijream.org/papers/IJREAMV02I021412.pdf
[9] https://www.niir.org/blog-archive/blog/479/production-paper-cups-plates-boxes-manufacturing-plant-detailed-project-report-profile-business-plan-industry-trends-market-research-survey-manufacturing-process-machinery-raw-materials-feasibility-study-investment-opportunities.html