Paper Bag Making Machine Using Newspaper as a Raw Material

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Abstract : *In this 21th century, with increasing population, markets and industries, usage of plastic bags has rapidly increased. This results in wastage of plastic in nature. It is also harmful to us and our environment. In this project we are replacing plastic bags with paper bags. Hence by using paper bags instead of plastic bags we can carry any product other than liquid. Our project is to make a machine which produces paper bags by taking newspaper as a input. As we know higher amount of newspaper are created daily and after that it has no value of newspaper on next day. By utilizing this wastage newspaper we can make paper bag machine which is best solution of waste product. So in this project we are creating a machine which consist a mechanism of manufacturing of paper bags. This will lead to create automation in production of paper bags in small scale unit. We are also focusing on using different types of paper as a raw material for achieving different strength of bags. It is economical & portable machine. Paper bag machine is also best idea for starting new business of paper bags.*

Keywords: Paper bags , Newspaper, Startup, DC motor, Galvanized iron, Grammage.

1. INTRODUCTION

1.1 Problem statement

Plastic have major disadvantages for environment, so there is dare need to replace it. Though there are machines available for making paper bags are bulky, big in size and also they are not fully automatic, they require human interaction. Also cost of this machines is so high which is not affordable to small scale business.

1.2 Objectives

- The main objective of this machine is to reduce the usage of plastic hence, it plays important role in the reduction of pollution.
- Best method to support environment.
- To develop a simple machine with economically cost effective.
- To provide valuable and supportive services to the society.

Hence it gives best solution to recycle newspaper waste. And it will also support to startup.

1.3 Market Potential

Due to the increasing awareness of the hazards of plastic bags to the environment among the public and the ban imposed on plastic bags throughout India and abroad by the governments, there is a great demand for paper bags.

Paper carry bags are common packaging materials being used by the textiles and cloth merchants, dry cleaners, bakers, grocers, stationers, sweet sellers etc. Establishment of shopping complexes and consumer stores in the rural, semi-urban and urban areas, the demand for paper bags has increased. Due to the bio degradability of paper and its origin from nature source, it has got an added advantage in packaging.

Fig- 1: Market Potential

The figure depicts the percent usage of plastic carry bags out of 100 vendors in Delhi. Nearly 99 % of

vegetable and fruit vendors out of 100 use plastic bags followed 95 % by meat and fish vendors. Thus the above figure clearly indicates the area of application of plastic bags. So the project aims to reduce the use of plastic bag even by some amount from these areas.

1.4 Scope

- Design the structure and framework.
- Design the tools and equipments.
- Design of the various mechanisms.
- Study of various paper materials.
- Analysis of the structure, links, framework and mechanisms.

2. CONSTRUCTION AND WORKING

2.1 Construction

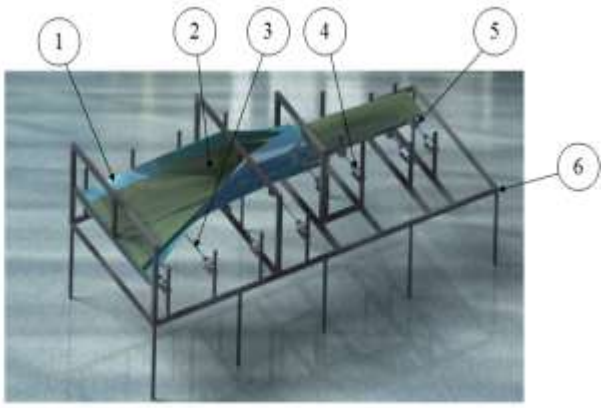

Fig 2: Assembly of machine

Paper bag machine which we are using to produce paper bags have following components in its construction:

1. Frame

Frame is main part of machine upon which all parts are assembled or welded.

Main function of frame is to support the all components of paper bag. Frame is made from square bars which are made from MS (mild steel).

2. Internal guide

Internal guide is part or sheet which is made from galvanized iron (GI) and it is used to support the paper from internally.

3 External sheet

It is part or sheet which is making flexible in order to adjust the cross section. It is used to support the paper from externally.

4 Circular guide

It is also made from GI sheet and it is the internal guide.

Main function of this guide is to support the paper after it gets Circular shape.

5. Gluing mechanism

In order to stick the paper (liquid fevicol) glue is used. It consists of reservoir for storing purpose. Pipes and nozzles are used to carry it. Gluing mechanism has also consisted of different types of sensor, battery and solenoid valve which is used in order to sense the paper and sprinkle the glue at right time.

6. Rollers and shafts

Machine consists of number of rollers which is covered by rubber tube. Function of roller is to make forward motion of paper or push the paper in forward motion. Shaft is used in order to carry and rotate the rollers.

7. Motors

Numbers of DC motors are used to provide rotary motion for the shaft. DC motors are having speed of 60 RPM and 1.5 kg torque. SMPS is used for connecting all the motors and providing required power to all motors.

2.2 Working

Fig 3: Actual paper bag making machine

1. We know the material handling system, in which conveyer are used to carry the material. Same phenomenon is used to carry the raw material paper i.e. news paper.

2. Input or inserting inventory of news paper is given in between internal guide and external guide manually. As all motors and rollers are rotating this traps the paper and pushes the paper in forward direction.
3 Due to change of shape of guides, paper gets circular and at the end of external guide, there is gluing mechanism is present which sprinkle the glue continuously, so that paper get stick.
4 After getting circular shape and passing from first gluing mechanism, paper gets closed and circular shape is obtained which is carried by internal guide.
5. At the end of circular shape there are second gluing mechanism is present which is having multiple nozzles and glue given by permission of solenoid valve. Two sensors are mounted at the end of circular guide which sense the paper when paper is at last stage. When there is a no paper then sensors get deactivate but when paper is there and both sensors are active then it gives instructions or current to the solenoid valve which gets open and glue will be dropped by multi nozzle on paper.
6. At the end of machine end rollers are mounted in order to press the bag and output of machine i.e. paper bag is obtained. If we use quality paper instead of newspaper then quality of paper bag in future will get increase. Thick paper results the more strength to paper bag. And hence paper bags are also useful for startup.

Table -1: Typical Bursting Strength Values

Grade	KPa
Coated Paper (130 g/m^2)	200-300
Coated Paper (250 g/m^2)	300-650
Bond Office/Business Paper (100 g/m^2)	250-300
Carbonless Paper (50-60 g/m^2)	150-200
Bleached Kraft (60 g/m^2)	210-260
Test Liner (186 g/m^2)	250-475

3. EXPERIMENTAL VALIDATION

3.1 Properties of paper used for making paper bags :

- **Strength Properties - Bursting Strength**
  Bursting strength is measured as the maximum hydrostatic pressure required to rupture the sample by constantly increasing the pressure applied through a rubber diaphragm on 1.20 - inch diameter (30.5 mm) sample bursting strength depends on basis weight of paper.

- **Stiffness (Taber)**
  A measure of flexural rigidity, Stiffness is the bending moment (g-cm or mNm) required to deflect the free and of a 1.5 in wide vertically clamped sample 15^0 from its center line when load is applied 50 mm away from the clamp.

- **Droop Rigidity CD**
  Droop rigidity measures the stiffness of the paper or board, more often applied to lighter weight grades. CD refers to cross direction, and MD to machine direction, Droop rigidity is higher in the machine direction. Higher value of it, stiffer the paper.

- **Tensile Strength**
  The tensile force required producing a rupture in a strip of paper or paperboard, measured in MD & CD, expressed in kN/m. Tensile strength is indicative of fiber strength, fiber bonding and fiber length. Tensile strength can be used as a potential indicator of resistance to web breaking during printing or converting.

Table-2: Tensile Properties of some paper grades

Grade	Tensile Strength (kN/m)		Breaking Length (KM)		Stretch (%)		TEA (kJ/m2)	
	MD	CD	MD	CD	MD	CD	MD	CD
Offset (107 g/m^2)	5.6	3.2	5.3	3.1	2.5	4.1	14.9	15.8
Bond (75	3.6	2.6	4.9	3.5	1.8	4.7	6.3	13.2

g/m²)								
Newsprint (50 g/m²)	1.8	0.9	3.7	1.8	1.1	1.4	1.8	13

- **Folding Endurance (Double Folds)**

Double Fold is the paper's capability of withstanding multiple folds before it breaks. It is defined as the number of double folds that a strip of 15 mm wide and 100 mm length can withstand under a specified load before it breaks. Folding endurance is log of double fold at base 10 (Folding Endurance = Log_{10} (Double Folds)). Folding endurance has been useful in measuring the deterioration of paper upon aging. It is important for printing grades where the paper is subjected to multiple folds like in books, maps, or pamphlets. Fold test is also important for carton, box boards, ammonia print paper, and cover paper etc. High folding endurance is a requirement in bond, ledger, currency, map, blueprint and record papers. Currency paper has highest folding endurance (>10,000). Long and flexible fibers provide high folding endurance.

Table -4: Typical Thickness Values

Grade	micron
Newsprint	60 - 80
Office/Business Paper	105 - 110
Blotting Paper (230g/m²)	540 - 590
Accepted trade tolerance +/- 10%	

- **Basis Weight or Grammage**

The basis weight, substance or grammage is obviously most fundamental property of paper and paperboard. The Basis weight of paper is the weight per unit area. This can be expressed as the weight in grams per square meter (GSM or g/M²), pounds per 1000 sq. ft. or weight in Kgs or pounds per ream (500 sheets) of a specific size. Paper is sold by weight but the buyer is interested in area of paper. The basis weight is what determines, how much area the buyer gets for a given weight. e.g. if basis weight is 50 g/m2, for every 1 kg weight, the buyer gets 20 m². When the basis weight is expressed as ream weight, it tells the buyers how many reams he/she getting for a given weight.

Table-3: Typical Grammage Values

Grade	g/m²
Newsprint	40 – 50
Cigarette Tissue	22 – 25
Bond	60 -90
Paperboard	120 – 300
Accepted trade tolerance +/- 5%	

- **Caliper or Thickness**

For a given basis weight, thickness determines how bulky or dense paper is. A well beaten/refined pulp, short fiber pulp such as hard wood or straw pulp, highly filled or loaded paper will show lower thickness for given basis weight. Thickness or Caliper of paper is measured with a micrometer as the perpendicular distance between two circular plane parallel surfaces under a pressure of 1 kg/cm². Uniform caliper is good for good roll building and subsequent printing. Variations in caliper can affect several basic properties including strength, optical and roll quality.

- **Friction**

Friction is the resisting force that occurs between two paper or paperboard surfaces in contact when the surfaces are brought to slide against each other. This property is measured as a coefficient of friction, which is the ratio of the frictional force, to a force acting perpendicular to the two surfaces. Two components of friction can be measured, these being static and kinetic friction. Static friction is the force resisting initial motion between the surfaces and kinetic friction is the force resisting motion of the two

Table -6: Weight Carrying Capacity

Trial	Load applied (Kg.)	Result
1	0.250	Sustain
2	0.5	Sustain
3	0.75	Sustain at medium fluctuate
4	1.0	Sustain at low fluctuate
5	1.25	Sustain at low fluctuate
6	1.5	Sustain at no fluctuate
7	2	Fail

- **Weight Carrying Capacity**

We did experiment on the paper bag for its weight carrying capacity.
Paper used - News paper (50 g/m^2)
Paper bag is manually made of purposed design
Dimensions 16.5cm*26.5cm

Results:
From above experiment we find some useful results as follow:
1] Paper bag can sustain low weight at high fluctuation.
2] With increasing load they need to be stable.
3] Load caring capacity depends on paper material.
4] Load caring capacity does not depends on glue if it perfectly applied.

3.2 Glue Sticks :

Glue sticks are great for paper. They are a low bonding adhesive, but do provide a permanent bond on various types of paper to include cardboard, foam board, and poster board. Glue dries clear.
Application examples: sealing envelopes, applying labels, paper crafting, art projects, scrapbooking.
From above types of glue we select White craft glue because of following reasons:

1) Good adhesive property
2) It is economical among the list
3) Time required for setting is low
   As white craft glue is very viscous, So to reduce its viscosity we added water in glue.

But after addition of water the adhesive property of glue reduces. Therefore we took trails for getting optimum solution of water and glue

Glue is going to stick at two different areas i.e. at bottom and at side therefore two different solutions with different properties are required.

1) At bottom strong(more glue) solution required
2) At side weak (less glue) solution required
3) For side of paper bag 70% of water And 30% of glue
4) For bottom of paper 65% of water And 25% of glue

surfaces sliding against each other when already sliding at a constant speed. This property is also important in printing papers, since a specific coefficient of friction is needed, so that individual sheets will slide over each other, otherwise double press feeding may result.

Table- 5: Typical Co-efficient of Friction Values Using Horizontal Plane Method.

Grade	Static Friction	Kinetic Friction
Office/Business Paper	0.50-0.65	0.35-0.5
Silk Coated Paper	0.45-0.55	0.30-0.45
Gloss Coated Paper	0.40-0.50	0.30-0.40

4. DESIGN

4.1 All dimensions of paper bag initial to final :

Stage 1: Initial news paper size: 54cm*62.5cm (54cm side is going to inserted into machine)

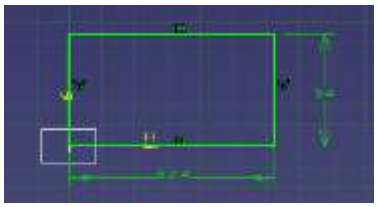

Fig 4: Input paper dimensions

Stage 2: folding a paper into circular shape with overlap of 5cm
Perimeter of circle: 54-5=49cm

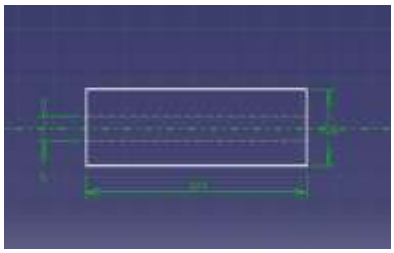

Fig 5: Cross section of paper bag

Stage 3: folding circular paper from both sides
Depth of folding= 4cm

Total length of paper used for folding
= (4*2) + (4*2) =16cm
Width of bag= (49-16)/2=16.5cm

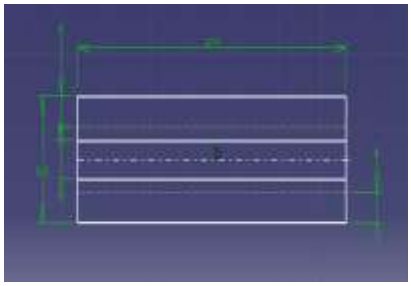

Fig 6: Cross section of folding of paper

Stage 4: cutting a bag for required length i.e. Its half length
Cutting length =62.5/2=31.2cm

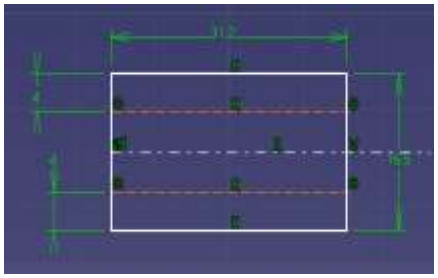

Fig 7: Dimensions of cutting paper

Stage 5: Folding one end of bag
Folding length of bag=31.5-5=26.2cm
Overall dimensions are=26.2cm*16.5cm

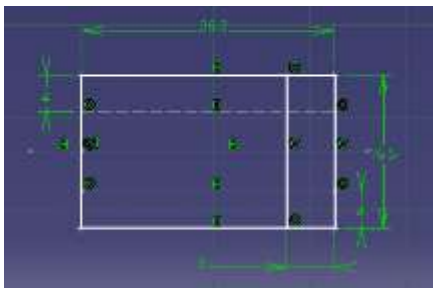

Fig 8: Dimensions of final bag

5. COST ESTIMATION OF PAPER BAG

Raw Materials

1. News Paper in Kg = 20/- {having 1Paper sheet 100gm × 10Paper = 1000gm}.
2. Total Pages of 10 or 12 pages.
3. Worker working time on machine is 8hrs/day, with performance rating 80%.
4. 15bags are produced in 1min.

Actual bags are produced by worker

Workers are working 8 hrs i.e. 8 × 60 = 480min {Ideal working time of worker}.

480 × 0.8 = 384min {Actual working time of worker}

Number of bags produced:

If 15 bags/min produced, 15 × 384 = 5760 bags are produced by worker in 1 day

5760 bags/day are produced by worker in 1 day.

Gluing cost

For 300 bags glue required of = 50/- i.e. 50/- per 300 Bags.
So, For 15 bags glue is required of = 2.5/-
For 1bag glue is required is = 50 ÷ 300 = 0.166/-

Worker cost

Worker cost per bag is 300 ÷ 5760 = 0.05208/- for 1 bag
Worker cost for 15 bags is 0.05208 × 15 = 0.7812/-

Cost of Paper Bag

Initially raw material of newspaper is = 20/- per kg

Whole paper sheet is of 15 pages so, 15 bags are made up of.

Total pages of 1kg of newspaper set is = 120 pages.

So, 120 bags are produced within 1kg of newspaper

For 1bag cost is = 20/- ÷ 120 bags = 0.166/-

A. Cost of Electricity for producing paper bags.
B. For 1hr 2Unit of electricity required. {By wattage}.

For 1Unit electricity price is 8/-
So, 1Unit = 1kwhr = 8/- per 1Unit
1hr = 60min = 8/-

Then, for 1min is 8 ÷ 60 = 0.14/-

Hence for 1min cost of electricity is required = 0.14/-

For 8hrs cost of electricity is required with considering performance rating of worker

Worker working time in 1day is 384 min, then 0.14 × 384 = 53.76/-

Hence cost of electricity for 1 day is = 53.76/-

Now,

Cost estimation For 15 bags / min.

Cost of Glue is = 2.5/- per 15 bags.

Cost of worker is = 0.05208/- per 15 bags.

Cost of raw materials newspaper = 0.166/- × 15 = 2.5/- per 15 bags.

Cost of electricity for 1min is = 0.14/- per 15 bags.

Total cost for 15bags/min.

Total cost = glue cost + worker cost + raw materials cost + electricity cost

= 2.5 + 0.7812 + 2.5 + 0.14

Total cost = 5.9212 ≈ 6/- per 15bags.

For 15 bags total cost is required = 6/-

& For 50 bags cost is required 0.4 × 50 = 20

For 50 Bags 35 Rs therefore machine is profitable.

6. FUTURE SCOPE

Considering the present position and working setup, some changes in present state would be done in future. The future scope of this project is as follows:

a. Using clamping mechanism to provide handles for every bag.
b. Printing mechanism by sensing position of bag to print manufacture's name and date of manufacture, etc on it.
c. Make machine available for any kind of paper to produce multiple bags.
d. Convert semi automation into total automated. Use paper feeder to feed papers if many and could be use glue dispenser using lead screw mechanism according to size of paper to apply glue at right place or glue level sensor to refilling mechanism could be use.
e. Increasing production rate as high as possible
f. Producing bags with different size and shape.

7. CONCLUSION

At present state it is need to save environment, government also banned some of the plastic bags. Plastic bags harm our environment, aquatic life and human health as well. So, paper bags are the best alternative for it, which eco-friendly and also a degradable. To give some contribution towards healthy environment we manufactured one Semiautomatic machine and that machine is for the making paper bags from newspapers means we built up one good thing from waste material. This is also one of the good things towards environment. Total Manufacturing setup was designed and fabricated. Also the paper bags having load carrying capacity is more as compared to plastic bags. Our machine is cheaper, compact, portable and easy for the operation as compare others heavy and costly machines of it made.

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