International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

Design and Fabrication of Portable Paper Recycling Machine

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Abstract - *In any big institution, especially educational institutions like schools or colleges, generation of large quantity of waste papers is quite apparent. And effective use of recycled paper is also possible (craft papers, registers etc). So, instead of disposing the waste papers into trash, recycling them makes sense. This not only helps the institute in cost saving but will also ensure its contribution towards the protection of the environment. Designing portable operated small-scaled paper recycling plant, which can be used in schools and colleges, ensures that a cheap and non-complex method of production of paper product is guaranteed.*

Key Words: **Paper Recycling**, **Pulp**, **Sieve**, **Hydrogen Peroxide**, **Paper Waste.**

1. INTRODUCTION

This chapter consists of general introduction on papers and recycling process. The general introduction contains theory, practice involved, important and the application of this topic. The content of this chapter are derived from journal papers, patents and other sources. This chapter gives brief information about the different type of paper products, recycling process, their advantages, disadvantages and applications.

1.1 Introduction to Paper recycling

Paper is one of the most important products ever invented by man. The primary raw material for the paper production is the pulp fibers obtained by complicated chemical process from natural materials, mainly from wood. This fiber production is very energy demanding and at the manufacturing process there are many of the chemical matters which are very problematic from the view point of the environment protection.

Instead of throwing the waste paper into trash, why don't we recycle them in our houses. If we recycle these wastage it can be used as some other purposes. ex: Tissue paper, or some board (in small thickness). In our project the recycle of paper is more and safe work and also less cost of production. The main concept of this project is to reduce the paper wastage in our houses with the help of manual operated paper recycling machine. It is fully mechanical operated, so there is no need of electricity is used, low cost, maximum usage of waste paper as in the form of recycled paper.

1.2 Recycling process

Pulping: A process of converting the paper into a paste by mixing with the required quantity of water and starch powder.

Paper Making: Once the paper gets mixed with water and become a pulp, it is poured inside the tank, and some chemicals are added ex: hydrogen peroxide and it is spread all over the sieve by hands. The large particles of pulp are get arrested by sieve, which will be going to be pressed.

2. LITERATURE REVIEW

It is very difficult for institutions to transport papers continuously which results in enormous capital loss and transportation and storage place.

At present, there is no perfect replacement for simple paper recycling machine which reduce time and human effort on work. So we're proposing a portable paper recycling machine which reduces cost and manual effort by surveying certain reviews.

Table -1: Literature Review

S.no	Author	Publisher	Points taken
1	Ajit K Ghosh	Fundamentals of Paper Drying-Theory and Application	The dying of paper from pulp
2	Iveta Čabalová et-al	The Effects of Paper Recycling and its Environmental Impact	The effects of paper recycling
3	Vrushabh R. Rathod et-al	International Journal on Recent and Innovation Trends in Computing and Communication	The operating of paper recycling machine

3. DESIGNING AND MODELLING

The 2D and 3D design of the machine

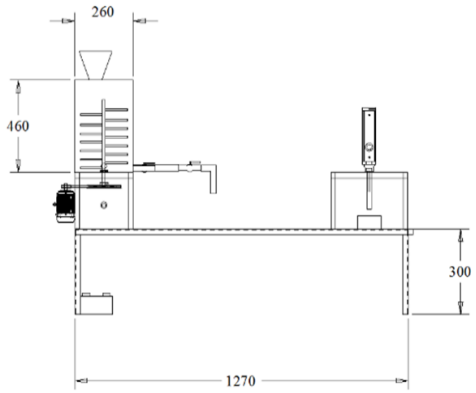


Fig -1: 2D Design

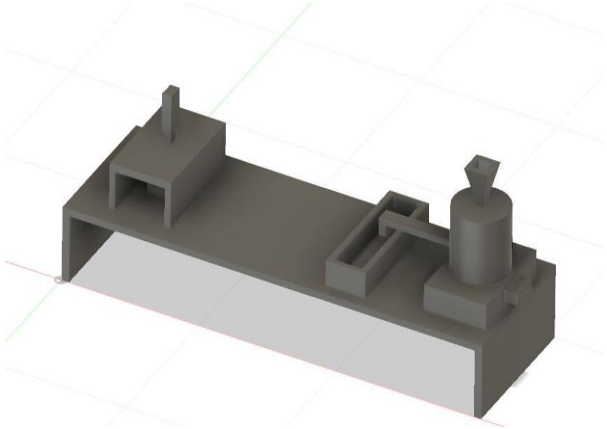
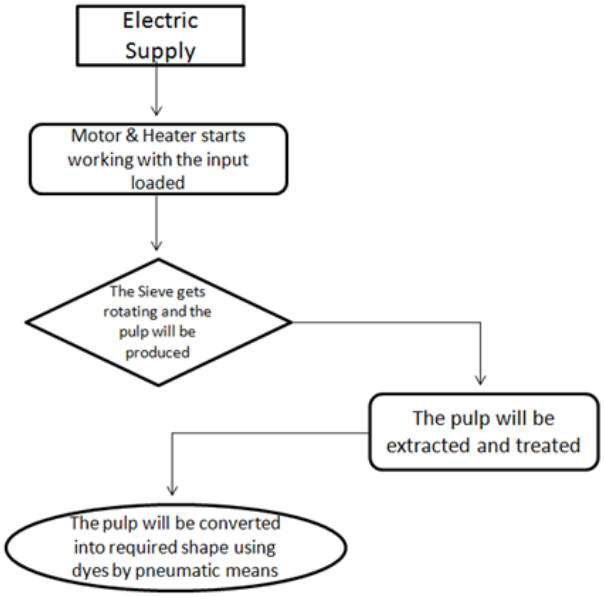


Fig -2: 3D Design

Fig -3: Manufacturing Process

4. WORKING PRINCIPLE

4.1 Flowchart



4.2 Principle

Here the motor and heater will be provided with electric current and starts working. The motor will start to run by getting the input power. The pulley connected with the motor drives the belt and transmits the power to the sieve. The sieve inside the hollow tank starts to rotate. The sieve will crush the paper and the ingredients will be added to make it a pulp. The pulp will be taken and mixed with Hydrogen Peroxide for the quality. The pneumatic cylinder will be used to make the paper into required shape and size.

COMPONENTS REQUIRED

S.no	Name of the parts	Description	Quantity
1	AC Motor	½ HP	1
2	V - Belt	A38 Grade	1
3	Pulley	-	2
4	Pneumatic Cylinder	10 BAR MAX.	1
5	Electrical Heater	600° Max temp	1
6	Mild Steel Materials	-	Required Qty
7	Sheet Metal	-	Required Qty
8	Plastic Pipe	-	Required Qty

5. CALCULATIONS

AC MOTOR

VOLT	:	230V A.C
RPM	:	1440 RPM
CURRENT	:	2.5A
PHASE	:	1 PHASE

PNEUMATIC CYLINDER

SIZE	:	DIA -45MM
STROCK LENGTH	:	100mm
MATERIAL	:	ALUMINIUM / M.S
PRESSURE	:	10 Bar Max.

Power & torque

Power:

0.5HP = 0.373KW

$P = 2\Pi NT/60$

Torque:

$T = P*60/2\Pi N$

$T = 0.373*60/2\Pi N$

$T = 0.373*60/2\Pi*1440$

T = 2.47N-m.

Belt & Pulley Calculation

Power = 0.373KW

Speed N_1 = 1440 RPM

Diameter of pulley:

DRIVEN, d = 50mm

DRIVING, D = 250mm

The pulley has selected for the torque requirement

Center Distance of Pulley C = 225mm

Selection of belt section:

For the power, Section A is selected from PSG DB pg no 7.58

Speed ratio

$D/d = N_1/N_2$

$280/56 = 1440/N_2$

N_2 = 288RPM

Centre distance:

C=225mm

Nominal pitch length:

$L= 2C + \Pi/2 (d+d) + ((d-d)^2)/(4c)$

L= 965.64mm

For the nominal inside length and a section. The next standard pitch length is selected as 1001mm (selected from PSG DB pg no 7.59)

Length correction factor:

F_c=0.88 (selected from PSG DB pg no 7.59)

Correction factor for arc of contact

Arc of contact = 180° – ((D-d)/C)*60°

= 180° – ((250-50)/225)*60°

= 126 .7 °

FOR 126 .7 ° From PSG DB Correction factor of AoC

F_d = 0.85

Service factor:

For light duty for over 16hrs continuous factor

F_a = 1.1

Max. Power capacity:

$kW = (0.45\ S^{(-0.99)} - (19.62/d_e) – 0.765*10^{-4}\ S^2)S$

S = speed of belt

$S = \Pi dN1/60$

$= (3.14*d*N1)/60$

S = 3.77 m/s

$d_e = d_p*f_b$

d_p = smaller diameter = 56mm

F_b = smaller diameter factor = 1.14 (From PSG DB pg no7.62)

$d_e = 50*1.14$

=70 mm

$kW = (0.45\ S^{(-0.99)} - (19.62/d_e) – 0.765*10^{-4}\ S^2)S$

kW = 0.444

Determination of no.of.belts.

$No\ of\ belts = ((P*F_a)/(kW*F_c*F_d)$

$No\ of\ belts = ((0.373*1.1)/(0.444*0.88*0.85)$

No of belts = 1.2 belt = 1belt

Calculation of Actual Centre Distance :

$Cactual = A+\sqrt{(A^2+B)}$

$A = L/4 – \Pi((D+d)/8) = 132.44$

$B = (D-d)^2/8 = 5000$

$C_{actual} = 132.44 + \sqrt{((132.44^2)+5000)}$

$C_{actual} = 244.44mm$

Volume of pulp slurry = mass/density

Mass = 0.5kg

Density = $1.201kg/m^3$

Volume = 0.5/1.201

Volume = $0.416m^3$

Pneumatic cylinder

Force Calculation:

Force to be exerted is 5bar

Pressure in the cylinder = $0.5*10^5$ N/m^2

Area of the piston = Force/Pressure

= 50/50000

= $0.001m^2$

Bore dia = 0.0356m = 35.6mm

6. ADVANTAGES

- Handling is easy.
- Manual power not required.
- Repairing is easy.
- Replacement of parts is easy.
- The involvement of manual work is highly negligible.
- Simple in construction.
- Easy to fabricate.
- No need of skilled operators to operate this system.

CONCLUSIONS

The suggestion of process of paper recycling helps to reduce the paper waste and save environment. The paper is getting recycled and the cost is getting reduced.

We are proud that we have completed the work with the limited time successfully. The "Paper recycling machine" is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality.

As discussed in future works the device can be automated and can be used for may purposes.

This machine will provide more efficient work and also cheaply available which also reduces the work stress and labour cost. It can save sufficient of time for the worker which increases the production rate.

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