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"PAPER RECYCLING MACHINE"

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Abstract - *Paper is one of the most important products ever invented by man. Paper is an essential part of our lives. We use paper in everyday chores. It is used for documentation of the data and packaging. The paper manufacturing industry faces major problem of unavailability of raw material. The primary raw material being wood is of great environmental concern. So industries have focused on using waste paper as raw material. The current scenario of paper recycling in India asks for a better solution for increasing the recycling rate. So, in this project we aim to design and fabricate a compact paper recycling machine*

Keywords- *paper, recycling, pulp making, Wet pulp, recycling machine, reusable paper*

1. INTRODUCTION

Paper is one of the most important products ever invented by man. The primary raw material for the paper production is pulps fibres obtaining by accompanied chemical process from natural material, mainly wood. This fibres production is very large demanding and at the manufacturing process there are used many of the chemical matters which are very problematic from the environment protection point of view [1]Today 90% of the paper pulp is made out of wood, paper production accounts for 35% of felled trees and represents 1.2% of the world's total economic output. [2] Recycling 1 ton of newspaper saves around 1 ton of wood and recycling 1 ton of printing or cartridge paper saves around 2 ton of wood [3]

So, it is necessary to carry out waste paper management.

2. EXPERIMENTATION WORK

Various process used for paper manufacturing
1. Shredding
2. Pulping
3. Pressing
4. Roller drying
5. Shearing off

1. Shredding
The shredding process includes tearing of the newspaper into small bits or pieces that can be turned into pulp form by inclusion of water and adhesives like fevicol and starch in some quantity. Shredding is necessary as the mixer cannot process with large pieces of paper and hence cannot fulfil the conditions of the type and the quality of the pulp to be formed. The consistency of the pulp is a main condition that needs to be fulfilled in order to produce good quality recycled paper.

2. Pulping
Pulping is a method by which waste paper such as newspaper, office paper, waste books are been processed for deinking, breaking paper fibers into small parts for further processing. For our project the aim was to decrease the size of the machine as compact as possible. Due to this constrain we had carried out various experiments for making the pulp with definite consistency, thickness, uniformity, etc

1) Wet pulp
First we had soaked pieces of newspaper in beaker for about 2 days in different beakers. For the uniformity we had used same amount of paper, same material of paper, and same environmental conditions for soaking period.

a. **Pulping by using water + bleach:**
We added 2 table spoon of bleach with about 150 ml of water. By this experiment we came to the conclusion that the deinking was not as expected.
Also the quality of pulp was not as expected for our machine.

b. Pulping by using only alcohol:
We added 150 ml of alcohol to pieces of paper and let it soak for 2 days. After the required period for soaking we made pulp but the result was not as expected. The paper didn't lose color, the consistency was also not enough
to make a paper by our machine.

c. Pulping by using chloroform:
We had used chloroform because of its deinking property. We added about 150 ml of chloroform to paper and let it soak for same period. Here we had observed that there was no color loss. For pulp making, same results were found same as above two.

d. Pulping by using acetone:
When we kept 150ml of acetone for about 2 days and we had found the after 2days all the acetone had evaporated. The results was that the pulp was very thin and cannot be used for any processing.

Conclusion: The results was concluded and we has observations that paper pulp was too difficult and inefficient to dry, also there was no proper consistency achieved..

2) Dry pulping

Here our aim was to use the amount of fluid as low as possible as we had faced it was our major problem was to dry the pulp [4]. Here also we had used same amount of paper, same quality and same conditions for pulping.

a. Pulping by using only paper:

Only paper was added in mixer grinder and the results was that there was no proper binding between the paper fibers

b. Pulping by using paper with fevicol

By using the fevicol there was too much bond between the paper. After pressing and drying the paper was too hard to use.

c. Pulping by using paper+fevicol+starch+water

We added the fevicol and starch paste (mixing 3 tablespoon of starch+25 ml of water). The result was perfect as desired. The drying can be done effectively by our design. Also consistency, uniformity, thickness was achieved as desired.

Conclusion: By using the right amount of paper with proper amount of starch and fevicol we can make the paper from our machine.

3 Pressing

Pressing as a method was decided to be used to get the pulp a basic shape and size of a single sheet of paper. As without the press there would be no uniformity in the separation of pulp and the paper produced would not have proper dimensions or thickness or the consistence to be classified as a useful and handmade paper. Designing of the press was one of the toughest tasks as due to the time limit, the manufacture of a press that could fulfil our requirements was very difficult but due the press being an inevitable part of the design and the manufacturing process the press had to be manufactured without the choice of avoiding the same.

4 Roller drying

Roller drying is a process where the wet pulp just pressed in the press used is now set to be dried to remove the unwanted moisture within the pulp. The process starts with switching on the motor connected to the battery , as the rollers start rolling the belt that is also starts moving about the rollers, the motion is transmitted by a chain drive that is mount on the two sprockets one on the motor and one on the roller shaft. The pressed pulp is then placed on the conveyer and it moves along with the conveyer. The conveyer is then passed between the two rollers and the pressed pulp also passes between the spaces of the two rollers (2mm) so that the pulp gets into uniform thickness. The pulp while passing through the rollers also loses the extra water content to the sides and it is then transformed into semi dried pulp that only contains the moisture content needed by it to maintain its structure and shape.

5 Shearing off

After roller pressing the uniform shape of paper is not obtained. To obtain uniform shape shearing off operation is necessary, hence by cutting the paper from all the sides manually the uniform shape of the paper can be obtained.

Fig 1. Pulp

3. PART LIST:

1. **Frame.**
2. **Motor: 24V, 300 rpm**
3. **Conveyor belt**
4. **Rollers**
5. **Sprockets**
6. **Mixer**
7. **Ply**
8. **Bearings**
9. **Chain**
10. **Press**
11. **Battery**

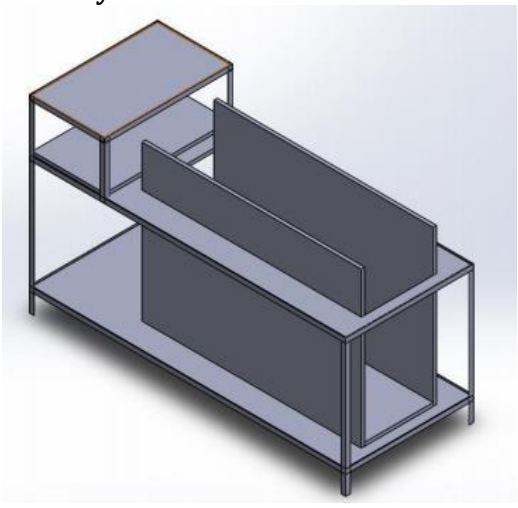

Fig -2: Model

4. DESCRIPTIONS OF COMPONENTS:

L Section:

The basic structure of the frame is shown

The whole frame is made of L Section.

Material: **mild steel**

Motor:

The motor used to run the project was based on various considerations such as the speed, power and the load that could be applied on it.

Conveyor belt:

The conveyer belt is one of the main parts of the project. According to our needs we found out the vendors selling conveyer belts made up of PVC material due to its durability and flexibility.

Rollers:

The rollers were designed by us according to the standard size and shape

The rollers were manufactured on a lathe machine

Sprockets:

The sprockets were used for transmission of power and motion from motor to the first roller and between the other rollers.

Mixer:

The mixer is used during the pulping process.

Bearings:

A bearing is a machine element that constrains relative movement to the desired motion and reduces friction between moving parts.

Chain:

Two chains are used of which one is 1000mm in length and the other is 500mm in length

Battery:

We require power to drive the motor.

4. WORKING:

- First the shredded paper will be put in the mixer with fevicol and a paste of water and the starch.
- Then the mixture will be churned till the time proper pulp will be formed.
- After the pulp is formed the pulp will we transferred into the press where it will be pressed and the excess of the water from the pulp will be removed.
- After the pulping and the pressing processes are done the power source will be switched on.
- A voltage reducer will be connected to the socket and the motor. The function of the voltage reducer is to lower the 220V supply from the socket to the required voltage that is 24V.
- When the supply of power will start the voltage will be reduced by the voltage reducer and the motor will get the required voltage and the motor will start to rotate.
- On the motor shaft a sprocket will be mounted which will transfer the rotary motion of the motor to the roller shaft onto which there will be a similar sprocket. The two sprockets will be connected by a chain.
- There are total of three rollers on the bottom side of the conveyor and there are two rollers above the middle and the last roller. The conveyor belt will pass between these rollers.
- The rollers on the bottom side of the conveyor are connected by a chain drive so that when the first roller will rotate the motion will be transmitted to the other two roller present on the same line. The shafts of middle roller and the last roller consists of gears which will mesh with the gears present on the roller shafts above them. This is how all the rollers will rotate simultaneously.
- Then the pulp made will be transferred on the conveyor belt. The pulp will move a small distance till it will be pressed between the rollers present at the middle of the conveyor.
- After the first pressing the pulp will again move a small distance and then will again be pressed by the calendar rollers to obtain a proper uniformity in the thickness.
- After the pulp is pressed by the rollers, recycled paper will be formed.
- Hence waste paper is recycled into new paper.

Fig -3: Actual Assembly (T.V)

5. RESULT AND OBSERVATIONS

Result:-

The paper obtained is not of A4 size but of a smaller size. 2 sheets of paper were shredded to the obtained result so to

make the A4 size paper 8 sheets of paper should be shredded.
After the pressing operation the thickness of the paper is 3mm but after the roller pressing the final paper obtained is about 1mm thick

Observations:-

Sr.no	Amount of pulp used	Size of paper produced	Quantity of paper produced
1.	1 litre	13cm x 4cm x 2mm	3
2.	2 litre	13cm x 4cm x 2mm	7
3.	3 litre	13cm x 4cm x 2mm	13

6. FUTURE SCOPE:

The machine made by us is semi-automated. The processes like the pressing and the shredding processes are done manually and the processes like pulping and the thinning of paper is automated.

As there was a constraint of budget we made a semi-automated machine but in the future we can make a fully automated machine. Like the process of shredding and the pressing are done manually can be then automated.

7. CONCLUSION

The output we get from the machine is the reusable paper from the waste paper. The paper is a A4 sized and the paper obtained can be used in making the wedding cards, invitation cards, craft paper.

By reducing the cost of the machine we have achieved to make paper which can be reused for multiple purposes.

If there will be an increase in the recycling of paper the deforestation will reduce and the effect of global warming will also reduce to a considerable extent.

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