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DEVELOPING ECO-FRIENDLY PAPER BOARD USING CORNHUSK

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ABSTRACT

This Work aims to create an eco-friendly paper board from corn husk due to its availability of cornhusk in our country and easy accessibility. Cornhusk is transformed into a paper board by mechanical pulping and paper making process. The paper board made from corn husk is tested for burst strength and moisture absorption properties. These boards are then used as base material to create eco-friendly commercial handcraft products. As these products can be marketed and sold, they may also start a home-based small-scale business and promote entrepreneurship. Using cornhusk as the base material in product making may also reduce the initial investment of a business.

Keywords*:* Cornhusk, Paper board, Papermaking, Pulping process, Mechanical pulping, Cornhusk paper

I. INTRODUCTION

Eco-friendly commercial product manufacturing has been widely developed and has become a trend in the world. Deforestation of trees for paper production presents multiple societal and environmental problems such as loss of biodiversity, destruction of forest-based societies, erosion, flooding, and climate change in the world. These immediate and long-term consequences of global deforestation are almost certain to jeopardize life on Earth. With the gradual deepening of the world's environmental protection awareness, we must look for new resources and adopting a new method to make the commercial products utterly free from the growing shortage of raw wood pulp resources.

Natural fibers such as straw, hemp, sugarcane bagasse, and jute have been well recognized as suitable replacements for wood fiber used for paper making. Wood and corn husk are similar which both of them are natural fibers. However, corn husk is categorized as natural waste because a very minimum corn husk is introduced. The concept of “Waste to Wealth” is introduced in this Work. Waste to Wealth in this context means that converting waste will be discarded and burned into a product that can benefit the environment and society. This Work aims to develop an eco-friendly alternative of producing paper board and producing handmade crafts from corn husks (as base material) – an agricultural waste. The corn husk is transformed to a paper board by mechanical pulping and paper making process. The paper board will be transformed into an eco-friendly handcraft which might also be an initiative for starting a small-scale business.

II. LITERATURE REVIEW

The danger on wooded area woods and environmental sustainability has brought about competitive studies into the suitability of numerous agricultural waste substances for pulp and paper production. The evaluation of fiber morphology of corn husk additionally confirms that it has short fibers just like numerous hardwoods, whose period is <2 mm. The paper from corn husk has sizable strength. Low lignin content material has been stated as one of the benefits inherent within side the use of non-wooden substances for pulp production. Cornhusk consists of low lignin of about 15%[1].Mechanical pulps are ideally suited to light-weight printing grades due to their capability to make opaque, low-weight grades at low cost[2].

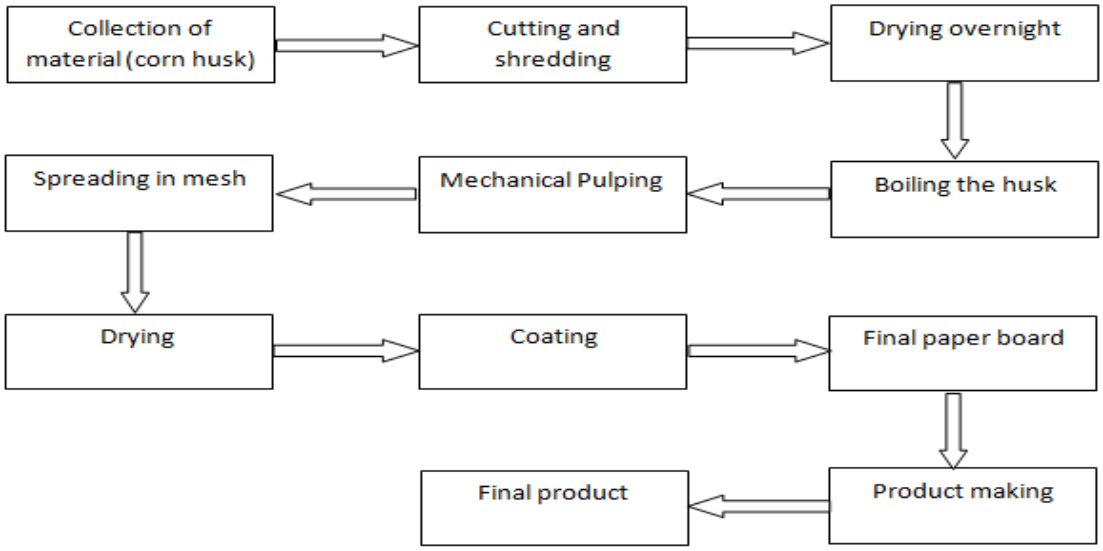
Paper pattern from 100% corn husk changed into discovered to own the bottom tearing value (1.22 N/mm)[3]. Starch is generally utilized in paper enterprise and paper coating extensively to be had and less expensive agricultural uncooked material. In local form, it may be used as a sizing agent simultaneously after few changes. It may be applied as a coating agent because of its splendid movie forming ability. Starch may be extracted from numerous plant reasserts such as corn, potato, tapioca, wheat, and rice.[4]

III. METHODOLOGY

The Work involves the making of cornhusk paper board by using mechanical pulping and paper making process. The paper board is then used as a base material to develop eco-friendly handicraft products.

A.BLOCK DIAGRAM

Figure 1: Block diagram of the Paper-making process



B. MATERIALS REQUIRED

Each stage of the Work required different types of materials. The below table shows the materials required and quantity for each process.

S.NO	PROCESS	MATERIALS REQUIRED
1.	Paper-making	Corn husk-10kg Sodium bicarbonate(NaHCO3)-250g Starch-450g
2.	Coating	Corn starch-100g Water
3.	Product making	Cornhusk paper board Foam sheet Craft paper Glue gun Decorative beads Glass pieces

Table 1: Materials required

C. PRODUCT MAKING

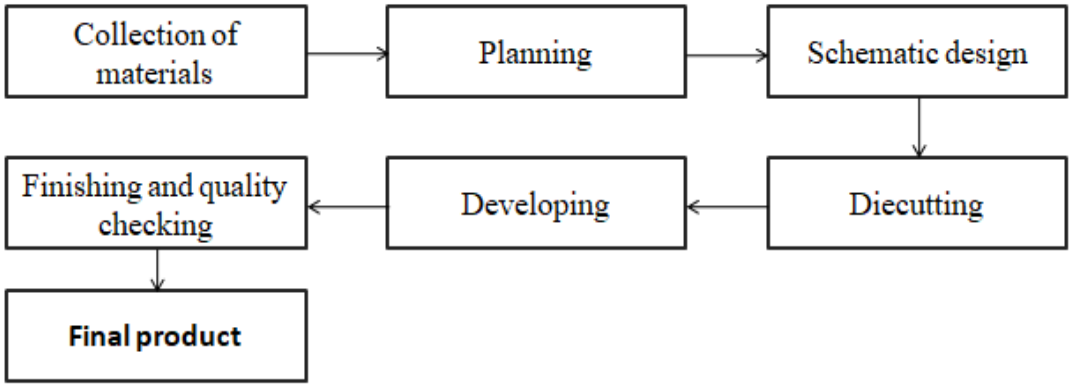


Figure 2: Block diagram of product making

IV. IMPLEMENTATION

A. PULPING PROCESS

First, weigh 100g of corn husk and remove all the dust materials. The corn husk is let dry out in an open place overnight. After the husks have dried, it is shredded to small pieces. The corn husk is placed in a slow cooker for 6 to 10 hours. Next, the corn husk is ground in a rolling stone to some extent. After that, the ground corn husk is made into a pulp using a blender machine. Next, the pulp is treated with starch to act as a dry strength additive.

B. PAPER-MAKING PROCESS

The deckle is prepared. The mush is transferred onto the deckle. Dab excess water from the paper using a sponge. The wet paper is then dried in sunlight and then in the shade to get the final material. The starch coating is done to enhance the material strength.

C. MATERIAL TESTING

GSM, Burst strength, and Moisture absorption test was done at the company named "South Indian Corrugated Box Manufacturing Association. The materials were cut into 10 cm *10 cm dimension, and the testing has proceeded.

D. GSM

The term "GSM" stands for "grams per square meter." No matter the length or width the paper becomes, the weight measurement is always taken from the square meter sheet. The gsm of the samples were found to be from the range of 414 to 837 gsm.

E. BURST STRENGTH

A paper or paperboard property used in packaging measures its resistance to rupturing, defined as the hydrostatic pressure needed to burst a paperboard sample when applied uniformly across its side. The increased use of fillers decreases bursting strength, while the increased use of longer fibers and surface sizing increases a paper's bursting strength. Bursting strength is measured utilizing a rubber diaphragm that is expanded hydraulically against the paper sample. A bursting test is also known as a Mullen test or pop test. The result ranges from 3.71 to 5.83.

F. MOISTURE ABSORPTION TEST

The Cobb test determines the amount of water absorbed into the surface by a sized (non-bibulous) paper, paperboard, and corrugated fiberboard paper or paperboard sample in a set period, usually 60 or 180 seconds (Cobb60 or Cobb180). Water absorbency is quoted in g/m2. The water absorbency of a material can have a strong influence on printability and the setting rate of water-based adhesives. The moisture absorption test ranges from 2.7% to 4.10%.

In Table 5,

- The testing sample size = 10*10 cm
- The proportions are selected based on the trial and error method.
- The accepted values are:

  Burst strength – 3.05 to 6.6 kg/cm^2

Moisture content – 4% to 6%

Sample Number	Proportion	GSM (g/m^2)	Burst strength (kg/cm^2)	Moisture absorption (%)	Result
1	2litre - Corn husk pulp	451	5.83	4.10%	Accepted (B.S > 3.05 M.A>4%)
2	1.5litre - Corn husk pulp	336	3.0	3.40%	Non-Accepted (B.S < 3.05 M.A< 4%)
3	3litre- Corn husk pulp	534	2.34	3.20%	Not Accepted (B.S < 3.05 M.A< 4%)
4	500 ml starch + 2litre corn husk pulp	506	4.33	2.20%	Not Accepted (B.S > 3.05 M.A< 4%)
5	500 ml starch +1litre corn husk pulp	398	2.89	3.40%	Not Accepted (B.S< 3.05 M.A< 4%)
6	500 ml starch +3litre corn husk pulp	561	3.71	3.98%	Accepted (B.S > 3.05 M.A< 4%)
7	1litre starch + 2litre pulp	837	5.15	4.25%	Accepted (B.S > 3.05 M.A>4%)
8	1litre starch + ¾litre pulp	414	3.28	5.01%	Accepted (B.S > 3.05 M.A>4%)
9	750 ml starch + 2litre pulp	721	3.92	3.94%	Accepted (B.S > 3.05 M.A>4%)
10	250 ml starch and 1litre pulp	528	3.48	5.34	Accepted (B.S > 3.05 M.A>4%)
11	500 ml corn husk pulp -500 ml of recycled paper	775	2.41	2.20%	Not Accepted (B.S < 3.05 M.A< 4%)
12	300ml cornhusk pulp	659	4.21	2.50%	Not Accepted (B.S > 3.05 M.A< 4%)

Table 2: Test results of samples

- The New samples have been created in the proportion of the accepted samples from
- Phase-1.
- The New samples have been segregated into two types:
- Coated sample (corn starch coating)
- Uncoated Sample

The readings were taken for both types of samples and tabulated, respectively.

Before coating

Table 5 shows the result of testing the samples before coating them with corn starch.

S. No	Burst strength	GSM	Burst factor	Cobb value	Moisture content
1	5.57	376	14.81	HALF	8.3%
2	4.64	631	7.35	HALF	8.2%
3	4.44	296	15	FULL	8.1%
4	4.05	464	8.73	NIL	6%
5	3.6	278	12.95	NIL	8.2%

Table 3: Test results of samples before coating

After coating

Table 6 shows the result of testing the samples after coating with corn starch.

S. No	Burst strength	GSM	Burst factor	Cobb value	Moisture content
1	6.17	406	15.2	HALF	10.6%
2	7.93	648	12.83	HALF	9.8%
3	3.96	329	9.6	NIL (Good)	10.1%
4	5.25	572	9.17	NIL	9.3%
5	3.61	337	10.71	NIL (Good)	8.8%

Table 4: Test results of samples after coating

VI. CONCLUSION

Thus the paperboard is made out of cornhusk and determine its GSM, Burst strength, and Moisture absorption. Moreover, to make products out of this cornhusk paperboard, such as handicraft products.

VII. FUTURE WORK

On further work, the surface finishing of the paperboard can be improved, and various effective testing can be done with various compositions. The color of the paper board can be enhanced by adding natural colorants.

VIII. REFERENCES

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