



PRODUCTION OF HANDMADE PAPERS FROM SUGAR CANE BAGASSE AND BANANA FIBERS IN OMAN

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Abstract--Solid waste is one of the biggest problem of civil society. In this project, agriculture waste from bagasse and banana fibers have been used to produce handmade paper. These fibers were collected, dried under the sun and passed through water vat to remove dust. Next, it is cooked with 10% caustic solution in pressure cooker and then blended in mixer for different timing. Diluted solution of Clorox was used for discoloration and purification of pulp.

Three types of papers were made from ready pulp. First type was by made by using raw material only, second type by addition of 2% of CaCO₃ and 2% of starch. And the third types by addition of 5% of both additives. These papers were dried and then ironed for straightening.

GSM, pH, Thickness, Bulk, and Moisture Content were calculated for all types of papers. It was found that papers from bagasse fibers are heavy and suitable for heavy and rough usage. While paper from banana fibers are useful for soft usage like tissues, wipes, tracing paper etc. This project is ecofriendly as it used agricultural waste and only little electricity was used.

Keywords: *Handmade papers; bagasse; banana fibers; GSM; Ecofriendly*

I. INTRODUCTION

Papers are substances which have been used universally for writing and packaging. The Chinese Cai Lun was the first person who made a sheet of paper about 105 CE. Papers have been spread from China through the Middle East to medieval Europe in the 13th century.

Papers are thin materials which are produced by pressing together moist fibers and then drying them into the flexible sheets. Paper have many uses such as for writing, printing, packaging, in many cleaning products, in a number of industrial and construction processes, and even as a foods ingredient.

Papers are made using wood and non-wood material such as bagasse and banana fibers. Eco-friendly papers production are alkali-free and non- pollution process which have many advantages over conventional process such as it saves our mother earth from global warming. Handmade paper Industries has become more popular because of its eco-friendly nature and has the significant impacts for growing forest and preserving the greenery.

In this project handmade papers are made from: Bagasse and banana fibers

Handmade paper from Bagasse: Bagasse is the fibrous residue which is remaining after sugarcane is crashed to extract its juice. By using agricultural residue rather than wood will add advantages of reducing deforestation. Sugarcane bagasse is particularly studied because it is one of the most important raw materials for paper pulp production in many countries. Bagasse is well suited for tissue, corrugating medium, news print and writing paper. Sugarcane can be finding in many areas in Oman such as Nizwa and Sohar

Handmade paper from banana fibers: Banana fiber has great potentialities for paper making because of its high alpha-cellulose and low lignin content. Today banana fibers is used as a source of raw material for preparation of a paper pulp. This pulp is used to prepare different types of paper such

as tissue, blotting, tracing and writing printing paper. Banana is the most important fruit crops in the world and Oman in particular, which is the largest producer of bananas in the Gulf region and is considered the province of Dhofar and Batinah region.

As result, research showed that sugarcane bagasse has lowest content of silica, 9.78% and highest content of carbon 90.22% compare to rice straw and rice husk. ([Salleh, Kasim &Saad,2005](#))

About 10% of the total chemical pulp produced in the world is made using non-wood material such as bagasse and wheat straw. Soda process is the preferred method of chemical pulping of non-wood materials, because it is considered to be economically viable on a small scale and for bagasse is compatible with sugarcane processing. A preliminary economic analysis of the soda process for producing commodity silica, lignin and pulp for papermaking is presented ([Doherty & Rainey, 2006](#))

One of the major impediment in utilization of bagasse in papermaking is the percentage of pith (35-40%) along with fiber. The conventional depithing methods including dry depthing followed by wet cleaning result in removal for only 50% of the pith associated with bagasse thereby resulting around 15% pith in depithed bagasse. ([Dixit, Thakur, JanR& Mathur, 2010](#))

II. METHODOLOGY, DESIGN AND EXPERIMENTATION

Material used: Bagasse, Banana fibers, Sodium Hydroxide (caustic soda), Clorox, Calcium carbonates (CaCO_3), and starch.

Steps involved in handmade paper making:

- i. **Raw material preparation:** Collected the agricultural residue of bagasse and banana fibers, dried under sun for few days and then wash it by tap water repeatedly.
- ii. **Pulping Process:** cooked it with 10% of caustic soda for 30 minutes. Then wash it with hot water and by tap water repeatedly.
- iii. **Blending Process:** Mix the pulp in blender for 5 minutes with little of water.

- iv. **Bleaching Process:** It is the method of pulp purification and *Discoloration*. Clorox's used to remove the brown color and get whiteness of pulp.
- v. **Paper Making:** Using the inlet frame to make sheet of paper. In this step, additives(CaCO_3 and Starch) were added to pulp to enhance the properties of paper with the percentage of 0% for 1stpaper, 2% both in 2nd paper and 5%both in the 3rd paper.
- vi. **Ironing:** It is the last step in making paper and it is used to achieve the smoothness and straightness of paper.



Figure 1: Banana Fiber and Bagasse



Figure 2: Discoloration



Figure 3: Ready pulp for paper making



Figure 4: Ready paper

Testing of paper Quality:

- i. GSM: By take the weight of each paper in gram. [GSM= Weight / Area of paper in cm^2]
- ii. pH: mixing paper with water and recording pH of solution.
- iii. Thickness: Using micrometer to measure the thickness of each paper at four different regions of paper and then take average.
- iv. Bulk: [Bulk = GSM/ Thickness]
- v. Moisture Content: put all samples in oven for 60 minutes at 110 C and then calculate the Moisture content.
 [Moisture content = (moisture amount / weight of paper) X 100]

III. RESULTS AND ANALYSIS

GSM Test: GSM values were calculated for 3 types of bagasse paper and 3 types of banana fiber paper. In both two types of paper, GSM ratio is increased by added CaCO_3 and starch. It can be seen that in the paper of row material only, GSM ratio for bagasse is

higher than banana fiber and the same can be seen in 2% of CaCO_3 and 2% of starch paper and 5% of CaCO_3 and 5% of starch paper. All in all, the highest value of GSM ratio can be found in bagasse 5% of CaCO_3 and 5% of starch paper.

pH Test: From the table and figure, it's clearly that pH value for there is an increase the value of pH and added CaCO_3 and starch for both bagasse and banana papers. By compared the pH value between bagasse and banana fibers papers in the three cases, Bagasse pH value is more than banana fibers.

Thickness Test: Bagasse papers are carrying high thickness and it is indicating that these papers can be used for rough usages and banana fibers are suitable for sophisticated usages. By comparing the thickness of all samples, the highest thickness value is found in bagasse 5% of CaCO_3 and 5% of starch paper with thickness of 0.3 mm. In both bagasse and banana fibers, there is an increase in the thickness by added of CaCO_3 and starch ratio.

Bulk Test: With high bulk value, the paper is in good quality. For bulk ratio, there is an increasing in value of bulk in raio by added of CaCO_3 and starch in bagasse paper. While in banana fibers papers, 2% of CaCO_3 and 2% of starch paper had the lowest bulk value and raw material only is the highest from banana fibers papers. For all types of paper made, bulk value in average of 400-500.

Moisture Test: Moisture content of banana fibers is quite higher than that of bagasse papers. It means banana fiber papers can be used for facial tissue, tracing papers, transparent papers etc. It can be shown in the below table and figure, there is decreased in the moisture% by added CaCO_3 and starch on bagasse and banana fibers pulp papers. By compared bagasse papers and banana fibers paper, banana fibers papers had moister content then bagasse papers.

IV. CONCLUSION

In this project Bagasse and Banana Fibers were used in making handmade paper. It is clear from this study that both bagasse and banana fibers have good properties and can be easily used as raw material for handmade papers in lab or home. By adding the

suitable additives like CaCO_3 and starch, properties of paper can be enhanced. CaCO_3 helped in giving white color to paper and worked as filler and starch serve as glue in holding fibers together. It is clear from results that bagasse fibers are heavier and this paper can be used for rough usages like packaging and banana fibers are suitable for sophisticated usages tissues, wipes etc.

Table 1: Comparison of paper quality from Banana and Bagasse fibers

Paper	Bagasse			Banana Fibers		
	Raw material only	2% CaCO_3 & 2% starch	5% CaCO_3 & 5% starch	Raw material only	2% CaCO_3 & 2% starch	5% CaCO_3 & 5% starch
GSM	140	108	80	100	68	64
pH	7.5	7.29	7.11	7.25	7.2	7.16
Thickness	0.3	0.25	0.2	0.2	0.15	0.1
Bulk	466.67	432	400	500	453.33	640
Moisture%	14.29	20	25	20	50	66.67

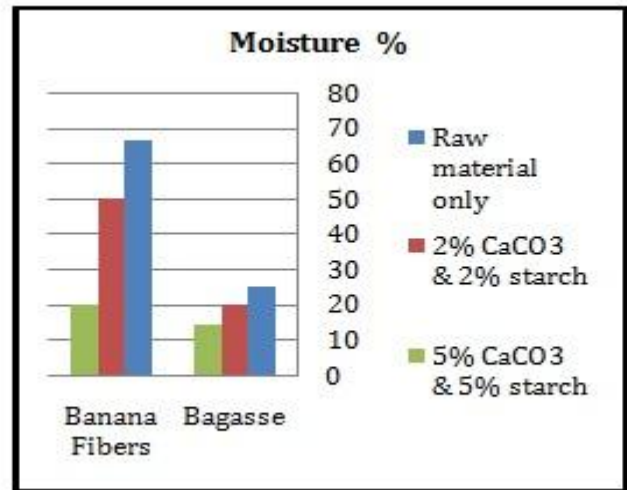


Figure 4: Graphical presentation of paper quality comparison

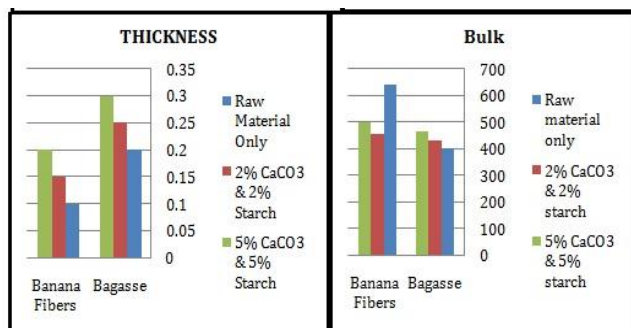
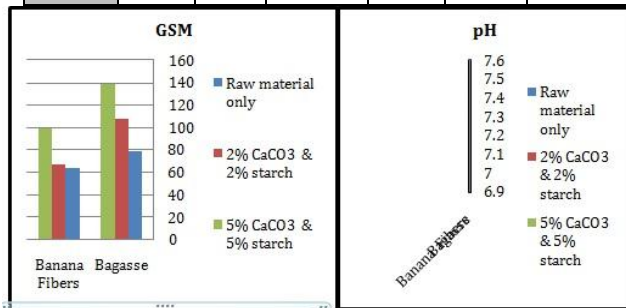
RECOMMENDATIONS

1. Save money on raw material since it uses agriculture wastes.
2. Eco-friendly and it reduce the greenhouse gas emission because it used only agriculture wastes and do not cut wood tree to made paper.
3. By using bagasse and banana fibers, this gives good quality to the paper.
4. By enhancing properties of paper, it can be used for commercial packaging, decorative purposes etc.
5. Small business unit can be developed around this project. It will create job as well as remove some solid agricultural waste.

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