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Production of Pulp and Paper from Bagasse

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ABSTRACT: *In this project sugarcane bagasse was investigated for the potential ofproducing pulp and paper. Experimentally Sudanese Bagasse is pulped applying the soda chemical pulping process. Using an alkali charge of 12.4% Na_2O for 140 minutes cooking time at maximum temperature of 160ºC, the screened yield obtained was 50.1% which is acceptable.The unbeaten pulp has shown freeness of 16 SR while beaten pulp for 5min was 37 SR and for 10min has given 44 SR this shows the increase of SR with beating time. This indicates that the drainability of pulp increases with beating.Samples of paper were made from the pulp and tested. The testes show that the brightness and the thickness decreased with the beating time while the tensile index, the burst index and weight increase.The Sudan can be considered as one of the most suitable countries for manufacturing paper and pulp because of the availability of raw material. It is recommended to investigate establishing a paper factory in Sudan because all the possibilities are available.*

Keywords: *Bagasse, pulp, paper.*

I. INTRODUCTION

Sudan has numerous natural resource and potentials that can provide inputs for industrial product most important of these are the agricultural element and products that can insure raw material for many food stuff Industries including sugar refining.Sugar industry started in Sudan with establishment of Guneid sugar factory country the Guneid factory, the New Halfa factory, the Sinnar factory, Assalaya Factory, Kenana factory and White Nile factory.Sudan has relatively advantageous distinction of having all the desired factors of sugar cane production [1].Sugarcane today is considered as one of the best convert of solar energy into biomass and sugar. It is a rich source of food (sucrose, jaggery and Syrup), fiber A (cellulose), fodder (green leaves and the top of cane plant, bagasse, molasses and to some extend press mud), fuel and chemicals.The main by products are bagasse, molasses and press mud.The other products and the byproducts of less commercial value are green leaves and tops, trash, boiler ash and effluent generated by sugar factory and distillery.Many countries have thought of diversification and utilization of it[s] by-product. In the case where economies entirely depend on sugar export earning any fall in international rates shatter their economies. They find it wise to diversify the activities of this sector by setting up industries based on by products.

The main By-products of the Sugar Industry

Bagasse:

Bagasse is the fibrous residue from the sugar cane after extracting cane juice the cane with 45-50% moisture content and consisting of a mixture of hard fiber with soft and smooth parenchymatous (pith) tissue with high hygroscopic property bagasses contain mainly cellulose, pentosans, lignin, sugars, wax, and mineral.The quantity obtained varies from 22-36% on cane and mainly due to the fiber portion in cane and the cleanliness of cane supplied which in turn depends on harvesting practices.The compositions of bagasse depend on the variety and maturity of sugar cane as well as harvesting methods applied and efficiency of the sugar processing.

Molasses And Based Industries

Molasses is the final mother liquor leftover after the crystallization of sugar it is sent out the factory as a waste product.However, molasses contains about 30-35 per cent sugars and 15-20 percent reducing sugars. Thus, the total sugar content of molasses is 45-55% percent .It is by virtue of these total sugars content that molasses is a valuable raw material for the production of many values –added products.

PRESS MUD

Press mud, the solid waste produced while processing sugar cane is rich inpotassium, sodium, phosphorous and organic matter. Press mud is also abase material for producing bio-earth which is done by composting with spent wash, a liquid –waste generated out of distillery operation

II. MATERIAL AND METHOD

1. Pulping

Raw Materials Collection

Bagasse samples were collected from the White Nile sugar factory (White Nile Province).

Raw Material Preparations

Bagasse was screened from sand and dust then depithed by crushing. The bagasse was air dried to approx. 9.6% moisture content before pulping.

Cooking liquor Preparation

The active alkali level was calculated as Na_2O on oven- dry bagasse.

Pulping Equipment

Soda pulping was carried out in 10-liter rotating electrically heated digester.

Pulping Conditions

The bagasse sample used for cooking was 553 g oven –dry weight.The following cooking condition 5:1 liquor-to-raw material ratio. Heating time needed to reach the maximum temperature was 70minute.The maximum cooking temperature for bagasse cooks was 160^oC. The cooking time at maximum temperature was 70minute.The sodium hydroxide as Na_2O on oven –dry bagasse used was 12.4%. And the pressures reach 9bar.

Characterizations of Pulp Properties

The pulp was defibrated in a turbo pulper 5 min and then screened in a strainer for determination of screenings (rejects).The pulp moisture content was determined according to TAPPI T 11 wd-79.The pulp yield was calculated as:Total pulp yield %=rejects %+screened yield%

2. Pulp Treatment

Pulp Beating

The unbleached pulp beaten in a jokro mill according to German Zellcheming methods V/8/76.The pulp freeness degree was determined with a Schopper-Rigler apparatus according to SCAN- C19:65.

Hand Sheets Formation

The sheets for physical and optical tests were formed according to the German Zellcheming methods.

3. Pulp Properties

The thickness, brightness, tensile strength, burst tensile, grammage were determined for unbleached pulp according to the standards given in blow table

Table standard used in testing pulp hand sheet

Test	Method
Thickness	Zellcheming V/12/57
Tensile strength	Zellcheming V/12/57
Burst tensile	Zellcheming V/12/57

All the practical work was done in the laboratories of the National Center of Research
A sample of the paper produced is included with the thesis.

III. RESULT AND DISCUSSION

Pulping of bagasse

The soda pulping of bagasse carried out with active alkali level of 12.4 as Na_2O on oven dry raw material, 70 minutes heating up time was need to reach the maximum temperature of 160^oC, and 70 minutes the cooking time at maximum temperature blow table the screened yield (50.1) was acceptable although, it was lower than what was found by Suhair, 2016 (55.45) this may be due to longer cooking time and lower temperature. This may also explain the higher rejects.

Table: Soda Pulping Conditions

Conditions	**Researcher**	**Suhair2016**
Active alkali as Na_2O on oven –dry bagasse, %	12.4	12
Liquor to bagasse ratio.	5:1	5:1
Maximum temperature, C^o	160	175
Time to reach maximum temperature, min.	71	60
Time at maximum temperature, min.	71	60

Table: Pulp Yield

Yield of oven –dry digested pulp on oven –dry bagasse, %	50.90	55.73
Yield of oven –dry screened pulp on oven –dry bagasse, %	50.10	55.54
Reject on oven –dry bagasse, %	.8	00.19

Next table shows beating and freeness of pulp. The unbeaten pulp has shown freeness of 16 SR while beaten pulp for 5min was 37 SR and beating for 10min has given 44 SR this shows the increased of SR with beating time. The brightness was decreased with the beating time, the thickness was decreased, and the tensile index was increase, the burst index increased, and gram increased with the beating time.

Pulp Evaluations

Initial pulp freeness,	^oSR	16
Beating time, min	5	37
	10	44
Brightness,	un beaten	2.7
	5	2.7
	10	2.6
Thickness µm	un beaten	19.283
	5	13.90
	10	13.20
Burst index kpm^2/g	un beaten	00.18
	5	0.875
	10	1.650
Tensile index Nm/g	unbeaten	1.180
	5	1.850
	10	4.220
weight g	unbeaten	108.166
	5	110
	10	111

IV. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- Sample papers were made from the produced pulp and tested.
- The following properties were obtained for the paper produced:

Brightness, tensile index, thickness, burst index and weigh.
Results were shown in before table.

- From the obtained result we can conclude that bagasse properties make it suitable for pulp and papermaking.
- Sudan is suitable for manufacturing paper and pulp because of the availability of raw material, particularly sugarcane bagasse.

Recommendations:

- It is recommend that further studies to be carried out to show other more properties of bagasse such as fiber dimensions and physical properties and their effect on pulp properties.

- It is also recommended to investigate establishing a paper factory in Sudan because all the possibilities are available.

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