Manufacture of Pulp Extraction to Produce Paper from Ground Nut Shell

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Abstract **- In recent years, with the growing shortage of wood from the forest, the search for alternative fibre producing plant material has been initiated in many countries of the world. The generation of fast growing high biomass yielding plant is thought to be one of the solutions to mean the shortage of cellulosic material. However, certain agricultural plants producing high biomass are found to be suitable substitute. Among them ground nut shell may serve partly as an alternative resource. In this study we extracted cellulosic fibre from ground nut shell by kraft's process and we compared other source of cellulosic fibrous materials. In application we produced paper from ground nut shell. This is going to be more effective and alterative for cellulosic fibre in future.**

Keywords **- Ground nut shell, Kraft's process, Cellulosic fibre, extraction, paper.**

I. INTRODUCTION

Paper is a thin material produced by pressing together moist fibre, typically cellulose from ground nut shell, rags or grasses, and drying them into flexible sheets. Paper is a versatile material with many uses. While common is for writing and printing upon, it is also widely used as a packaging material, in many cleaning products, in a number of industrial and construction processes, and even as a food ingredient-particularly in Asian culture. Paper, and the pulp paper making process was said to be developed in china during the early 2nd century AD, possibly as early as the years 105AD (Han court eunuch CaiLun), although the earliest archaeological fragment of paper derive from the 2nd century BC in china.

From then on paper is used as the major source of communication in the form of writing letters, keeping record of valuable information like books, entertaining people in the form of novels and spreading information about the daily happenings in the form of news paper, which is the major revolution in communication that ever happened in the history of mankind. Various technologies available for production of paper, made it useful in lots of applications. It not only has role in communication but also to large extent in packing materials, which is reason for selection of the project. It burns up to 75% cleaner than fossil fuel (oniya et al., 2014) use of agricultural waste having no economic value for bio fuel production give a better way of efficiently utilizing agricultural land. Sugarcane molasses, groundnut shell, rice husk, strew, corncobs, etc. are being studied as substrates for bio fuel production. Ground nut contain cellulose, lignin, ash, pentose (Somkiat Ngamprasertsith et al., 2007).

Cellulose is the most abundant biopolymer in the world (Lavanya et al., 2013). Cellulose is found in a wide range of species and present along with hemicelluloses, lignin, pectin, wax, and resins (Abbakar et al., 2015). The structure of cellulose is organized into fibrils, which are surrounded by a matrix of lignin, extractive in organics and hemi celluloses (Costa et al., 2013). The higher cellulose content togetherPresent in ground plant may be a suitable source for producing paper in low-cost and eco-friendly environmental.

A. *What is ground nut?*

The peanut also called as the groundnut and taxonomically classified as Arachishypogeae belongs to leguminous family, is a legume crop grown mainly for its edible seeds. It is widely grown in the tropics and subtropics, being important to both small and large commercial producers. It is classified as both a grain legume and, because of its high oil content, an oil crop. A typically among crop plants, peanut pods develop underground rather than aboveground. It is this characteristic that the botanist Linnaeus used to assign the specific name hypogeal, which means "under the earth." Like most other legumes, peanuts harbour symbiotic nitrogen-fixing bacteria in root nodules .This capacity to fix nitrogen means peanuts require less nitrogen-containing fertilizer and improve soil fertility, making them valuable in crop rotations.

Peanuts are similar in taste and nutritional profile to tree nuts such as walnuts and almonds, and as a culinary nut are often served in similar ways in Western cuisines. The botanical definition of a "nut" is a fruit whose ovary wall becomes very hard at maturity. Using this criterion, the peanut is not a true nut, but rather a legume. However, for culinary purposes and in common English language usage, peanuts are usually referred to as nuts.

Fig .1 Ground nut

II. MATERIALS AND METHODS

A. Raw materials

Generally wood are two types, hard woods and soft woods. Wood from conifers is called soft wood, and the wood from dicotyledons (usually broad-leaved tress, e.g. Oak) is called hardwood. Hard woods are not necessary hard, and softwoods are not necessarily soft. The well-known balsa is actually softer than any commercial softwood. Some soft woods are harder than many hardwoods.

These woods contain basically three materials in them.

They are;

1. Cellulose
2. Ash
3. Lignin

1) Cellulose: The cellulose present in wood is mostly in the form of fibres. The cellulose fibres are obtained as pulp after pulping process. Cellulose fibre is a long chain of single monomer ($C_6H_{10}O_5$).

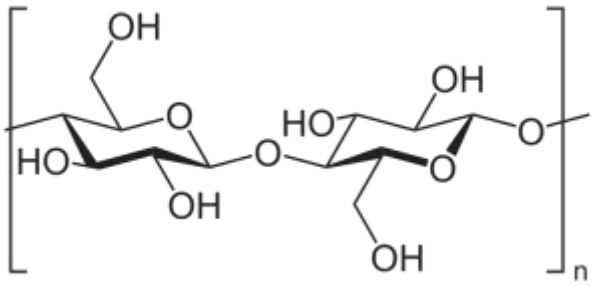


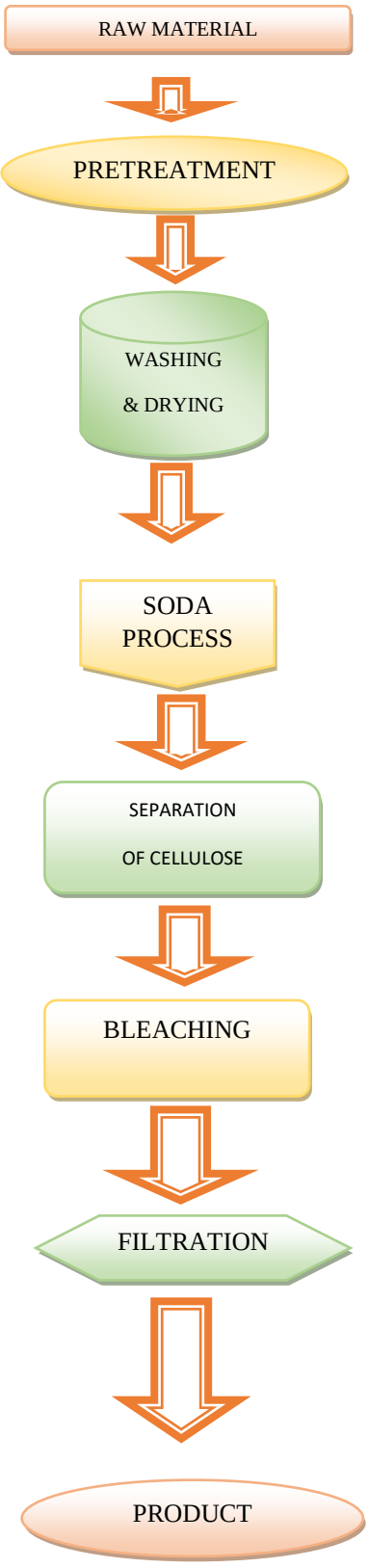
Fig. 2 Cellulose

2) Lignin: A complex organic polymer deposited in the cell walls of many plants, making them rigid and woody.

B. Chemicals used

- Sodium hydroxide
- Sodium hypochlorite
- Sodium sulphide
- Sodium carbonate

C. Overall process in flow sheet



D. Pulping

Pulping is the process of production of pulp using wood material which is a lignocelluloses fibrous material. It is prepared by chemically or mechanically separation cellulose fibrous from wood, fibres or waste paper.

III .RESULTS AND DISCUSSION

A. FTIR Analysis of ground nut shell

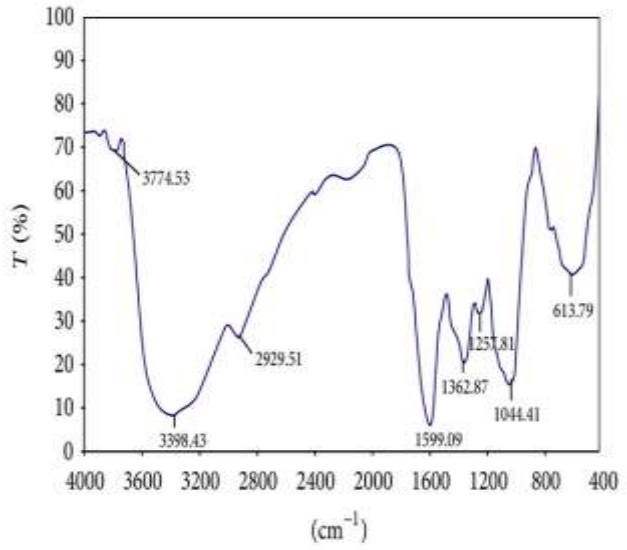


Fig. 3 FTIR Analysis of ground nut shell

A Fourier-transform infrared spectroscopy (FTIR) spectrometer simultaneously collects high spectral resolution data over a wide spectral range. This confers a signification advantage over a dispersive spectrometer, which measures intensity over a narrow range of wavelength at a time.

Peak ranges are 3774.53, 3398.43, 2929.51, 1599.09, 1362.87, 1257.81, 1044.41 and 613.79. The range of 3398cm^{-1} corresponds to –OH group. Peak 2929 cm^{-1} corresponds to alkenes. Peak at 1600 cm^{-1} Corresponds to C=C group. Peak 1363 cm^{-1} corresponds to $–CH_3$ group (gunasekarvaradarajan et al., 2013). The peaks are references to lipids, Cellulose, Hemi cellulose, Organic carbon, Ash, Volatile solid. Compositions obtained from (VedikaHatekar).

Table. 1 Composition of ground nut shell

Composition	Dry weight Percentage
Cellulose	35.7
Volatile Solids	68.7
Organic Carbon	48.3
Ash	5.9
Total Nitrogen	0.8
Hemicellulose	18.7
Lignin	30.2

B. Experimental procedure

1) Preparation of raw material: Initially20gofground nut shell are taken and washed several times with distilled water to remove dust and soil particles present on it. Further crushed and sized with US mesh number 230 to 270 with size of 53 microns to 63 microns obtained. To remove moisture content dried at 80^0C for about 30 minutes.

2) Kraft's Process: For cooking liquor to be prepared chemical must be taken in right proportions so that effective cooking would happen. Kraft consists of following chemical NaOH, Na_2SO_4, and Na_2CO_3 weight of solution.

In this Weight of solution, according to kraft's process solid analysis says.

- 58.6% is NaOH

- 27.1% is Na_2SO_4 and 14.3% of Na_2CO_3 (Mukhtarfaithuhamza et.al.., 2016)

Next, it is heated to about 90^0C for 4hrs 30 min with continuous stirring. But the heat is not enough as the cooking liquor is weak basic compared to Kraft's process. So, it is heated for one more hour to increase the effectiveness of heat and cooking liquor in breaking the lignin molecules and dissolving in the cooking liquor.(Mukhtarfaithuhamza et.al.., 2016)

After digesting, brown stock and black liquor are formed, Brown stock contain cellulose and small amounts of lignin. And the black liquor contain the dissolved lignin and

Fig. 4 Black liquor

Cooking chemical filtered using filter paper obtains black liquor as waste that contains cooking chemicals that can be recovered. So, once the filtration is done remove the lignin traces completely. So, once the chemical associated with the brown stock to dissolve in it. And, this mixture is again filtered with the filter paper and this process is repeated.

It is washed several times with 1000ml of water to reduce the lignin content. Finally, the obtained product from

the filtration must be in such be in such a way that lignin traces must be less in amounts.

Fig. 5 After removal of lignin

3) Bleaching: Once filtration and washing is competed the washed pulp is dissolved in 100ml of water to which 100ml sodium hypochlorite or hydrogen peroxide in the ratio 1:1 is added to completely remove the brown colour to obtain white paper grade pulp. The above is the main process involved in the cellulose; once the digesting is competed brown stock is washed with water and bleaching. Black liquor is sent to chemical recovery section.

Fig.6 Bleaching Cellulose

4) Filtration: Filtration is done to find the yield in the process. To removed entire water content in the bleaching cellulose.

Fig .7 Cellulosic fibres

5) *Process:*

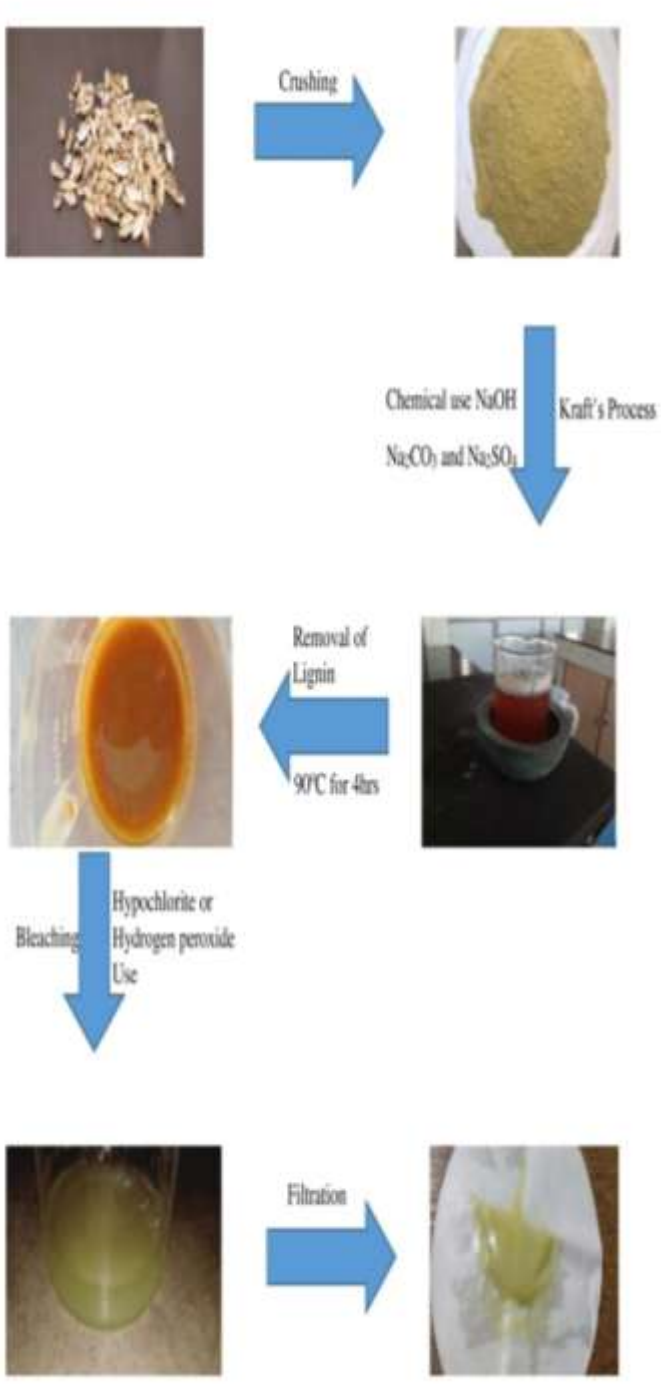


Fig.8 Process

6) Comparison of composition analysis in various raw materials:

Table. 2 Comparison of composition analysis in various raw material

	Bamboo		Soft wood		Hard wood		Ground nut shell	
	Available	Extracted	Available	Extracted	Available	Extracted	Available	Extracted
Lignin	25.30	5.30	28.00	5.90	20.00	3.90	30.00	4.80
Cellulose	47.20	46.00	42.00	28.00	45.00	38.00	44.00	27.20
Hemi cellulose	23.90	14.00	26.80	13.80	29.00	16.80	18.70	10.70
Extractives	2.20	1.30	3.00	1.00	5.00	1.30	3.50	1.90
Ash	1.40	0.50	0.20	0.00	1.00	0.30	3.80	0.80

Composition found in dry weight basis for various raw materials by production of cellulosic fibre. The table shows the percentage extraction of cellulosic fibre from bamboo, softwood, hardwood and groundnut shell. By Kraft's process cellulosic fibre extracted from bamboo and hardwood is more than 85%. The same thing extracted from groundnut shell also. Lignin is removed more than 95% by Kraft's process because lignin reduces the efficiency of paper production (Yuan – Yuan Bai .et.al 2013) (Sreejith M P et.al 2014) (XinZheng .et.al 2016)(Lillie Austen).

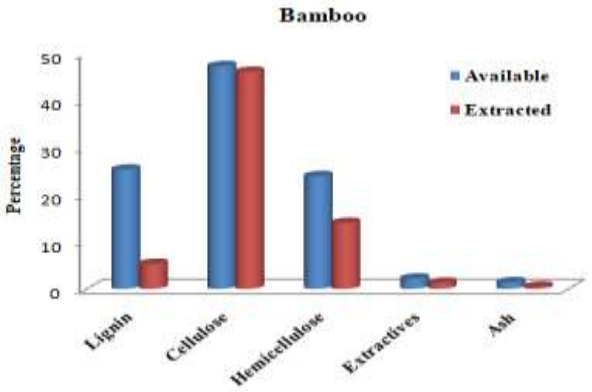


Fig .9 Bamboos

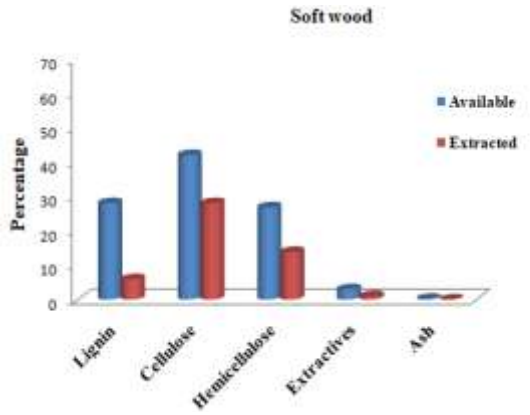


Fig. 10 Softwood

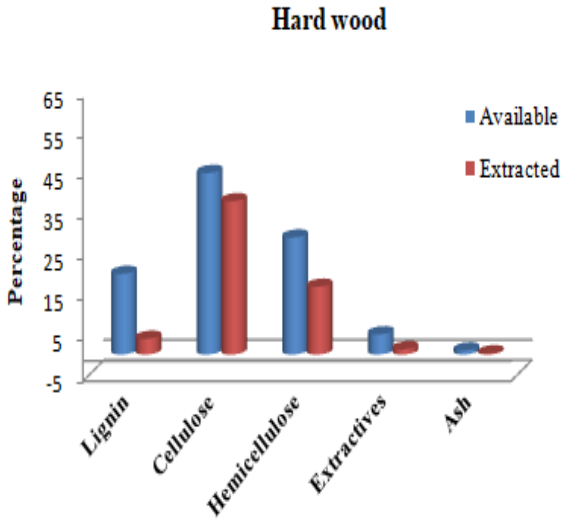


Fig. 11 Hard wood

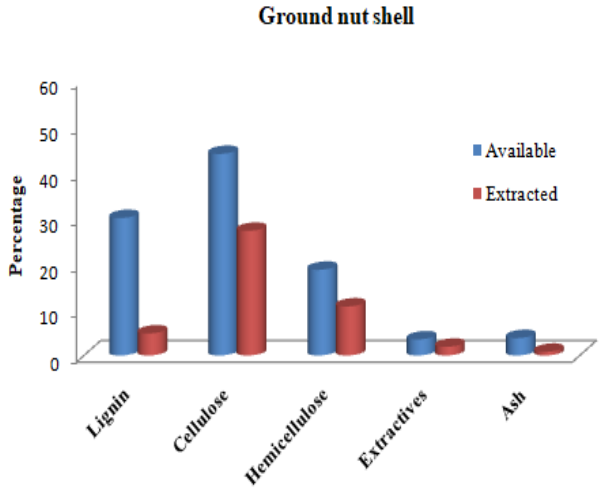


Fig. 12 Ground nut shell

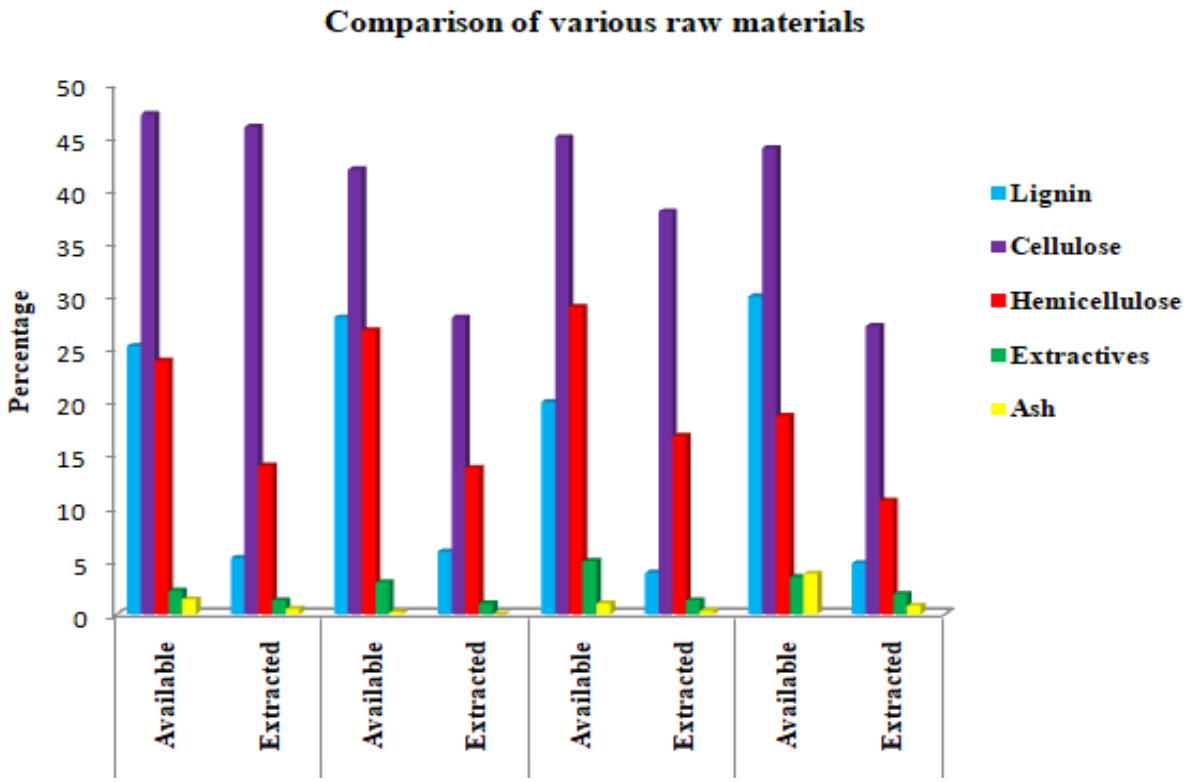


Fig. 13Comparison of composition analysis from various raw materials

IV. CONCULSION

From the study we observe that by Kraft's process lignin molecules broken more than 95% and needed cellulosic fibres extracted more than 85% from the available quantities in bamboo and hardwood. 76.18% cellulosic fibre extracted from groundnut shell. 8 gram of pulp was obtained from 20gram of groundnut shell. Groundnut shell results similar that of hard wood and bamboo properties so, we conclude that the groundnut shell also will help to produce pulp to manufacture paper.

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