SSRG International Journal of Applied Chemistry
ISSN: 2393 – 9133 /doi:10.14445/23939133/IJAC-V8I1P108

Volume 8 Issue 1, 34-40, Jan-April 2021

Production of Paper From Walnut Shells

Farheen Naaz , Syeda Naheed Fatima , Syeda Sameena Aziz

Department of Chemistry, Anwarul Uloom College, New Mallepally, Hyderabad, Ts, India

Received Date: 08 March 2021
Revised Date: 12 April 2021
Accepted Date: 25 April 2021

ABSTRACT:

The use of walnut shells as a raw material source for the manufacture of cellulose fiber products was elevated by the krafts process and soda pulping process. In recent years, with the growing shortage of wood from the forests, in many countries, the search for an alternative fiber-producing plant material has been initiated. Several types of experimental paper products were made from the unbleached and partially bleached pulps.

In the present work, we produced paper from walnut shells; these shells are found to be the most effective and alternative for cellulosic fiber in the future.

This method is eco-friendly and also helped in the management of solid waste for the production of paper.

KEYWORDS: *Walnut shells, krafts process, soda pulping, cellulosic fiber, paper.*

I. INTRODUCTION

Paper is a versatile material that has many uses. It is a thin material produced by pressing together moist fibers of cellulose pulp derived from wood, rags or grasses, and drying them into flexible sheets. Some common uses of paper are for writing, printing, packing, cleaning, decorating, and a number of industrial and construction processes and even as a food ingredient- particularly in Asian cultures. Paper and pulp papermaking is an ancient process that was developed in China during the early 2nd century; in the 13th century, the knowledge and uses of paper spread from China through the middle east to medieval Europe, where the water-powered paper mills were built.

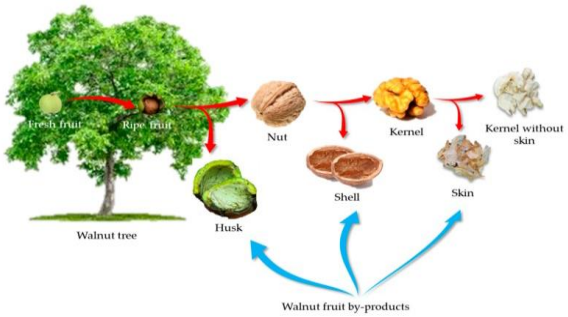
The production and use of paper have a number of adverse effects on the environment. Worldwide consumption of paper has risen by400% in the past 40 years, leading to an increase in deforestation, with 35% of harvested trees being used for paper manufacturing. Logging off old-growth forests accounts for less than 10% of wood pulp, but is one of the most controversial issues.

Thus the increasing demand for paper products has initiated a widespread search for fibrous raw materials other than wood. Secondary fibers, annual crops, and agricultural residues also offer possibilities to supplement wood as a raw material source for paper production and can reduce the cause of deforestation to some extent. As technology progresses in an evolutionary fashion, the pulp industry will have to learn to use raw materials that have not been used before. Walnut shells seem to offer one particular escape from the wood supply shortage.

WALNUT:

The walnut is an appreciated nut that belongs to the Juglandaceae family. It is widely cultivated due to edible kernels. In walnut production centers, a high amount of the shell as an agroforest waste products are discarded away. Recently, it has been demonstrated that the walnut shells could be valued as a source of paper production. This widely spread deciduous tree grows natively and commercially in Europe, Asia, and the eastern and southern parts of the united states for two primary purposes: quality timber and the nut containing the edible meat. In the rural areas of some countries, the hard shells are traditionally used as an energy source for heating purposes. The chemical composition of walnut shell fibres includes ash[3.4%], lignin[50.3%], hemicelluloses[22.4%] and cellulose[23.9%]. Due to greater quantities of hydrophobic components in walnut shells compared to wood, it has significant commercial benefits. The botanical definition of a “nut” is a fruit whose ovary wall becomes very hard at maturity.

Most of the external uses of walnut shell powder extend to skin issues. Walnut shell powder can also be used in cosmetics and also to treat skin conditions that occur as a result of fungal infection. Here the reason behind the selection of walnut shells as raw material is, after the nuts are removed, the shells are wasted. Tons of walnut shells are thrown away annually.



II. RAW MATERIAL

Generally, woods are of two types,

[i] Hardwood

[ii] Softwood

Wood from conifers is called softwood, and the wood from dicotyledons is called hardwood. Hardwood is not necessary to be hard, and softwoods are not necessarily soft; some softwoods are harder than many hardwoods.

These woods contain basically three materials in them. They are:

1] cellulose

2] ash

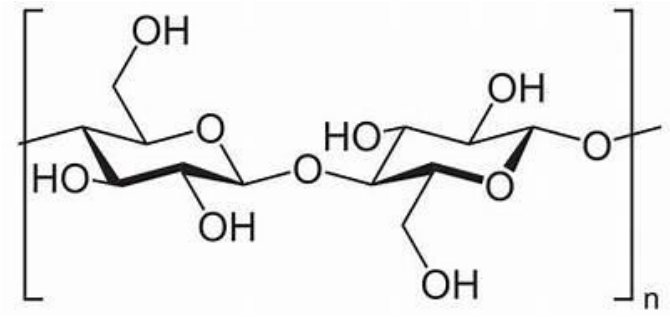
3] lignin

A. CELLULOSE:

The wood containing cellulose is mostly in the form of fibers.

After the pulping process, the cellulose fibers are obtained as pulp.

Cellulose fiber is a long chain of single monomer [$C_6H_{10}O_5$]



B. LIGNIN:

Lignin is a class complex organic polymer that forms key structural materials in the support tissues of vascular plants. Lignin is particularly important in the formation of cell walls, especially in wood and bark, because they lend rigidity and do not rot easily.

III. MATERIALS AND CHEMICALS USED:

*** Walnut shells**

*** Dried banana stem**

CHEMICALS:

*sodium hydroxide [NaOH]

*sodium hypochlorite [NaClO] / calcium hypochlorite [$Ca(ClO)_2$]

*sodium sulphide [Na_2S]

*sodium carbonate [Na_2CO_3]

SODIUM CARBONATE:

Sodium carbonate [Na_2CO_3] is a sodium salt of carboxic acid. Most commonly occurs as a crystalline heptahydrate, which readily effloresces to form a white powder, the monohydrate.

Sodium carbonate is domestically well known for its everyday use as a water softner. It can be extracted from the ashes of many plants. It is Synthetically produced in large quantities from salt and limestone in a Process known as solvary process.

SODIUM SULPHIDE:
sodium sulphide is the chemical compound with the formula Na_2S or more commonly its hydrate $Na_2S.9H_2O$. both are colourless water soluble salts that give strongly alkaline solutions. When exposed to moist air, Na_2S and its hydrates emit hydrogen sulphide, which smells like rotten eggs. Sodium sulphite have a yellow appearance owing to the presence of poly sulphides.

SODIUM HYDROXIDE:
It is also known as caustic soda. The molecular formula is NaOH and is highly caustic metallic base. It is a white solid available in pellets, flakes, granules and 50% saturated solution.

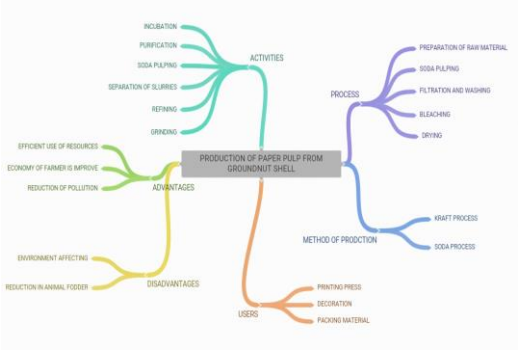
It is soluble in water, ethanol and menthol. Sodium hydroxide is used in many industries, mostly as a strong chemical base in the

Manufacture of pulp and paper, textiles, soap sand detergents, etc.

IV. PULPING

It is an important process of production of pulp using wood material which is a lignocellulosic material. [1]It is prepared by taking the various chemicals in their desired proportions so as to form a solution and then heating it at very high temperature to separate cellulose fibres from wood, fibre crops or waste paper for almost 3-4 hours.

FLOW CHART PRESENTING OVERALL PROCEDURE:



***A. METHODS OF PULPING*:**
Many processes came into existence for production of pulp from wood material in past decades. These methods work differently based on the quality of pulp obtained after the process and also based on their effeciencies and also the heat energy that is required for pulping process.

CHEMICAL PULPING-:

Chemical pulping is the process in which the pulp is produced by combining small pieces of walnut shells and chemicals in large vessels known as digester where heat and the chemicals breakdown the lignin, without seriously degrading the cellulose fibres. Chemical pulp is used for materials that needs to be stronger or combined with mechanical pulps to produce different characteristics.

V. EXPERIMENTAL PROCEDURE FOR PAPER PULP PRODUCTION

A. PREPARATION OF RAW MATERIAL-:
Initially walnut shells are taken and washed properly with water to remove dust particles present on it. The washed walnut shells are dried in sunlight and later it is crushed into small and tiny pieces into mortar with pistil. Then grind the small crushed pieces of walnut shells in grinder into fine powder.

B. KRAFT'S PULPING:

To prepare the cooking liquor, chemicals must be taken in right proportions, so that effective cooking would happen. The chemicals required in kraft's pulping are as following-

i] NaOH

ii] Na_2SO_4

iii] Na_2CO_3

These 3 chemicals must combine to give total of 12.5% by weight solution. In this 12.5% of solution, according to krafts pulping we took 58.6%NaOH, 27.1%Na_2SO_4 and 14.3% of Na_2CO_3.

But if we take basis as 1000ml solution of cooking liquor, then by taking 12.5% by weight we got 125 gms which was the total weight of all three chemicals required. Composition of solids given by weight % then we calculated the individual weight of chemicals required, they were:

NaOH weight = 0.586 x 125 = 73.25gms

Na_2SO_4 weight = 0.271 x 125 = 33.875gms

Na_2CO_3 weight = 0.143 x 125 = 17.875gms

Take the 3 chemicals after weighing in a clean and dry standard flask of 100ml. Add some water to it and all the 3 chemicals into a standard flask. Dissolve well and make the volume upto the mark. Shake well for uniform concentration.

C. DIGESTION:

Once the cooking liquor was prepared we took 250ml of it separately in a 500ml beaker to which 5gms of raw material was added and the level was marked. The reason for marking the level is-

- Firstly it would serve as the heating medium for the digester.
- Secondly, once the steam exchanges heat with the cooking liquor and the raw material, the water present in the cooking liquor evaporates due to increase in temperature difference. Then the initial concentration of the cooking liquor is not maintained which would result in weak cooking, so if stem is used, it condenses into the cooking liquor after exchanging heat, thereby maintaining the concentration of the cooking liquor.

If heat continuously supplied, the water present in the cooking liquor evaporates there by initial concentration of the liquor is varied. So to bring back the initial concentration we added water upto the marked level in the beaker. Throughout the process of digesting care should be taken. The heat is supplied by means of a hot plate for about 5hrs 30 minutes at a temperature of 90 degree Celsius. Continous stirring throughout the process is

necessary. So it is convinent to use magnetic stirrer with hot plate.

In the process of digestion the strong basic cooking Liquor and the action of heat combine and help breaking the bonds in lignin molecule. The broken lignin molecules dissolve in cooking liquor there by turning it into dark brown colour called as black liquor and cellulose remains unaltered which is present in the cooking medium as brown stock along with traces of lignin.

D. SODA PULPING:

Soda pulping is the process in which, 40% by weight solution of NaOH is required as cooking liquor. Take 400 grams of NaOH and dissolved in water and make upto 1000 ml to give required concentration of cooking liquor. After cooking liquor is prepared, 5 to 7grams of raw material is taken in 800ml of Cooking liquor in 1000ml beaker and the level is marked. It is necessary to makeup the mark with water to maintain the concentration as already described above in kraft's process which we performed even the same temperature and time for heating should be maintained as in kraft's process.

E. FILTRATION AND WASHING OF PULP:

After the process of digesting, brown stock and black liquor are formed. The brown stock contains pulp and small amount of lignin which gives brown

colour to it and the black liquor contains the dissolved lignin and cooking chemicals which can be recovered. Then the mixture is filtered using a cloth [muslin cloth is preferable] to obtain black liquor as waste that Contains cooking chemicals which can be recovered. One time filtration is not enough. So we did filtration of it in another beaker once again. After filtering twice we washed it with water to let lignin and chemicals associated with the brown stock to dissolve in it completely. We washed it again and again with 1000ml water to reduce the lignin content by 5 times.

After that we got a good filtered form of it. Finally, the product obtained has less lignin content in it.

***F. BLEACHING*:**
Once we are done with filtration and washing we took the pulp which was collected on a cloth after filtering and dissolved the washed pulp in 200 ml of water to which 7 grams of bleaching powder was added to completely remove the brown Colour to obtain white grade pulp. Here we used calcium hypochlorite as a bleaching agent, you can also use sodium hypochlorite in place of calcium hypochlorite.

A.


B.


C.


A. Pulp collected on a cloth after filtering; B. Dissolved the wasahed pulp in 200ml water; C. Bleaching powder added to remove brown colour

G. DRYING:
To find out the yield, we removed the entire water from above using boltman filter paper. And to remove the remaining entire water content from the bleached pulp, it is dried at a temperature of 120 degree Celsius for one hour, in a hot air oven by

spreading the thin layer of pulp on a borosil petri plate or on a watch glass. Below are the pictures of drying process.

VI. PAPER FROM PULP

Once the process of drying is completed the pulp is ready. It is then used to make paper in a process that is quite similar to the process first used by ancient Chinese more than 1900 years ago. We sprayed the pulp mixture onto a flat and smooth surface to make a layered mat. The mat of pulp is then heated to remove water and then dry it out. When the paper has the desired thickness, it may be coloured or coated with special chemicals to give it a special texture, extra strength or water resistance. We got a wrapping paper.

VII. RESULT AND DISCUSSIONS

Firstly we require only 5hrs 30minutes in kraft's process to break lignin molecules completely.

Secondly kraft's process consist of strong cooking liquor which can break lignin more effectively where as soda processes consist of weak cooking liquor. Because of this reason we can find the traces of lignin is more in soda process than in kraft's process.

We compared the products from the two processes and got the conclusions. The pulp obtained in kraft's process is less dark in colour as it contains less lignin content in it due to strong basic nature of the solution which break the lignin bonds. Soda process involves weak basic cooking liquor that acts weak in breaking lignin bonds.

VIII. CONCLUSION

After experimenting and observing the process the following , Conclusions are listed below. They are:

1. Though soda process requires only one chemical but in more amount. But soda pulping does not help in complete breakage of lignin bonds. On the other hand kraft's process requires different chemicals but in fewer amount and the lignin breakage is also proper from this we can conclude that krafs process is more advantageous.

2. In terms of heat requirement kraft's process is more advantageous is able to break and dissolve the lignin in it soda process is supplied with heat for one hour or more and still the cooking liquor could not effectively break the lignin.

3. Pulp obtained from washing is added with bleaching agent. the amount of bleaching agent required is more in soda process when compared to kraft's process. So, the pulp obtained in kraft's process can be used for high grade pulp for paper production and that obtained for soda process for low grade paper production. But as we are interested in making wrapping paper, so the pulp must be entirely lignin free because it acts as an impurity and may vary the conditions of the packed material. By this we conclude that Kraft process is convenient and safer.

4. Thus after the production of paper, after pulping we conclude that Kraft's process is more advantageous than soda process and the quality of paper is also good as compared to kraft's process.

5. Experimental results obtained for pulp production show that this agricultural residue has the potential to be used for

REFERENCES

[1] Production of paper from shells, Upendra Kadre, Akshay Talekar, Vedika, Hatekar, Dhanashree Kachhawada, Prathamesh Shete, Prof. Vivek Nagnath, Vishwakarma institute of technology, Pune [India].

[2] Production of paper from groundnut shell, T.Goswami, Pipul Kalita and PG Rao, Northeast institute of science and technology [CSIR].

[3] Manufacture of pulp extraction to produce paper from groundnut shell, Adhiyamaan College of engineering, Tamil Nadu, India.

[4] A study on production of pulp from groundnut shells by YN Ramgopal, M Reshma Chowdary, V Chaitanya.

[5] http://www.meritnation.com/ask-answer/question/how-to-make-a-piece-of-paper/work-and-energy/9401849.

[6] http://www.paperonline.org/paper-making/paper-production/pulping.

[7] http://en.m.wikipedia.org/wiki/paperinformation.

[8] A comprehensive review on the chemical constituents and functional uses of walnut husk by Ali Jahanban- Esfahlan, Alireza Ostadrahimi, Mahnaz Tabibiazdr and Ryszard Amarowicz, 2019Aug; 20[16]: 3920.

[9] http://www.ijser.org/.