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RESEARCH ARTICLE

THE STUDY OF PHYSICAL PROPERTIES OF THE EUCALYPTUS CELLULOSIC PULP PRODUCED BY THE KRAFT PROCESS ON WOOD SPECIES

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ABSTRACT

The cellulose Morocco Produces about 125,000 tons / year of bleached eucalyptus pulp chlorine-free (ECF) depending on Kraft process of cooking (soda + sulfide), the oxygen bleaching and chlorine dioxide. The eucalyptus wood are Composed of other macromolecular chains of cellulose origin (these macromoleculars are Formed by the repetition of monomer units of the cyclic glucose type. The junction has its effects by the removal of water) associate fibers which are interconnected to each other by in an amorphous way by hemicellulose and lignin. Our work is to study, on the one hand, the effect of the increasing sulphidity at the level of boil on the physical properties of the bleached pulp, and on the other, the impact of the increased refining time of the unbleached pulp on the same the physical properties. This is done to the two different species of wood namely: The ROSTRATA species which gives more opacity and volume to the pulp. The latter is preferred in industries manufacturing all kinds of paper used for printing, writing or hygiene. The GRANDIS species giving more strength to the pulp is rather used by manufacturers of packaging papers

INTRODUCTION

The best known natural polymers originally extracted from vegetables are rubber, starch, glycogen, dolichol and cellulose, the latter is the component that provides protection and support in plant organisms. It is located in the cytoplasmic membrane of cells and is the most abundant organic substance in nature. Indeed it is estimated that a tree produces about 10g of cellulose per day and at the global scale, the production is around 1,310 10 tons per year. (Sjöström Frenger, 1994) .The cellulose which is the raw material for the manufacture of paper pulp is constituted by a sequence pattern of β-D glucopyranose linked by anglucosidic β link (1-4). The second major component of wood, which is the hemicellulose, is a polysaccharide consisting of hexosans (especially mannans) and pentosans (xylans above) which are incorporated into the cellulose chains. The third major component of wood lignin is an amorphous and crosslinked polymer of phenylpropanes units. It is the link between the cellulose fibers. The manufacturing process of the paper paste is achieved by the isolation of cellulose fibers, wood boiled with soda to make the lignin soluble in alkali milieu.

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The presence of the latter may split the cellulosic channels and make their features weaker. In addition, certain kinds of sugar, such as galactose, mannose and xylose which are incorporated in the chains may cause additional fragility especially by the presence of xylose. (Nevell and Zeronian, 1985).

CHEMICAL CONSTITUENTS OF WOOD

The proportions of the three major components vary according to different types of wood. Hardwoods are generally richer in cellulose but their lignin contents are lower than softwoods. Cellulose is the main component of the wood (Figure 1). It is a homogeneous and linear polymer, consisting of about 10,000 cellobiose units (the pattern formed by the molecules of β-Dglucose). The cellulose chains are oriented in parallel to each other, forming micro fibrils and then fibril. Hemicelluloses are polysaccharides (Figure 2) of a low degree of polymerization (200-500 units). The chains are not linear. There is a wide variety of hemicellulose composed of various sugars (oses) (monosaccharides), such as pentoses (xylose, arabinose) that are found in large amounts in hardwoods.

Hemicelluloses are much easier to degrade than cellulose. They are characterized by their ease of hydration, which makes all the fibers swell easily.

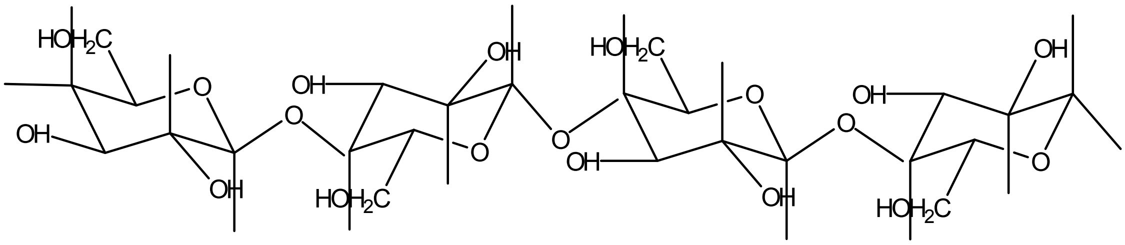

Figure 1. cellulose Formula (Presentation in perspective) (ANNIK VEZZIER, 1996)

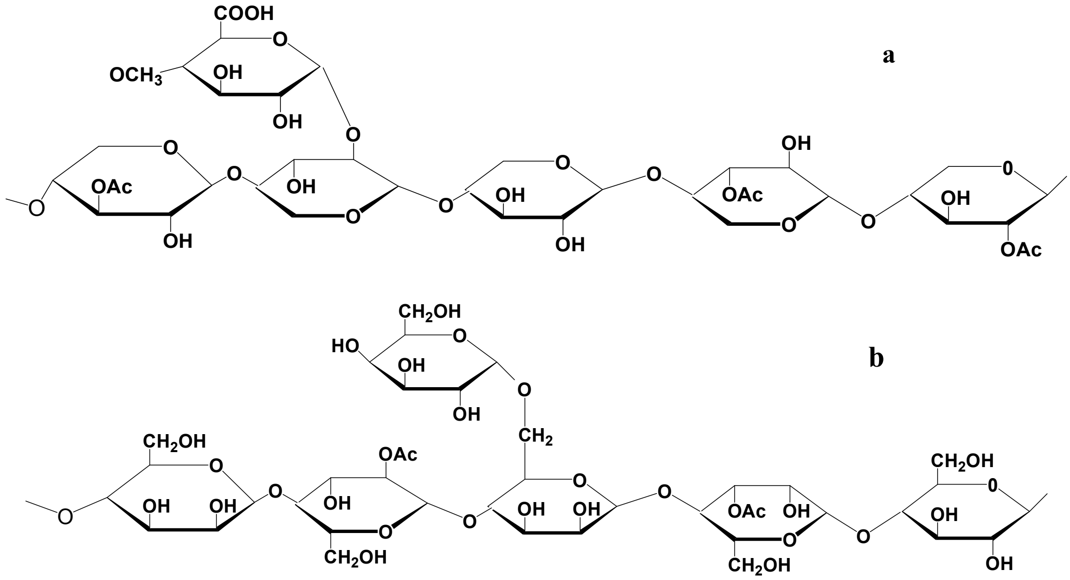

Figure 2. Structure of the main types of hemicelluloses found in wood (ANNIK VEZZIER, 1996)

a: O-acetyl-O-methyl-4-glucoronoxylane
b: O-acétylgalactoglucomannane

Lignin is the third major component of plants. It is an amorphous and crosslinked polymer of phenylpropane units (Figure 3). This molecule contains aromatic compounds substituted by hydroxyl groupings (OH) and methoxyls (OCH3). Lignin is mostly found around the fibers and in primary fiber wall. It is the cement of the fibrous tissue. This polymer is heterogeneous by the nature of substituents of the monomers and the inter-monomère linkages. In wood, lignins are related to polysaccharides. Lignins of softwood practically consist of only gaiacylpropane patterns (G) while those of hardwoods consist of gaiacylpropane patterns (G) and syringylpropane (S).

MATERIALS AND METHODS

According to the Kraft process, this study is to conduct wood boiling: (Rostrata and Grandis) in different sulphidities (0,10,20 and 30%) to assess the influence of sulfides on the quality of the produced paste. This research is undertaken in a test laboratory equipped with a set of semi-pilot aircraft (digester, disintegrator, classifier (photo 4), the unbleached paste from boils and then bleached. Then we carried out measurements of the physical characteristics of both types of pastes (the bleached and the unbleached).

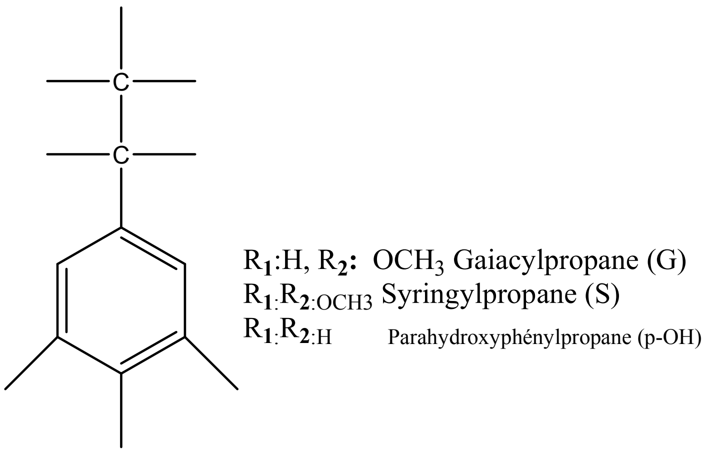

Figure 3. Structure of lignin monomer (ANNIK VEZZIER, 1996)

Figure 4. Disintegrator (ADAMEL LHOMARGY)

Step of semi-pilot boiling

Preparation of shavings

Wood shavings should be homogeneous in terms of size that should be standard. The large and too small shavings are excluded by putting the set in a classifier.

Preparation of the liquor of the boil

The white liquor of the boil is taken of the production circuit. We determine its concentration in active alkali and sulphidity.

Weak black liquor

This liquor is also taken from the production circuit. It is low in active alkali and it serves to bring the relation liquid / wood to 4, which is the major boiling condition.

The boil start

We initially had to determine the load in active alkali in relation to dry wood for each species of wood in order to obtain approximately the same kappa (boiling degree) for all types of boils. This kappa should be 16 ± 1 units.

The paste's characterization technique

Disintegration: ISO 5263

The paste sample undergoes a mechanical treatment in water, so that the interlaced fibers, which were dispersed in the suspension of the paste, are again separated from each other without substantial changes in structure.

Figure 5. DynamometreAdamel LHOMARGY type – DM No. 01 in 1389

Length and Rupture Index (ISO 1924-1, 1994)

The testing machine is designed to stretch a specimen of given dimensions to a constant and appropriate gradient of elongation and to measure the tensile strength and the produced elongation as well.

Resistance to wrench (wrench Index)

The average force required to continue the wrench caused by an initial cut in a sheet of paper is expressed in millinewtons (mN). This facilitates the measurement of the wrench index (WI). Maximum pressure uniformly distributed is supported by a single paper sample perpendicular to its surface under the conditions of the test.

Figure 6. DechiromètreAdamelLHOMARGY- ED 01 model # 518

Resistance to bursts (Burst Index)

Maximum pressure uniformly distributed is supported by a single paper sample perpendicular to its surface under the conditions of the test.

Figure 7. ÉclatomètresAdamel LHOMARGY 05.1 EC # 271 B

RESULTS AND DISCUSSION

In this study, we evaluated the influence of sulphidity for both types of wood (Rostrata and Grandis) on the performance, the bleaching and the physical characteristics of the unbleached paste. As to the bleached paste, we studied the influence of this sulphidity on the consumption in chemical products and on the bleaching.

Table 1. Variation of different parameters according to sulphidity

Sulphidity %	A.A. Resid. g/l	Poids Brut g	Siccité %	Poids Sec	Rend %	P. Classifiedg	unboiledg	unboiled %	Kappa %	Bleachiso
0	9.7	3466	26.0	901	48.15	830	7.90	0.95	17.6	15.8
10	8.4	3216	25.0	804	47.90	722	6.87	0.95	16.1	21.5
20	9.1	3406	22.7	773	46.90	708	4.63	0.65	15.7	21.8
30	8.5	4456	19.8	882	46.50	750	5.50	0.73	16.0	22.5

Table 2. Variation of different parameters depending on sulphidity

Sulphidity %	A.A. Resid. g/l	Gross Weightg	gross Weight %	outputg	Rend %	P.Classifiedg	unboileg	Unboiled %	Kappa	Blanchiso
0	10.2	6220	20.5	1275	63.75	1090	40	3.67	23.2	18.6
10	05.8	5783	19.8	1145	57.30	1060	4	0.38	16.0	24.7
20	05.2	5972	19.0	1134	56.70	909	5	0.55	15.7	25.0
30	05.9	5092	21.8	1110	55.50	970	5	0.51	15.6	25.5

Influence of sulphidity (Wood / Rostrata)

The results of Rostrata wood boil of different sulphidities (Table 1) allow to conclude the change of various parameters at different sulphidities. We find that the more sulphidity increases, the more brightness increases and efficiency decreases. This is explained by the fact that at a low sulphidity, there is lignin which increases the output of fibers and decreases the brightness. While at zero sulphidity, the kappa and high residual alkali are indexes of bad delignification (bad boil).

Wood / Grandis

The results of wood boiling grown at different sulphidities (Table 2) show the variation of different parameters at different sulphidities. We note that the same phenomenon observed in Rostrata wood boiling occurs for the Grandis wood. The more the sulphidity increases, the more brightness increases and the output decreases. As to the difference between the two types of wood (Grandis and Rostrata) lies in the fact that the performance and whiteness of Grandis wood are higher than those of Rostrata, which is due to the presence of more cellulosic fibers with a degree of high polymerization and less lignin.

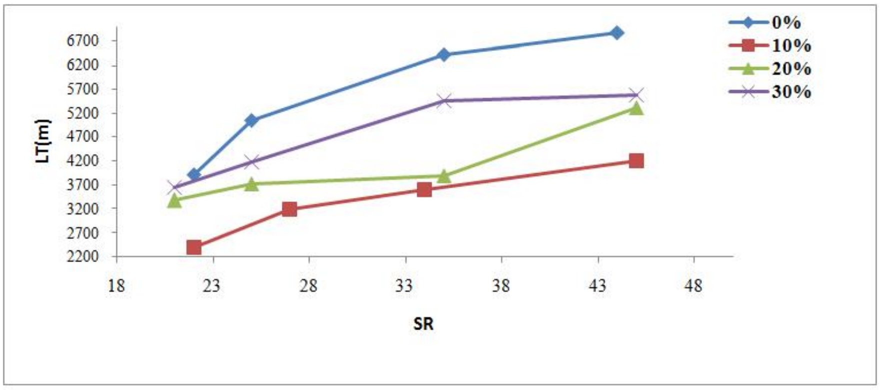

Figure 8. Evolution of the R.L according to sulphidity with different Schopper degrees

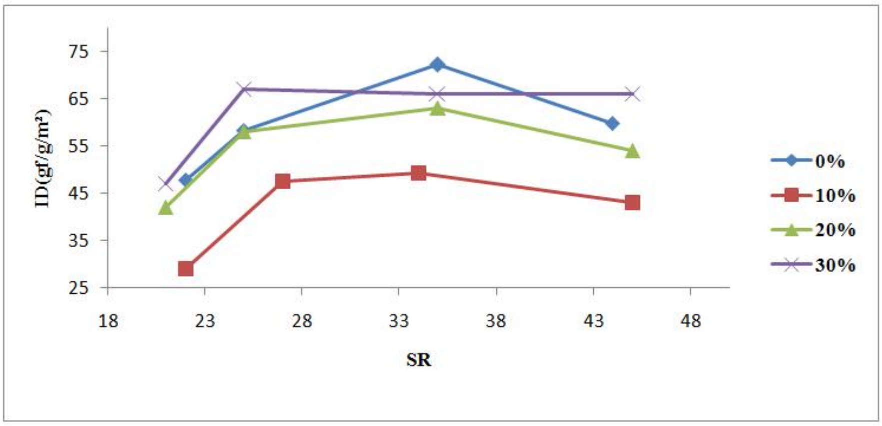

Figure 9. Evolution of ID according to sulphidity with different Schopper degrees

WOOD ROSTRATA

Mechanical properties

Rupture length (R.L.)

The rupture length values for different sulfidities with different Schopper degrees are represented in Figure 8. We find that the rupture length evolves in upwardly by increasing sulphidity from 10% to 30% except for the values at 0% sulphidity where we see a significant increase which is explained by the fact that there is still the presence of lignin.

Wrench index (I.D.)

Figure 9 shows the values of the wrench index for various sulfidities with various Schopper degrees. We observe an increase in the wrench index from 10 to 30% of sulphidity, with a significant increase in this index of 0% sulphidity; this is due to insufficient delignification which is also due to the absence of sulphur, hence a high resistance to wrench.

Burst index (B.I.)

Figure 10 shows the values of the burst index for various sulfidities with different Schopper degrees. From the results obtained, we see the same phenomenon of evolution as that observed in the WL and ID, namely an increase in B.I from 10 to 30 of sulphidity with a higher ID of zero sulphidity. So we conclude that the mechanical characteristics LR, ID and IE evolve upwardly when we increase the sulphidity from 10 to 30%

OPTICAL CHARACTERISTIC

Hand (H):

The values of the hand for different sulfidities with different Schopper degrees are represented in Figure 11. The Hand, which is an optical property that refers to the inverse of the density, increases according to the The Hand, which is an optical property that refers to the inverse of the density, increases according to the sulfidityincrease, except for 0% where we see higher values which are always due to poor delignification.

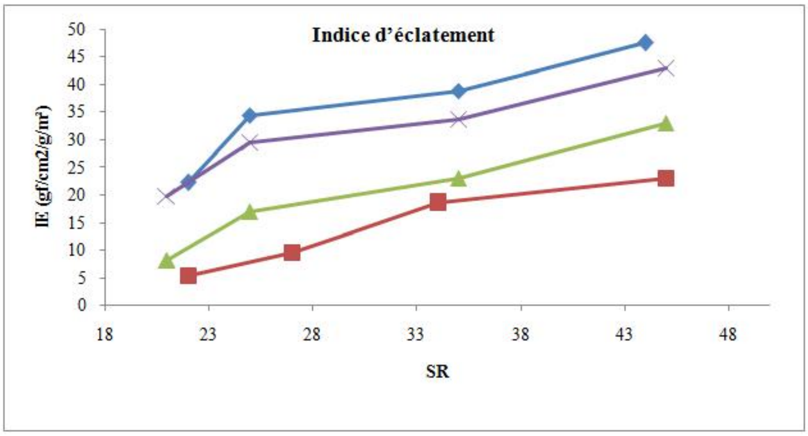

Figure 10. Evolution of the B.I. according to sulphidity with different Schopper degrees

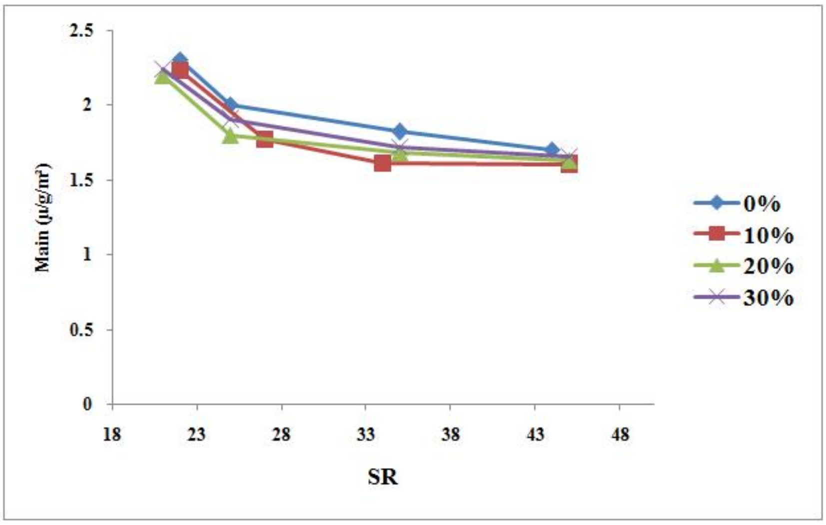

Figure 11. Evolution of the hand according to sulphidity with different Schopper degrees

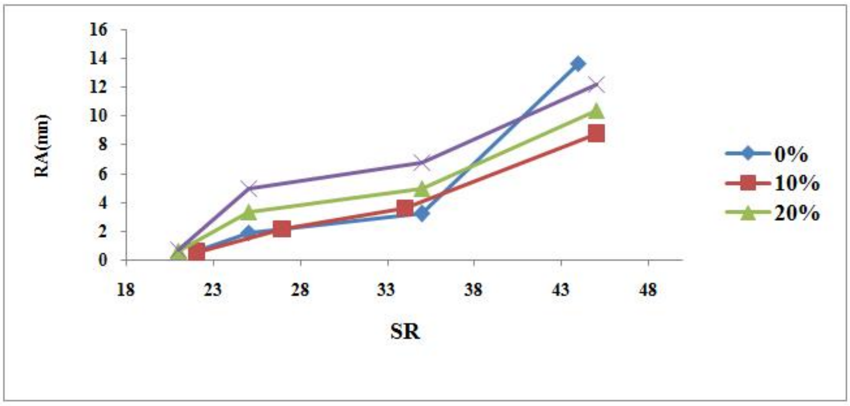

Figure 12. Evolution of AR according to sulphidity with different Schopper degrees

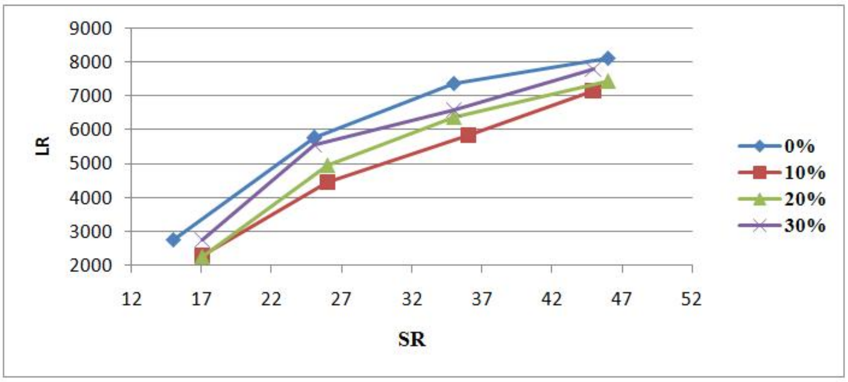

Figure 13. Evolution of R.L. depending on sulphidity with different Schopper degree

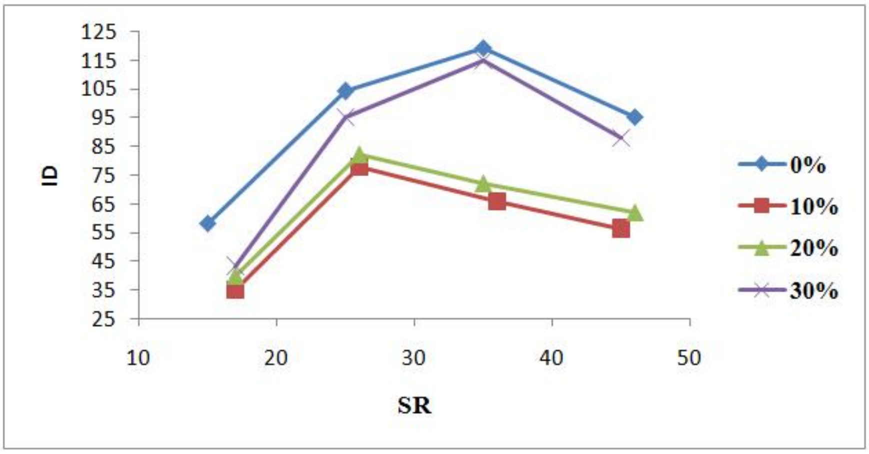

Figure 14. Evolution of the WI of sulphidity with different Schopper degrees

PERMEABILITY

Air resistance (A.R.)

Air resistance values for different sulfidities with different Schopper degrees are shown in Figure 12. We find that air resistance (characteristic of permeability and absorption) follows the same evolution as the previous features for sulfidities from 10 to 30% and takes random values for 0% sulphidity.

MECHANICAL PROPERTIES (GRANDIS WOOD)

Rupture length

The rupture length values for various sulfidities with different Schopper degrees are represented in Figure 13. We notice a rupture length increase from 10 to 30% of sulphidity, and we also see a remarkable increase in this parameter of 0% sulphidity.

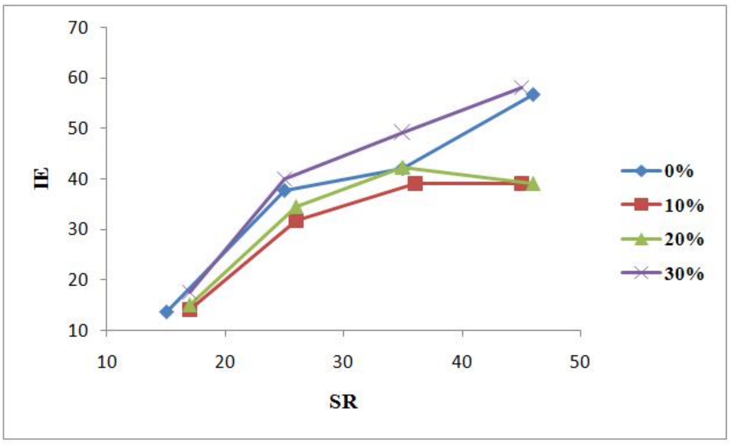

Figure 15. Evolution of B.I. according to sulphidity with different Schopper degrees

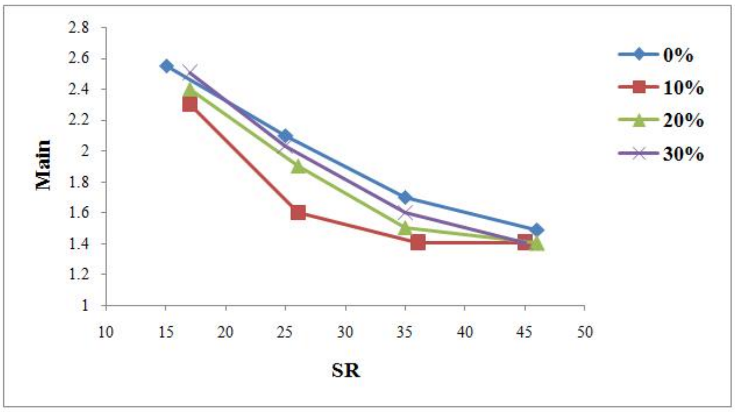

Figure 16. Evolution of the hand according to sulphidity with different Schopper degrees

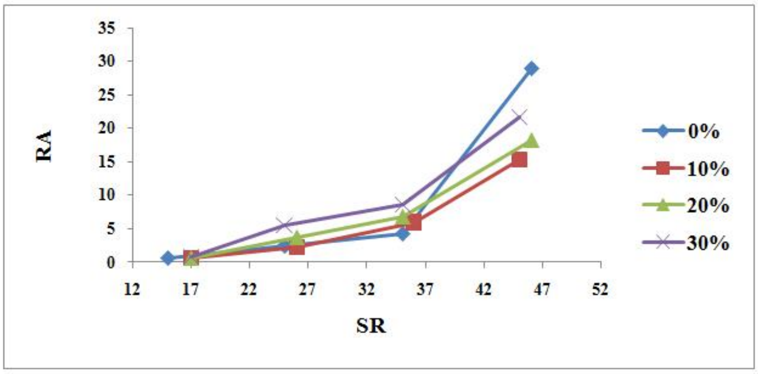

Figure 17. Evolution of A.R. according to sulphidity with different Schopper degrees

Wrench index (I.D.)

The wrench index values for various sulfidities with different Schopper degrees are shown in Figure 14. By analyzing the WI curve, we see an increase in this index from 10 to 30% of sulphidity except for 0% sulphidity where we obtained a remarkable increase.

Burst index (B.I.)

The values of the burst index for different sulfidities with different Schopper degrees are represented in Figure 15.

After analyzing the curve of BI, we note that at 0% of sulphidity there are fluctuations in comparison with the other mechanical properties, while in the sulfidities of 10, 20 and 30% we see an increase ranging from 10 to 30 %.

OPTICAL CHARACTERISTIC

The Hand (H)

The hand values for the different sulfidities with different Schopper degrees are represented in Figure 16.

The hand refers to the ratio of the thickness in microns to the leaf mass in g / cm ^{2} Hand = E / F E: thousandth of a millimeter in thickness and F: force of the leaf in g / m ^{2} We find that the more we increase the sulphidity, the more we get a better hand except for 0% where we have higher values

PERMEABILITY

Airresistance

The values of resistance to air for different sulfidities with different Schopper degrees are shown in Figure 17. We note that air resistance increases according to sulphidity of 10 to 30% except for the 0% sulfidity where air resistance takes random values. From the obtained results of the different physical characteristics of Grandis wood, we notice that the same observed phenomenon in Rostrata wood is produced once again in Grandis wood with slightly higher values.

Conclusion

The sulphidity plays an important role in improving the physical characteristics of the pulp.

In fact, the addition of sodium sulphurs in the liquor's boil increases the rate of delignification without degrading cellulosic chains. HS ion concentration must be maintained at higher levels throughout the boiling process on the one hand, and these ions emanate OH ions on the other hand in order to maintain the pH at its level, and to avoid the reprecipitation of the dissolved lignin.
Therefore, the optimum sulphidity, in order to get a better quality of pupl, should be around 30%.

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