SOME INVESTIGATIONS ON ASAM PULPING METHODS OF EGYPTIAN CASUARINA GLUCA

A thesis

Submitted in Partial Fulfilment of the Requirements of

M.Sc. Degree in Chemistry

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1994

SOME INVESTIGATIONS ON ASAM PULPING METHODS OF EGYPTIAN CASUARINA GLUCA

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ii) Pericyclic reaction mechanism.
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6- Advanced studies in aromaticity.
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SUMMARY

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Besides unsatisfactory selectivity of the delignifying action, the main drawbacks of the conventional acidic sulfite and kraft pulping processes are their noxiousness to the environment and their difficulty to bleach with chlorine free sequences. Progress in the pulp industry is integrated at present mainly by environment protection reasons, causing the initiation of many improvements to existing processes or to the investigation of new pulping techniques. ASAM, Alkali Sulfite pulping reinforced by addition of Anthraquinone and Methanol, is a new pulping process and represents the possibility of extending the delignification level of lignocellulosic materials without deterioration of the strength properties of the pulps. The cooking liquor in ASAM pulping consists of Na_2SO_3 supported by either NaOH in ASAM I, or Na_2CO_3 in ASAM II, in addition to a catalytic amount of anthraquinon, an appropriate charge of methanol, and water. In the current literature, it was found that ASAM cooking liquors could delignify different soft-, hardwoods and annual plants selectively to low residual lignin content and the produced pulps are very strong and offer excellent prerequisites for full bleaching with chlorine-free compounds.

The aim of this study is to determine the optimum pulping conditions to produce ASAM pulps from Casuarina gluca with low rest lignin content, satisfactory yields and desirable papermaking properties. Casuarina has been chosen for this study beacuse it is an important genus of trees in Egyptian forestry and has not been yet investigated in the

literature. After determining the optimum methanol charge and optimum cooking time the effect of varying the chemicals% and alkali ratio on kappa number, yield, pentosan content, alkali resistance and papermaking properties of ASAM I and ASAM II Casuarina pulps has been investigated. Similar studies have been also carried out on ASAM pulps obtained by mixing different amounts of NaOH and Na_2CO_3 as supporting alkalis for Na_2SO_3. Kraft pulps have been also studied for comparison. It was found that the ASAM process is a versatile process which gives many possibilities for a wide range of pulp varieties by using either NaOH or Na_2CO_3 or a mixture of both or by using different alkali ratios or chemical charges, whereas the chemical composition of the pulp will be influenced, therefore its properties. Moreover, delignification, total and screened yields in ASAM pulping are superior to kraft, but the rejects are fairly high. Papermaking properties, such as breaking length, burst factor, folding and brightness, of the different ASAM alternatives are higher than in kraft pulp, whereas the tear factor of kraft is intermediate between ASAM I and II

INTRODUCTION

1. INTRODUCTION

Pulp and paper industry represents one of the most important and interesting industries, because it is founded upon reproducible natural resources and creates a product, without which the advance of civilization would be impossible. This industry deals with the processes of converting the plant fibres into useful pulp and paper products. In the past, the establishment of pulping processes required basic understanding and creative thinking from the scientists, and nowadays, the scientists are forced to search for innovative solutions for the serious problems associated with this industry : How to produce more and better pulp and paper from the available sources at the lowest possible cost and least environmental pollution ? The appearance of these problems is a healthy sign and does not indicate that the old facts are wrong, but it means that so many new facts have emerged on the surface, and also ensures the progressive interest in change.

The global production and consumption of chemical pulp is increasing enormously so that by the year 2000 the world may need four to five times as much paper as in the last twenty years (1). Therefore, serious studies on the source of fibres are required, extensive efforts are needed to utilize the present supplies as effeciently as possible and to seek other fibre sources. Also, the pulping processes have to be modified and renewed so that the pulps produced can fulfill the requirements of the market and consumer.

In the following the lignocellulosic sources and some pulping processes used in paper industry will be discussed.

1.1. Lignocellulosic Raw Materials for Pulp Products

The coniferous species of wood (softwood) was thought to be the best raw material for paper pulp . At present, other wood species, such as broadleaf wood (hardwood), grasses and other small fibre plants (annual plants), are being successfully employed in ever-increasing amounts. It should be understood that the designation soft- and hardwood are used to distinguish two different botanical classes of wood with different anatomical characteristics, and are not otherwise accurately descriptive (2). Although the fibres of nonwoody plants are much smaller than those of softwood (1-2 mm compared to 2-5 mm) some nonwoody plants ,(e.g., bagasse), are excellent fibre sources for paper industry (3). However, the principal factors that determine whether a plant shall or shall not be used in the manufacture of paper are : Suitability of fibre, dependability of supply, cost of collection, transportation and preparation, and tendency to deteriorate in storage (2).

Lignocellulosics, like wood and annual plants, represent a complex heterogeneous product of nature made up of interpenetrating components of high molecular weight. Plant cells are composed of cellulose (40-50%) and hemicelluloses

(20-35%) bound together by lignin (15-35%). On this matrix is deposited a mixture of low molecular weight compounds called extractives, i.e., solvent soluble substances (3-10%) (4).

Cellulose, in the strong and durable form of elongated tubular fibres, is the basic substance of paper. In paper manufacturing the fibrous portions of plants are reduced to pulp by chemical or mechanical actions, which remove the material that holds together the walls of the neighbouring cells (2). Because of the high molecular weight of cellulose, hemicellulose and lignin, it is normally impossible to separate them in quantitative yield without alteration and degradation of their structure. The similarity between many of these components and the physical and possibly chemical bonding between them also contribute to the difficulty of separation of the wood components (5).

A knowledge of the cellular structure of wood is of value to the pulp chemist since the anatomical structure of wood has an important influence on the penetration of liquids in pulping, and affects the course of pulping reactions (3).

1.2. Anatomical Structure of Wood

The cell walls of a mature plant cell contain aggregated chains of cellulose in the form of long, threadlike fibres (microfibrils). The cellulose microfibrils are embedded in a matrix composed mainly of hemicellulose and lignin. The dimensions of microfibrils are not uniform. The cellulose molecules are highly ordered in the crystalline areas and less ordered in the amorphous or paracrystalline regions, a property which affects the accessibility of cellulose towards chemical reactions (6).

There are several layers of cell walls in the plant cell. The primary wall contains a randomly and loosely organized network of cellulose microfibrils. Below the primary walls is the secondary wall consisting of three layers that have different thicknesses and cellulose microfibril orientations.

Between the cells is the compound middle lamella, which contains mainly lignin and pectic substances (4).

1.3. Chemical Composition of Wood

1.3.1. Non-cell wall substances

a. When wood is extracted with neutral solvents such as cold water, alcohol, benzene, ether, acetone....etc.,3-10% of the wood substance dissolves. This fraction, termed extractives, is composed of many organic compounds (although no one wood species has all) such as low molecular weight carbohydrates, terpenes, aromatic and aliphatic acids, alcohols, tannins, colour substances, proteins, phlobaphenes, lignans, alkaloids and soluble lignins(4).