1. INTRODUCTION

1.1. The properties of paper pulps:

The "Paper Dictionary" defines paper as being "all kinds of matted or felted sheets of fiber.... Formed on a wire screen from water suspension"[1].

The properties of paper pulps are determined, among other things, by their content of cellulose, lignin, hemicellulose and the dimensions of the fibers themselves. The hemicellulose fraction is of considerable importance in papermaking. As a general rule, the greater the hemicellulose content, the faster will be the pulp respond to beating, the harder and denser will be the resultant paper, the higher will be its bursting strength and tensile strength and the greater will be its transparency.

In glassine and greaseproof papers, the highest possible amount of hemicellulose should be present in order to produce very dense and hard sheets with good transparency, while in case of facial tissue, the fibers are of low hemicellulose content, with soft feel and little bonding. These are two extremes of paper grades. In between there are other grades as paper towels, blotting, and soft type printing paper on the soft side, wrapping papers in the medium range, and strong bond papers on the hard side. A low lignin content is generally required. However, the complete removal of lignin may result in considerable loss and degeneration of cellulose. Thus, it is desirable to leave as much lignin in the fiber as can be tolerated. Sometimes the presence of lignin is desirable. In paperboard, it contributes stiffness to the product, while in hardboard, it acts as resin, thus, making the product extremely hard and dense.

From what has been mentioned above it is claimed that it differ considerably in their specifications according to the purpose intended in their use. It must be mentioned however, it is impossible to establish definite standards, since the source and type of raw material play an important role. In softwoods, for example, the principle cell of fiber elements are the tracheids, frequently mistakenly referred to as fibers. Tracheids are highly elongated lignified cells having an average length of about 3-5 mm. and an average diameter of 0.03 mm. hardwood are more complex in the variety of cell components. They contain two principle types of cells, wood fibers and vessel elements. The wood fibers, which are the predominating cell type, and are represented by long schlerenchymatous cells, bast fibers are elongated thick walled fibers, having an average length slightly over 1 mm. And an average diameter of about 0.02 mm. The vessels are relatively short in length, but have a large diameter.

Straws, are still less homogenous than hardwood, as they contain besides the fibers and wood vessel segments, non fibrous cells which are represented by parenchymatous and epidermal cells. Straws posses about the same average fiber length as hard wood. In the higher plants, the primary wall, also called the cuticle, is a thin, continuous, and fairly elastic membrane around the outside of the fiber. The secondary wall is a relatively thick layer and constitutes the major portion of the wall of most cell types. It is bordered on the outside by the primary wall and on the inside by the lumen or central cavity of the fiber. The secondary wall is noticeably laminated into layers. Usually three distinct zones are recognized. The outer layer, next to the primary wall, is fairly thin. The inner layers of the secondary wall are thicker. The wood fiber cells are completely surrounded by the so-called middle lamella, which is continuous throughout the wood structure.

1.2. Chemical constitution of pulps:

(a) Cellulose:

The cellulose molecule is composed of a series of glucose units containing three free hydroxyl groups, two secondary and one primary, in positions 2, 3 and 6 respectively, on the glucose unite. Thus, the glucose units are linked together by 1-4 glucosidic oxygen bonds which, must be beta form since they can be hydrolyzed by emulsion. In addition to the alcohol groups, wood cellulose ordinarily contains a number of carboxyl groups, these groups occur at a frequency of one for every hundred or more glucose units. They are mainly in the number 6 positions, although they may also be found in the number 2 and 3 positions[2].

(b) Hemicelluloses:

The hemicelluloses are characterized by a much lower degree of polymerization than cellulose, being about 155, compared to a value of 4000 or more in case of native cellulose. They are composed of polymers of pentoses such as xylan and arabinan, and polymers of hexoses e.g. mannam and galactan. Mixed polymers as glucoxylan are arabinogalactan, derivatives of sugars (e.g. methyl pentosans), and oxidized sugars containing the uronic acid grouping are also included. The hemicelluloses consist of two main classes, the cellulosans and the polyuronides[3].

(c) Cellulosans:

The cellulosans include all those hemicelluloses, which are built up of simple sugars, they include both the hexosans and the pentosans. The cellulosans are not easily removed by alkali as are strongly associated with cellulose.