COMMERCIAL PAPER MAKING WITH KENAF

Thomas A. Rymsza

KP Products Inc. dba Vision Paper
Albuquerque, New Mexico

Introduction

Cost effectively manufacturing paper and paper board from non wood fibers and crop residues is something that is within our reach. My company is producing and selling printing and writing papers made with kenaf, and we have been for nearly ten years.

There is an important difference between "cost effective" and "cost competitive." Cost effective means economical in terms of tangible benefits produced by money spent. Cost competitive means at a cost that is equal, or near equal, to the cost of other similarly functional products.

We currently produce products that are cost effective, but not necessarily cost competitive. To become cost competitive we must acquire a dedicated kenaf pulping capability. This is the subject of our research and development efforts, but not the topic of discussion for today

My topic today is "Commercial Paper Making with Kenaf." I will discuss some of the details of what we do, and how we do it. Due to a number of confidentiality agreements, and proprietary business concerns, I will not be able to describe every aspect of our work.

In general, we make arrangements with existing pulp and paper mills to manufacture product to our specifications. Our specifications are developed with full consideration to the mill's existing manufacturing capabilities. Almost without exception, these mills have no prior experience running kenaf, and in each case a learning curve has been observed. The mills are always cautious when making technical specification guarantees for the first production runs, and after gaining some production experience, product quality improvements follow.

Additionally there are cost considerations. Different mills have different fixed and variable costs that are incorporated into the final product pricing. These variables are taken into consideration when scheduling the size of a production run. For instance, some smaller mills can change basis weight every five to ten thousand pounds, and larger mills must stay on grade for forty to sixty thousand pounds. Each situation is different.

Because of this non-dedicated production method, the technical quality of our papers has varied from time to time. All of our papers are high quality, and we have been able to maintain consistency in the look, feel, and printability. Before describing some of the key fiber properties of kenaf, I would like to share with you what we have found to be significant advantages to kenaf as a raw material for papermaking.

With a dedicated processing capability, kenaf paper can be competitively priced. The raw material is cost competitive, and provides long-term price stability. The growing of kenaf provides an economic benefit to farmers and rural communities. Kenaf production results in a reduction of agricultural chemical use. Using kenaf to produce paper will reduce the demand for tree fiber, which will reduce the need to cut natural forest systems, whether on public or private land. Additionally, kenaf provides a CO2 absorption and carbon sequestration rate that is significant, and probably greater than trees. And lastly, pulping kenaf consumes less chemicals and energy than pulping trees..

Why alternatives are needed

Data from multiple sources will show that either global timber supplies are shrinking, staying the same, or growing, depending on the sources chosen. Supplies notwithstanding, the prices for timber are rising, slowly at times, but surely over the long run.

The global population is six billion and growing, and the demand for paper products is also growing. This supply/demand dynamic provides an economically and long term environmentally beneficial opportunity for a superior non-wood fiber such as kenaf to fill the gap between supply and demand.

While the environmental benefits of nonwood fibers may be substantial, in order to be considered a truly viable alternative fiber source, the specific fiber must be technically comparable to current fibers. It must provide comparable strength, optical, and surface characteristics, on an economically competitive basis.

What is Kenaf?

Kenaf (Hibiscus cannabinus L.) is related to cotton and the State Flower of Hawaii. It is a plant that produces fibers similar to hardwoods and softwoods. Numerous studies have shown that farmers in many parts of the U.S. can grow it, and it can be profitable, without the need for subsidies.

Raw Material Characteristics

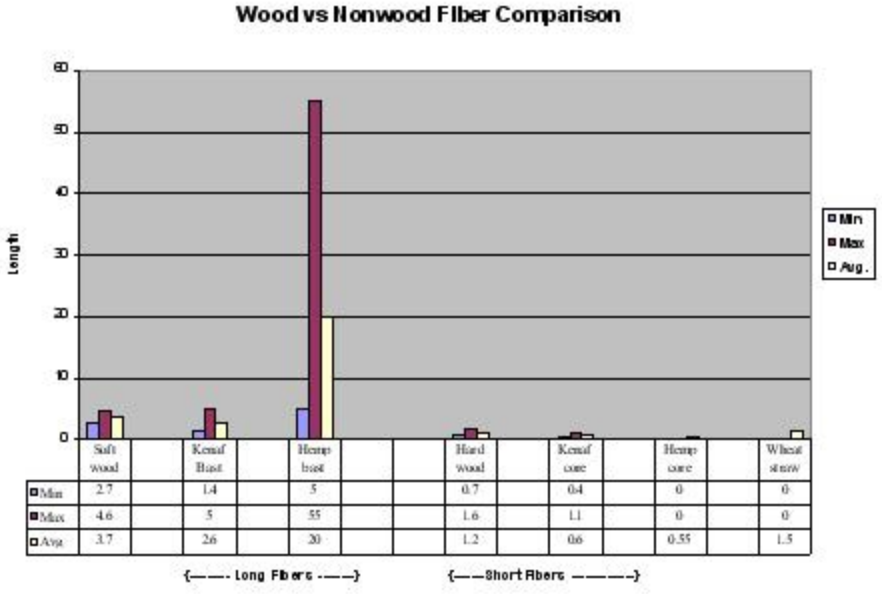
The kenaf plant consists of two distinct fibers. The softwood-like bast fiber makes up 35% - 40% of the total dry weight, and the hardwood-like core fiber makes up the balance. The following table (Table 1) shows the key characteristics of whole stalk kenaf, kenaf bast, and kenaf core raw material.

Table 1: Kenaf whole stalk, bast, and core properties

	Whole kenaf	Kenaf bast	Kenaf core
Fiber Length mm	1.28	2.6	0.6
Fiber diameter microns		20	30
Lingin %	13.2	7.7	17.4
Cellulose Crude	54.4		
Alpha	37.4		

Figure 1 (below) illustrates the similar fiber length of kenaf bast and core fiber compared to softwoods and hardwoods. This similarity is very important when considering the ability of a fiber to replace or supplement wood fiber in commercial pulp and paper processing. Kenaf fibers provide technical capabilities that allow the papermaker to match nearly any effect normally achieved by blending hardwood and softwood pulps. In comparison, the bast fiber of hemp is nearly ten times longer than softwood fiber, and it requires additional refining to shorten it to the point where it can duplicate the characteristics of wood or kenaf fibers on a paper machine. The short inner fibers of kenaf and hemp core provide characteristics typical of hardwood fiber. Straw fibers provide roughly the same hardwood like characteristics.

Figure 1: Fiber Comparison Chart



Because raw kenaf contains fibers that are different in length, an approach whereby the two fiber types are separated, and directed to different end uses and processes has evolved. Pulping the fibers separately and then blending the resulting pulps can produce a wide range of paper products while achieving the optimal technical properties of each fiber type.

Chemically pulping whole stalk kenaf also shows potential given the appropriate fiber preparation and processing equipment. This whole stalk pulping is the subject of a major research and development effort currently in process at our company.

Lignin and Silica

Like many nonwoods, kenaf has a low lignin content. Whole stalk kenaf contains thirteen to fourteen percent lignin, as compared to twenty five to thirty percent for some trees. Unlike many other nonwoods, kenaf does not contain any significant level of silica, which allows for efficient black liquor processing and chemical recovery.

Kenaf Paper Products

The kenaf paper products we have produced since 1992 have been made in a number of different ways at a number of different mills. Our very first kenaf products were produced at the Ecusta Division of P.H. Glatfelter, located in Pisgah Forest, North Carolina.

This mill specialized in producing cigarette and other lightweight specialty papers using flax as a raw material. They had researched kenaf as a potential replacement for flax in the 1970's and 1980's, and had a good understanding of the raw material characteristics.

Our initial product definition was for a totally chlorine-free, commercial quality printing paper in a 60# text weight (89 g/m2) with an ISO brightness of 86%. However, the types of paper machines and the bleaching system at the mill required that we adjust our product definition to fit the manufacturing capability.

After numerous meetings and laboratory trials, forty-five pound basis weight (67g/m2) and a lower, unspecified brightness was determined.

Approximately forty thousand pounds (40,000 lbs.) of raw material was used to produce the very first run. The kenaf was partially separated and comprised of roughly 80% bast fibers, and 20% core fibers. The raw kenaf material was received in bales, and pulped using a batch kraft AQ process.

Ecusta technicians were able to utilize old mill equipment to achieve a single stage hydrogen peroxide bleach sequence, and produced a sheet of ISO 68% brightness. While the sheet was below our current quality standards, it did meet the minimum technical specifications, and it did perform well on printing presses and in copy machines. We produced approximately 500 tons of kenaf paper with Ecusta over a two-year period. We were able to increase the basis weight by 15%, and the brightness was increased to 72% ISO. Typical values achieved at this mill were:

Basis Weight: 77 g/m2
Brightness: 72 ISO
Opacity: 96%

These initial papers were used to produce magazines, books, and high quality four-color process marketing materials. The papers were run in large volume on heat set web presses and large format color process sheet fed presses.

Since 1992, we have continued to produce kenaf based paper products, and we currently offer 100% kenaf products as well as blends made from kenaf and post-consumer recycled pulps. Our product line includes both coated and uncoated printing papers, in basis weights ranging from 74 g/m2 up to 216 g/m2.

We can now produce multiple basis weights and finishes, and are able to produce an uncoated 100% kenaf sheet that is 86% ISO brightness, and coated products that are currently 91% ISO brightness.

Recycling of Kenaf

We are the first company to recycle kenaf paper on a commercial basis. Our work has demonstrated that papers made entirely of kenaf fibers blend well with typical wood based recycled fibers, and that production efficiencies, technical values and functional performance are at least equal to wood fiber furnishes.

The objective was to incorporate kenaf-based paper into a commercial recycling system, demonstrating its compatibility in mainstream recycling and paper production.

Materials And Methods

Raw Material

The furnish for the initial recycling run consisted of 20% uncoated offset printing paper made from 100% kenaf fibers. This material was produced at the Ecusta mill, and was a mix of obsolete stock items, damaged rolls, and envelope trimmings. Filler (precipitated calcium carbonate) in amounts ranging from 8-20% was present in this material, and it had an ISO brightness ranging from 66-72%. Another 20% of the furnish was recycled pulp made from 100% post-consumer waste, and processed chlorine-free.

The fiber content of this type of commercial-grade recovered waste paper pulp typically consists entirely of wood fibers that have been chemically pulped.

The remaining 60% was pre-consumer recycled pulp made from white mill broke (manufacturing wastes), as commercially available. The fiber content of this type of commercial grade recovered waste paper pulp typically consists entirely of wood fibers, which have been chemically pulped. This portion of the furnish was estimated to contain less than 20% of already-recycled wood fibers.

Methods

A total of 18.1 metric tons of raw materials were proportionally blended in a standard hydropulper, with dyes added to achieve a color match to the original semi-bleached sheet. The resulting slurry was run on a 2.13 m (84 in.) wide Fourdrinier paper machine, at normal operating speeds and with normal production efficiencies.

The resulting paper was sheeted to standard commercial sizes, and was tested on one-, two-, and four- color printing presses.

Results

Recycled paper containing 20% recycled kenaf content performed as well or better than typical wood fiber recycled uncoated papers with at least 20% post consumer content. There were no pulp blending or paper machine production problems. Print performance was un-compromised, with press speed, ink holdout, and finished quality meeting or exceeding typical values. These results demonstrate the feasibility of producing papers containing recycled kenaf fibers, and the compatibility of kenaf with conventional recycling systems.

Printing Characteristics of Kenaf Based Papers

We produce a variety of kenaf-based papers that are made from 100% kenaf, blends of kenaf and recycled pulps, kenaf and virgin pulp blends, as well as coated products. Depending on the manufacturing process and paper machine finishing capability, nearly any effect can be designed into a kenaf content sheet. Characteristics like ink holdout are more related to the internal and surface sizings used, than they are to the kenaf fibers themselves. But one key attribute is present in all of the papers we produce. High opacity. The initial 45# offset (67 g/m2) sheet produced with Ecusta had a TAPPI opacity of 96%. Initially, this high opacity was attributed to the lack of brightness, and mild bleaching, but as brightness has increased, there is still a higher opacity than comparable wood based papers. This characteristic of kenaf was identified during the U.S. Department of Agriculture's initial studies in the 1960's and is supported by the kenaf newsprint work that occurred in the 1970's.

References

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