

ENVIRONMENTAL FOOTPRINT COMPARISON TOOL

A tool for understanding environmental decisions related to the pulp and paper industry

OVERVIEW OF EFFECTS OF NON-WOOD FIBER USE

Introduction

There is currently little environmental or economic impetus for wider use of agricultural crops and crop residues for the manufacture of paper products in North America. Research by Bowyer, who has extensively evaluated opportunities for using agricultural fiber as a papermaking raw material, provides the following conclusions that sum up the situation.

- *When environmental attributes of kenaf and wood fiber are compared, the yield advantage of kenaf, and thus, lesser land requirements to produce a given amount of pulp, appears to be overwhelmed by the highly intensive nature of activity on the land that is in production. Thus, among the factors that favor production of kenaf fiber for use in papermaking rather than wood, environmental protection is not one of them (Bowyer 1997).*
- *Examination of the total environmental impacts of papermaking fiber production in forest plantations versus fiber production using agricultural crops shows significant advantages to wood fiber (Bowyer 2001).*

Circumstances in the developing world, however, are economically more favorable for non-wood fiber use and continue to prompt technological research and development to improve manufacturing processes related to non-wood fiber. In the past, paper producers in North America have explored and will continue to explore opportunities to reduce costs or improve fiber quality by using non-wood fibers in specific mills and product lines.

What options exist for the use of agricultural fiber?

Potential sources of non-wood fiber that have been considered for papermaking in North America include

- *dedicated annual crops* grown specifically for fiber, such as kenaf, jute, flax, and hemp. In extensive studies the USDA found kenaf to be the most promising annual fiber crop (Kugler 1990; Taylor 1993), and
- *agricultural residues* remaining from the harvest of food-based crops such as wheat and other cereal straws (barley and oats), rye seed grass, cornstalks, and bagasse from sugar cane.

Wood, agricultural crops, and crop residues are all important sources of papermaking fiber. Choices will be inherently driven by

- relative abundance and delivered costs,
- compatibility with existing manufacturing infrastructure,
- contribution to product characteristics and manufacturing efficiencies,
- environmental objectives, and
- economic viability and success of products in the marketplace.

Why can't the international experience with non-wood fiber be extended to North America?

Globally, the predominant use of non-wood fiber in the manufacture of paper products is concentrated in geographic areas characterized by historically diminished forestlands and wood fiber scarcities. Even in areas where non-wood fiber has historically been the predominant domestic fiber source, wood fiber has been the preferred choice to supply larger, more efficient paper manufacturing equipment now being installed to sustain large and rapid capacity increases (for example, in China).

Effects of Non-Wood Fiber Use

General Overview

At present, non-wood fiber use in North America is largely limited to the manufacture of specialty and niche paper products that command premium prices in the marketplace.

Though there is a body of information to suggest the technical feasibility for using non-wood fiber in a broad array of paper applications, economic evaluations in North America have thus far not favored the construction of mills dedicated to the use of non-wood fiber. This is, in part, attributable to the efficiencies of scale and fiber acquisition advantages related to the manufacture of wood pulp-based products.

What, if any, manufacturing hurdles discourage existing mills from using non-wood fiber?

Use of non-wood fiber would require significant adaptations to mills designed for fiber with distinctly different characteristics, operating at significantly different scales of production. Paper manufacturers with investments in large-scale wood-based technology continue to find wood far easier to source, transport, store, use and plan for than non-wood alternatives (Roundtable 1997).

Non-wood sources of fiber are amenable to the same basic pulping approaches as wood fiber sources. Chemical processes are most common worldwide. Yet the amenability of non-wood fiber sources to conventional pulping processes has not led to significant commercial scale application in North America. A number of barriers have contributed to this state.

- Widespread use of non-wood fiber sources would require a fundamental change in the paper industry's raw material supply and procurement infrastructure.
- The costs for transportation and storage of low-density non-wood fiber limit mill size and lose the economies of scale enjoyed by wood fiber mills.
- Lower lignin and higher silica contents associated with agricultural residues make conventional chemical recovery systems at wood-based mills inefficient.
- Material handling systems designed for wood, wood chips and wood pulps are not equally well suited for non-wood fiber. Most agricultural fibers are not compatible with the raw material handling and pulping stages of existing wood pulp mills (Kinsella 2004).
- Slower draining short-fibered non-wood fibers such as those associated with wheat straw impair paper machine efficiencies.

Are there environmental advantages related to use of non-wood fiber that would justify manufacturing compromises?

Potential environmental co-benefits and trade-offs associated with the use of alternative fibers include those related to water consumption, use of renewable and fossil fuel energy, the generation of chlorinated compounds, wastewater quality, and emissions of greenhouse gases. In addition, one of the most significant aspects to consider is the relative land impacts of growing non-wood fiber versus wood-based fiber. Differences relate not only to land use patterns, but also to the impacts related to differing agronomic practices associated with alternative crops in terms of energy use and associated atmospheric emissions, water consumption, and the character of land surface runoff. As a generalization, the environmental advantage rests with wood fiber.

How can wood fiber use be justified when paper can be made from otherwise wasted agricultural residue?

Use of agricultural residues for paper production would make use of what would otherwise be a waste material. A similar synergy exists between the lumber industry and manufacturers of wood pulp (McKeever 2004), and thus, both sources of fiber have this co-benefit associated with them. At the root of the forest products industry is the harvesting of timber for production of lumber and other wood products. Sawmills annually generate enormous quantities of bark, wood chips, and other wood residues that are a valuable commodity. Nearly all of these residuals are used to produce other products, primarily paper, nonstructural wood panels, and biofuel (McKeever 1998).

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The pulping of wood also yields commodities beyond the fiber used in paper manufacturing. For example, tall oil and turpentine are two versatile products recovered from the wood pulping process that have given impetus to a wood-derived chemicals industry. Once recovered, these chemical feedstocks are used to produce products with numerous industrial and household uses. As the forest products sector embraces technologies that allow for a broader spectrum of co-products (e.g., nanocrystalline cellulose), the compounded value of these additional commodities will increase.

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