



Eco-Link

Linking Social, Economic, and Ecological Issues

The Miracle Resource

Volume 14, Number 1

In the children's book "The Giving Tree" by Shel Silverstein the main character is shown to benefit in several ways from the generosity of one tree. The tree is a source of recreation, commodities, and solace. In this parable of giving, one is impressed by the wealth that a simple tree has to offer people: shade, food, lumber, comfort. And if we look beyond the wealth of a single tree to the benefits that we derive from entire forests one cannot help but be impressed by the bounty unmatched by any other natural resource in the world. **That's why trees are called the miracle resource.**

The forest is a factory where trees manufacture wood using energy from the sun, water and nutrients from the soil, and carbon dioxide from the atmosphere. In healthy growing forests, trees produce pure oxygen for us to breathe. Forests also provide clean air and water, wildlife habitat, and recreation opportunities to renew our spirits.

Forests, trees, and wood have always been essential to civilization. In ancient Mesopotamia (now Iraq), the value of wood was equal to that of precious gems, stones, and metals. In Mycenaean Greece, wood was used to feed the great bronze furnaces that forged Greek culture. Rome's monetary system was based on silver which required huge quantities of wood to convert ore into metal. For thousands of years, wood has been used for weapons and ships of war. Nations rose and fell based on their use and misuse of the forest resource.

Our wood resources must be utilized sustainably if we are to benefit from it into the future. We are all consumers of wood and wood products. It's in the places we inhabit and things we use everyday. We use over ten thousand different products derived from trees and wood fiber. Half of all the wood harvested in the world is still used for cooking and heating, a major cause of forest degradation. But many nations are learning how to live sustainably, by both conserving and developing their natural resources. We are using science and technology to do a better job of managing our forest resources while producing superior wood products with very little waste or pollution.

In North America, forests are abundant and growing. It is important for the public to understand that we can meet their needs for material forest products—lumber, engineered wood products, paper, and by-products—in a sustainable manner while looking out for all the amenities that forests provide. Sustainable forestry is at the heart of sustainable development.



From Forest to Products

What is the Forest Products Industry?

The people who bring wood products to the public include workers in the forest, in mills, in labs, and in thousands of businesses that use wood and wood products as raw materials for products we use daily. We can divide the industry into three categories: primary producers, secondary manufacturers, and suppliers. Primary producers process logs into basic products; pulp and paper mills (where market pulp, paper and paperboard is made) and sawmills (where lumber is made) are examples of primary producers. Secondary manufacturers are those who handle wood after it leaves the primary production mill. That means secondary manufacturers are the companies that make specialized value-added products out of wood. Everything from beautiful guitars, to the spindles on your staircase, to the special cut of wood needed to make a window frame and the dinner table you eat at each night. Suppliers are companies that support primary and secondary manufacturers with specialized equipment and/or technical expertise. Supplementing the industry are distributors (wholesalers and retailers) who convey the finished forest products to consumers.

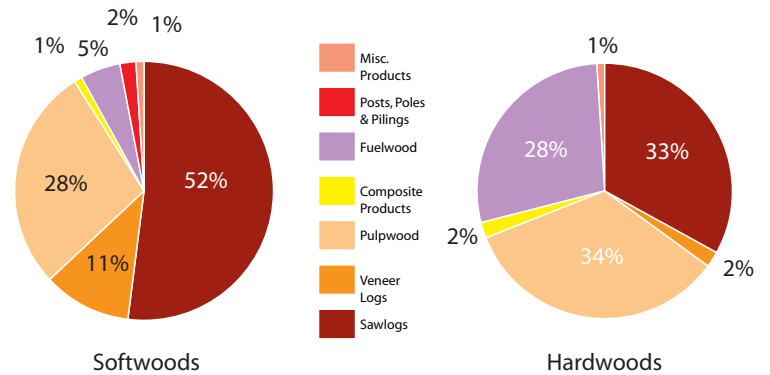
Hardwoods

Hardwoods are deciduous trees that have broad leaves, produce a fruit or nut and generally go dormant in the winter. There are hundreds of varieties of hardwood trees in North America including oak, ash, cherry, maple, and poplar.

Softwoods

Softwoods are conifers, evergreens, and cone-bearing trees. Some examples, widely used as lumber in the U.S. include cedar, fir, hemlock, pine, redwood and spruce. Softwoods are primarily used in residential buildings as structural lumber for framing.

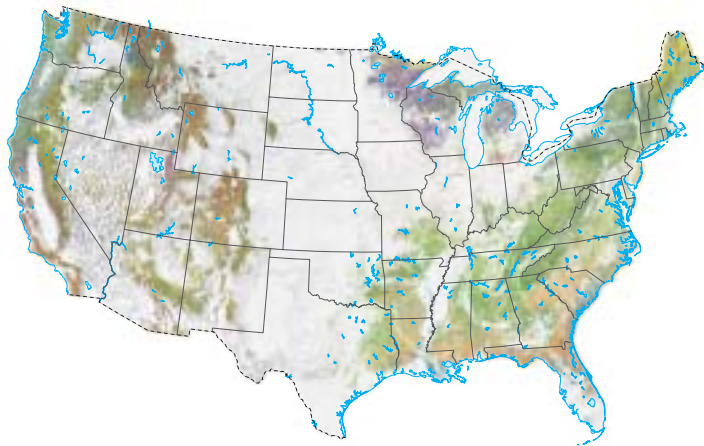
U.S. Timber Consumption, 1996



Annual timber harvest of approximately 16.0 billion cubic feet [AF&PA, USDA FS, 1996]
U.S. Growing Stock = 58% softwood/42% hardwood

Utilizing Wood Sustainably

Increasing wood consumption by the public demands that producers of wood products make efficient use of available trees. The first step in this process occurs before any trees are cut down when forest managers design management plans that consider the management objectives of the site. Values such as aesthetics, stand health, and habitat are considered along with production. Once a harvesting plan is decided, sustainable harvesting practices are utilized to maintain the value of the harvested logs while maintaining the health of the site and future trees.



33% (747 million acres) of the U.S. is forestland. (Colored areas on the map above.)
Of that, 67% (504 million acres) is timberland. [Map from USDA Forest Service]

Today, placing a cut in the right place may make a difference of hundreds of dollars in log value. In the past, most loggers simply cut trees into standard lengths following harvest. Modern harvesting equipment allows trees to be debarked, delimited, and bucked to optimal lengths right on-site. Harvested trees are sorted to maximize value.

Considerations for determining what a log will be used for take into account such things as log diameter, log length, amount of rot, the number and kind of surface defects, and log curvature (or sweep). It is not considered economical to use large logs for paper when they could instead be used to make lumber or plywood. Long straight trees with good wood may be used as telephone poles or structural beams for buildings. Shorter lengths could be used for lumber and veneer for construction and for consumer wood products. Smaller trees with defects may be used in engineered wood products or in making paper products.

Solid Wood Products

Wood is an important raw material for the manufacturing, construction, and shipping segments of the U.S. economy. Hardwoods (ash, oak, maple, and cherry) are more durable than softwoods (pine or poplar) and tend to offer greater choices in respect to natural finish, graining, texture, and durability. Hardwoods are generally more expensive than softwoods, due to supply and workability (i.e. hardwoods are more challenging to work with). All the commercially available U.S. hardwoods are crafted into flooring, furniture, cabinetry, woodwork, and built-ins. It's simply a matter of taste, preference, and availability.

Manufacturing



Solid wood is used extensively in a variety of manufactured products—from toothpicks to furniture. Most people can probably name dozens of products commonly made from wood. Secondary manufacturing activities in the United States accounted for about 13 percent of the lumber, 10 percent of the structural panels, and 47 percent of the non-structural panels consumed in 1996. Lumber consumption for manufacturing increased by nearly 30 percent between 1986 and 1996. Structural panels increased by about 80 percent and non-structural panels by about 50 percent.

Construction

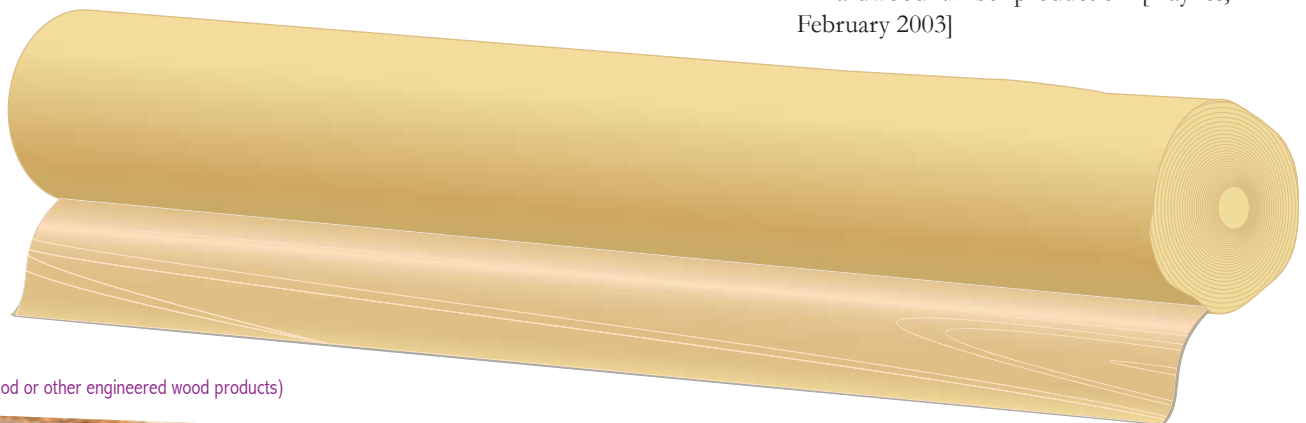


Large amounts of wood products are used in the construction of new nonresidential buildings, and in the upkeep and improvement of existing structures. Nearly all new U.S. single family houses and low-rise multifamily residential structures are framed with lumber and sheathed in wood panels. Wood also provides a renewable energy source for industrial, commercial, and residential applications. In the late 1990s, hardwood lumber consumption averaged about 12.5 billion board feet per year, roughly one-fourth the level for softwoods.

Shipping



Nearly all manufactured products are shipped on wooden pallets. Packaging and shipping accounted for about 10 percent of the lumber, and 2 percent or less of all structural and non-structural panels consumed in 1996. Just over 6.4 billion board feet of lumber, 0.5 billion square feet of structural panels, and 0.1 billion square feet of non-structural panels were consumed for packaging and shipping in 1996. The 388 million new pallets produced in 1996 required 5.8 billion board feet of lumber, more than 90 percent of all the lumber used for packaging and shipping. With the advent of wide-scale pallet reuse, recycling, and repair, growth in new pallet production has slowed appreciably and with it the rate of growth in hardwood lumber production. [Haynes, February 2003]



Veneer Log (peeled for plywood or other engineered wood products)

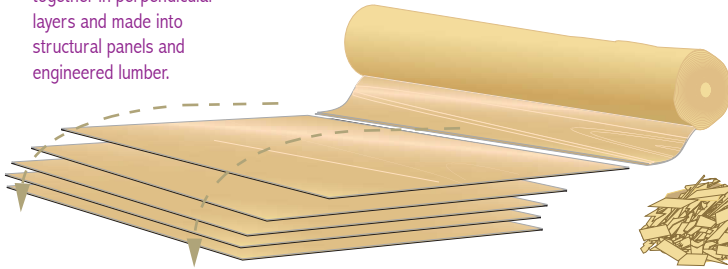


Sawlog (processed for timbers, dimension lumber and boards)

Engineered Wood Products

Engineered wood products are helping us to effectively and efficiently utilize smaller, faster growing trees and lower grade trees that wouldn't normally be used. By bonding wood strands, veneers, lumber, or other forms of wood with adhesives, we create products that improve upon many of the material's inherent structural advantages. The process of making engineered wood products homogenizes the raw material, eliminating defects and weak points, or at least spreading and mitigating their impact. The performance advantages of these building materials are becoming increasingly accepted by builders and can be found in many construction applications. They also alleviate the burden on old growth by providing an alternative to using large timbers. In addition, engineered wood products are carving out new niches for the forest products industry. Examples of engineered wood products include plywood, oriented strand board, glued-laminated timber (Glulam), wood I-joists, and laminated veneer lumber. [apawood.org]

Wood veneers are glued together in perpendicular layers and made into structural panels and engineered lumber.



Young, small diameter trees from thinning operations can have defects cut out of their lengths and then be finger-jointed and glued into longer, stronger lengths, and laminated into long glulam beams.



Wood in the form of chips and/or sawdust from low-grade trees and mill waste is glued and pressed to become structural boards, lumber, and panels

Structural Wood Panels, like plywood and oriented strand board (OSB), are engineered for many structural applications; siding, sheathing, flooring, and as webs for wood I-joists.



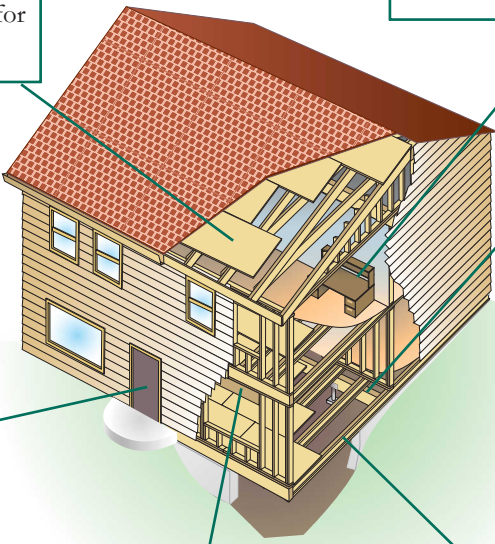
Particleboard is used widely in the manufacture of furniture, cabinets, floor underlayment in home construction, and in many other applications.



Glued Laminated Lumber (Glulam) is also among the most versatile engineered wood products. It finger joints and laminates varied lengths of lumber together with adhesive into forms ranging from straight beams to complex curved members, used in residential and nonresidential building construction applications.



Medium Density Fiberboard is utilized as substitute for solid wood in many interior applications. MDF allows intricate and precise machining and finishing techniques for superior products such as stereo cabinets and relieved door fronts and moldings.



Structural Composite Lumber products made from veneer such as laminated veneer lumber (LVL) or wood strands like in oriented strand lumber (OSL) are engineered products that are used as headers and beams, load bearing columns and studs.



Wood I-joists utilize OSB and LVL to create strong and light substitutes for 2x lumber floor supports for residential and commercial construction.



Wood Pulp

Wood is a key source of the raw material needed by the pulp and paper industry—wood pulp. Pulp is composed of cellulose, long chains of sugar molecules which make up all plant cell walls. In order to acquire cellulose from wood, the bonds binding the cellulose together into wood must be broken down. This is accomplished either mechanically or chemically in a process known as pulping. Different pulping methods result in pulp with different qualities.

The most common pulping method in the U.S. is Kraft (sulfate) pulping. Wood chips are combined with an alkaline solution and subjected to heat and pressure to break down the lignin, a hard brittle material, which binds the wood fibers together. In the process the cellulose is freed from the lignin, hemicelluloses, and small amounts of wood resins. Modern chemical pulping methods allow the recovery of much of these constituent parts for use in other by-products. Some of these constituents; cellulose, turpentine, and tall oil are described below.

Only about one-third of the fiber used to make paper in the U.S. is from round wood (whole trees.) Primarily, trees harvested for papermaking are smaller than 8 inches in diameter, or larger trees not suitable for solid wood products. Another third of the raw material is residue—from sawmill operations. The last third of the raw material is from recovered paper.



Sawdust along with wood chips are used as raw materials for wood pulp.

Cellulose

Cellulose is the most abundant naturally occurring organic substance and is the primary component of wood fiber. Cellulose makes up 40-45% of the dry weight of wood.

Cellulose derivatives include guncotton, fully nitrated cellulose, used for explosives; celluloid (the first plastic), the product of cellulose nitrates treated with camphor; collodion, a thickening agent; and cellulose acetate, used for plastics, lacquers, and fibers such as rayon.

Refined cellulose is required for the manufacture of rayon and acetate fibers used in apparel, curtains, and draperies, and in thermoplastics used in tool handles, toys, automotive parts, surface coatings, films, food thickeners, latex paints, drilling muds, and cellophane.

Digester—In chemical pulping the digester is where wood chips are “cooked” under heat and pressure in a caustic solution to break down the lignin bond between the cellulose fibers

Turpentine

Turpentine is a clear, flammable liquid produced as a by-product of chemical pulping of pine trees. As pine wood chips are “cooked” under high heat and pressure in a digester, turpentine is recovered from chemical compounds called terpenes contained in the relief gases.

Whole turpentine is used in paint solvents, cleaning agents, paints, and varnishes. It is also a very versatile material chemically, and nowadays, it is used mostly after further processing in flavor and fragrance chemicals.

The chemicals used in sulfate pulping are recovered and processed for reuse

Heat/Steam from the pulping process are recovered for use within the mill.

Tall Oil

Another by-product of chemical pulping, tall oil, is an important source of raw materials for the Naval Stores specialty chemicals industries that utilize tall oil rosin acids and tall oil fatty acids. The chemicals used during pulping cause waxes and related compounds found in trees to break down to form glycerol and fatty acids. The strongly alkaline solution then reacts with these fatty acids to produce fatty acid salts. This process is known as saponification.

The material washed from the pulp, including the dissolved lignin, resin, and the fatty acid salts is a dark liquid called “black liquor.” When black liquor is concentrated, the resin and fatty acid salts separate and float on the surface where they are skimmed off. After the fatty acid salts are neutralized, the resulting product is known as tall oil (“tall” is the Swedish word for pine.)

After chemical pulping, cellulose fiber is washed and further processed for use in paper products

Paper Products

Paper and paperboard products are the most common use of wood pulp. Once wood has been broken down into cellulose fibers, the fibers are washed and bleached and then combined with water and various pigments, dyes, and resins. Many papers use a combination of several different types of pulp and recovered paper. This “recipe” is known as the fiber furnish. The furnish is combined according to the needs of the finished product. Fine quality papers used for communications are made from high grade pulp which help provide printable and readable surfaces. For paperboard packaging where strength is an issue longer fibered pulp may be used. Even the type of trees used impart different characteristics. Fibers in softwoods are longer which impart more strength to paper versus hardwood fibers which are shorter and used for smoother papers.

Kraft Paper

Kraft paper is a strong, coarse paper made from bleached and unbleached Kraft pulp. It is used for paper grocery bags, multiwall sacks (for things like pet foods, lawn and garden seed, fertilizer, yard/leaf compost, cement, agricultural seed, and chemicals), and other consumer and industrial packaging. The word Kraft is from the German word for “strong.”

Tissue Paper

Tissue refers to a class of papers with a characteristic gauzy texture. It’s commonly utilized in sanitary grades such as toilet, facial, napkin, toweling, and wipes but some types like crepe paper are used for decorative purposes and gift wrapping.

Newsprint

Newsprint is the type of paper used in newspapers. It is used occasionally for other types of printing or to make products such as art or school tablets or packing paper.

Newsprint is a major end-use for recovered paper. In 1998, for instance, recovered paper accounted for just over half the fiber used by U.S. newsprint mills, up from 29 percent in 1990.

Printing and Writing Papers

Printing and Writing paper refers to a variety of papers used in offices, communications, books, magazines, catalogs, annual reports, brochures, direct mail, and other printed papers. The United States has more than 25 percent of the world’s capacity in printing and writing papers.

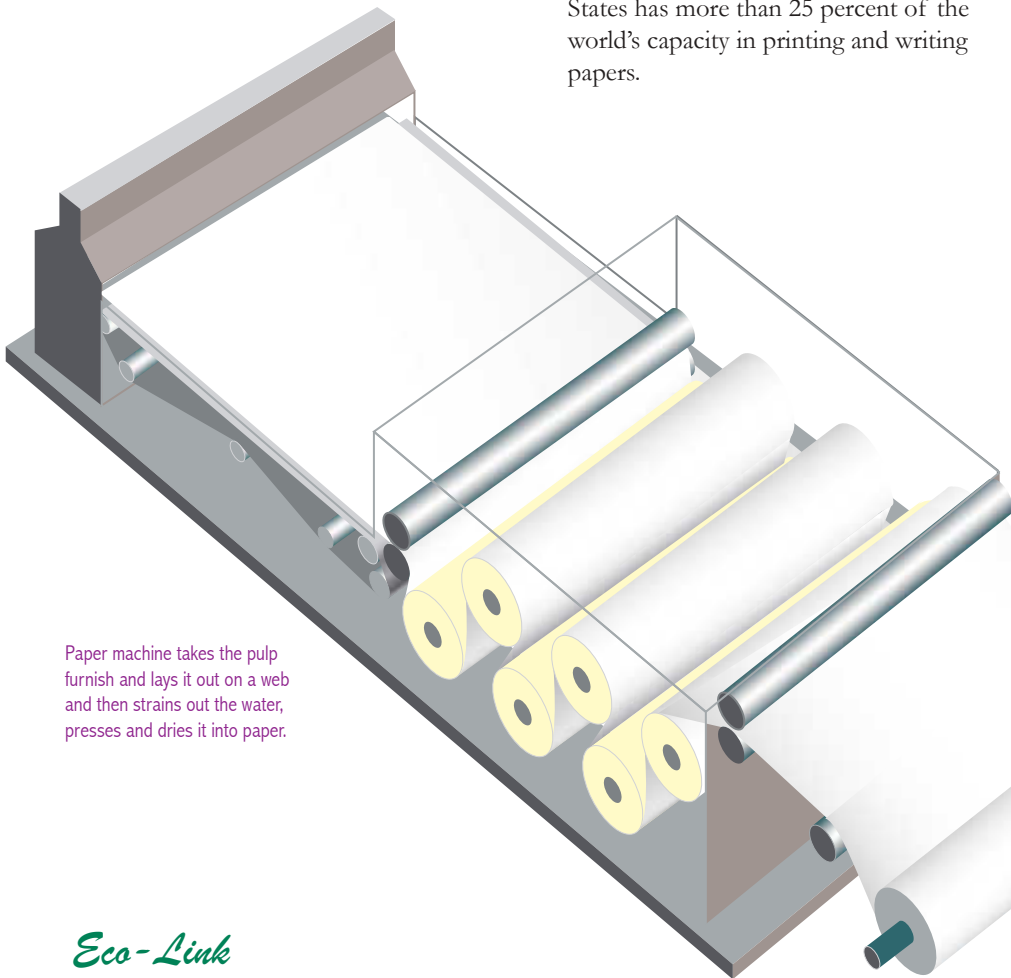
Paperboard

Paperboard is heavier in weight, thicker, and more rigid than paper making it well suited to a variety of packaging products. About 70 percent of paperboard packaging is used to protect food and other consumer goods. The main difference between types of paperboard is the fiber source.

Containerboard/Corrugated Containers

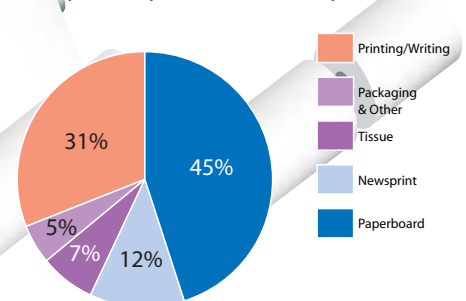
Containerboard is solid fiber or corrugated and combined board used in the manufacture of shipping containers and related products. Corrugated containers are most commonly found as boxes manufactured from containerboard—two layers of linerboard (facing) sandwiching one layer of corrugated medium (fluted paper). The strength of corrugated containers comes from the structure of the corrugated medium. An arch with a certain curve can support many times its own weight, especially when the ends of the arch are anchored. In corrugated containers, they are anchored to the facing. Most linerboard is produced using softwoods. They have the longest fibers, and produce the strongest paperboard.

Corrugated boxes ship over 95 percent of all products in the United States because of its strength and convenience.



Paper machine takes the pulp furnish and lays it out on a web and then strains out the water, presses and dries it into paper.

U.S Paper & Paperboard Consumption, 1999



By-Products

Besides more common wood products, various tree species produce varying amounts and kinds of extraneous materials collectively called **extractives**. These extractives contribute to a whole range of cellulose and silvichemical by-products that are derived from wood. In softwoods, for example, there are considerable amounts of resins consisting of both fatty acids and so-called resin acids which are derived from the simple terpenes such as turpentine and pine oil. Tannins are polyhydroxylic phenols which are found in the heartwood and bark of many species. Rubber is obtained from the inner bark of certain trees in the form of a latex. Aromatic oils and water-soluble sugars may also be obtained from various species. Cedar oil and maple sugar are familiar examples. [Goldstein. 1978.] Along with providing us a range of useful products, these wood by-products help extend the full utilization of the resources.

Clothes



Rayon is a purified cellulose product made of regenerated (dissolved and reformed) cellulose. Most rayon is made by the viscose process which converts purified cellulose to xanthate (an organic salt), dissolves the xanthate in dilute caustic soda, and then regenerates the cellulose as it emerges into chemical baths from a spinneret. All rayon fibers manufactured in the U.S. are wet spun using this viscose process. Rayon is used to make clothing, curtains, sheets and bedspreads, upholstery, carpet, and tire cord.

Energy

By utilizing wood waste to produce their own electricity and heat, forest-products companies maximize utilization of forest resources. By-products of sawmill and pulp mill production are utilized as raw materials for on-site energy production. Sawdust, bark, and other wood waste are collected, ground to an appropriate size, and used for fuel to run electric cogeneration plants. This has the added benefit of making more of the utility's energy available to other consumers.

On a national basis, forest-products companies are among the most energy-efficient of all manufacturing industries, furnishing up to 75% of their own energy needs through cogeneration.

Flavors and Fragrances

Turpentine can further be fractionated by distillation into alpha- and beta-pinene which are key components in synthesizing numerous derivatives for common flavor and fragrance products such as gum, toothpaste, detergents, and shampoos. The biggest single turpentine derivative, synthetic pine oil, is used in disinfectants, cleaning agents, and other products with a "pine" odor. Many derivatives, including isobornyl acetate, camphor, linalool, citral, citronellol, citronellal, and menthol are used either on their own or in the elaboration of other fragrance and flavor compounds. A few of the minor constituents of turpentine, such as anethole, are employed for fragrance or flavor use without the need for chemical modification.



Soaps and Additives

Tall oil is refined to produce purified rosin acids and fatty acids. The main uses of tall oil rosin acids are printing inks and adhesives. Tall oil fatty acids are used in soaps, cleaners, detergents, surfactants, lubricants, and ore flotation reagents.

Lignosulfonates

Lignosulfonates are non-toxic chemicals which are left over after the pulping process removes the cellulosic material from the wood during the acid-bisulfite pulping process. Lignosulfonates were first used in the 1880s in leather tanning and dye baths. Since then, they have found applications as emulsifiers in animal feed and as raw material in the production of vanillin, an ingredient in food flavors, and pharmaceuticals and a fragrance in perfumes and odor-masking products. [<http://www.lignin.info/whatis.html>]

Nutritional Supplements

Torula yeast is a high-protein product made from wood sugars spent in the pulping process. It has 17 nutritional trace elements, including four to five times the amount of iron found in uncooked spinach or raisins. Type S Torula is used in baby foods, cereals, imitation bacon, baked goods, beverages, vegetarian food and dietary preparations. Type F Torula is used in feed supplements for cattle, hogs, fish, chickens and mink, and Type FP Torula goes into pet foods.

Glossary of Terms

Black liquor

Spent liquor, produced in the digester from the chip cooking process, which is sent to the recovery process to be reconstituted into cooking chemicals.

Chemical Pulping

A process using a chemical solution to dissolve lignin from fiber. The two types of chemical pulping are sulfite and sulfate (Kraft) pulping.

Ester

Any one of a group of organic compounds that are formed by the reaction between an alcohol and an acid.

Furnish

The pulp mix of fibers, water, dyes, and chemicals that is pressed and dried into paper.

Hardwood

Short-fibered wood obtained from deciduous trees, which is used to produce pulp with high standards of opacity, brightness, smoothness, and density.

Hydroxyl group

In chemistry, a functional group that consists of an oxygen atom joined by a single bond to a hydrogen atom. An alcohol is formed when a hydroxyl group is joined by a single bond to an alkyl group or aryl group. A metal hydroxide is formed when a hydroxyl group is joined to a metal (e.g., sodium hydroxide).

Kraft Pulping

The most common chemical pulping process involving the cooking of wood chips in a solution of sodium hydroxide and sodium sulfide. It produces pulp with high strength and can be used for a wide variety of wood species.

Linerboard

Linerboard is paperboard made on a fourdrinier or cylinder machine and used as the facing material in the production of corrugated and solid fiber shipping containers.



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More Info

APA—The Engineered Wood Association
www.apawood.org

ATHENA Sustainable Materials Institute
www.athenasmi.ca

Canadian Wood Council
www.cwc.ca

Forest Products Association of Canada
www.fpac.ca

Forestinformation.com
www.forestinformation.com

Evergreen Magazine
www.evergreenmagazine.com

TAPPI—the technical association for the worldwide pulp, paper, and converting industry
www.tappi.org

Wood Promotion Network
www.beconstructive.com

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www.afandpa.org



www.forestinfo.org

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14780 SW Osprey Drive, Suite 355
Beaverton, OR 97007-8070
Tel: (503) 579-6762 Fax: (503) 579-0300
E-mail: office@forestinfo.org