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The Effect of Aspen Wood Characteristics and Properties on Utilization

Kurt H. Mackes[1] **and Dennis L. Lynch**[2]

Abstract—*This paper reviews characteristics and properties of aspen wood, including anatomical structure and characteristics, moisture and shrinkage properties, weight and specific gravity, mechanical properties, and processing characteristics. Uses of aspen are evaluated: sawn and veneer products, composite panels, pulp, excelsior, post and poles, animal bedding, animal food supplements, fuel applications, and novelties. Aspen is a preferred species for paneling, veneer products including matchsticks and chopsticks, waferboard and oriented strandboard (OSB), fiberboard, pulp, excelsior, research animal bedding, animal food supplements, and tourist or gift items.*

Introduction

Quaking aspen (*Populus tremuloides*) is widely distributed and commonly found in Colorado and throughout the Rocky Mountain Region. Although aspen up to 120 feet tall and 4 feet in diameter have been reported (Perala and Carpenter 1985), mature trees are typically smaller, averaging in the range of 60 to 80 feet tall with a diameter of 11 inches diameter at breast height (d.b.h.) or larger (Baker 1925). Although aspen trees are fairly straight, have little taper, and are relatively free of limbs, limb scars persist and trees in some stands can be very contorted (Perala and Carpenter 1985). Aspen continues to be an underutilized species for wood products in the Rocky Mountain West.

The purpose of this paper is to review characteristics and properties of aspen wood, including anatomical structure and characteristics, moisture and shrinkage properties, weight and specific gravity, mechanical properties, and processing characteristics. Then, based on these characteristics and properties, traditional and potential uses for aspen are evaluated. Assessments are presented for a wide range of uses, including sawn and veneer products, composite panels, pulp, excelsior, post and poles, animal bedding, animal food supplements, fuel applications, and tourist or gift items.

Characteristics and Properties

Anatomical

Aspen is a diffuse-porous hardwood. The pores are small and evenly distributed throughout annual growth increments. The heartwood is white to light brown or creamy. The sapwood is typically whiter and blends into the heartwood with no clear lines of demarcation. Annual growth increments are delineated by slight color differences between earlywood and latewood. The density gradient between earlywood and latewood is small, giving uniform texture. Rays are extremely fine and hardly visible even with a hand lens. Aspen wood is straight grained, light, and soft. Dry aspen has no characteristic taste or

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odor. However, green aspen can have both, which is most likely due to the presence of wetwood.

Both tension wood and wetwood are commonly found in aspen. Tension wood is a type of reaction wood. Wetwood is a water-soaked condition commonly found in both the sapwood and heartwood of aspen (Knutson 1973). However, in the Rocky Mountains, wetwood seems to occur primarily in heartwood (Ward 1976). Wetwood is usually discolored from normal wood and dark-colored heartwood that are usually associated with wetwood (Boone 1989). Although wetwood typically harbors high populations of bacteria and yeast, their role in wetwood formation is not clear.

Moisture Content

Water in freshly harvested green wood is located within the cell lumen and the cell wall. The point where all the water in the lumen has been removed but the cell wall is still saturated is termed the fiber saturation point (FSP). As wood is dried, water leaves the lumen although some water vapor still remains, and water begins to leave the cell walls.

The amount of water in wood is usually expressed as the moisture content. Typically, moisture content is determined by weighing the green sample, drying it to oven-dry status, and then weighing the oven-dry sample. The oven-dry weight is subtracted from the green weight and divided by the oven-dry weight to calculate moisture content. Thus, moisture content can often exceed 100%.

The average green moisture content for aspen given in the *Wood Handbook* (USDA 1999) is 95% for heartwood and 113% for sapwood. The moisture content of aspen wood in standing trees varies considerably, depending on the season and the amount of wetwood present in the wood. Wengert (1976) reported that the moisture content of aspen sapwood can range from 65% in the summer to 110% in the winter. Wengert et al. (1985) reported an average summer heartwood moisture content of 71% and sapwood moisture content of 91% for aspen logs from southwestern Colorado. The moisture content of wetwood is considerably higher than that of normal wood and can be as high as 160% (Bois 1974).

Shrinkage

Aspen has relatively low shrinkage from the FSP to OD condition. From the FSP to OD conditions, quaking aspen shrinks on average 3.5% in the radial direction and 6.7% in the tangential direction. The volumetric shrinkage is 11.5% (USDA 1999). The ratio of radial-tangential shrinkage is relatively high, which can cause drying defects. Because tension wood is commonly found in aspen, longitudinal shrinkage can be significant. The longitudinal shrinkage of tension wood is up to five times that of normal wood (USDA 1999). This can also cause a variety of drying defects. From the FSP to OD condition, longitudinal shrinkage can range from 0.16 to 0.72% (Kennedy 1968).

Specific Gravity

For a given wood sample, specific gravity is defined as the ratio of oven-dry sample weight to the weight of a volume of water equal to the sample volume at a specified moisture content (USDA 1999). Since specific gravity is a relationship or index, it has no units. Specific gravity is typically based on green volume or volume at 12% moisture content. The *Wood Handbook* (USDA 1999) reports an average specific gravity for quaking aspen of 0.35 based on green volume and 0.38 based on volume at 12% moisture content. This compares to an average specific gravity value of 0.38, with a variation from 0.30 to 0.46, reported for quaking aspen in the West by Wengert et al. (1985). An average value of 0.45, varying from 0.38 to 0.57, was reported green for aspen bark. The specific gravity of wetwood is 0.03 to 0.04 less than normal wood (Haygreen and Wong 1966).

Weight

Green aspen wood typically weighs 40 to 45 pounds per cubic foot, although the presence of wetwood can increase weight to 50 pounds per cubic foot or more. Wengert et al. (1985) reported average summer values for aspen of 41 pounds per cubic foot sapwood and 44 pounds per cubic foot for heartwood. Green aspen bark is heavier, averaging about 55 pounds per cubic foot. An average cord of green aspen will weigh between 4,000 and 4,500 pounds. Approximately 15% of this weight is bark.

Lynch and Jones (1998) found that green aspen logs hauled from the forest weighed approximately 82 pounds per merchantable cubic foot based on scaled sample loads. This means that if a merchantable cubic foot of wood actually weighs 40 to 45 pounds, up to 50% or more of the aspen being transported is bark or wood considered unmerchantable in the scale. Thus, hauling weights per merchantable cubic foot may be considerably higher than weights of green wood cited in tables. See the *Foresters Field Handbook* (Larrabee et. al. 1994) for information on scaling and log rules.

Wengert (1985) reported an average oven-dry weight of 24 pounds per cubic foot for aspen wood and 27 pounds per cubic foot for oven-dry bark. The weight of aspen wood at 12% moisture content averages 27 pounds per cubic foot. This equates to roughly 1,800 pounds per thousand board feet of lumber at 12% moisture content.

Mechanical Properties

Although mechanical properties specifically determined for quaking aspen from the Rocky Mountain West are not available, table 1 summarizes values given for quaking aspen in the *Wood Handbook* (USDA 1999). Aspen has a relatively low specific gravity, which tends to correlate with strength and stiffness properties. Therefore, aspen mechanical properties are low relative to most North American hardwoods.

Table 1—Mechanical properties of quaking aspen (source: Wood Handbook [USDA 1999]).

Property	Moisture content	
	Green	12%
Specific gravity	0.35	0.38
Static bending properties		
Modulus of rupture (psi)	5,100	8,400
Modulus of elasticity (psi)	860,000	1,180,000
Work to maximum load (inch lb/cubic inch)	6.4	7.6
Compression parallel to grain		
Maximum crushing stress (psi)	2,140	4,250
Compression perpendicular to grain		
Stress at proportional limit (psi)	180	370
Shear parallel to grain		
Maximum stress (psi)	660	850
Tension perpendicular to grain		
Maximum stress (psi)	230	260
Hardness		
Side (lbs)	300	350

Nailing Characteristics

Aspen accepts nails well and does not have a tendency to split. However, because nail joint strength is correlated to wood density, low-density wood species such as aspen do not tend to perform as well as higher density species. This is especially true regarding the resistance of wood to the withdrawal of nails. In addition, the withdrawal resistance of nails driven into green wood decreases as the wood seasons. The nail withdrawal resistance of aspen can decrease up to 90% during the seasoning process (Johnson 1947).

Processing Characteristics

Drying

Normal sapwood of aspen is easily dried. Aspen sapwood is typically dried rapidly. One-inch aspen lumber has been successfully dried in 36 hours using kiln temperatures up to 240 °F (Wengert et al. 1985). Aspen heartwood and wetwood are considerably more difficult to dry. Normal heartwood dries slower than sapwood because of tyloses present in the vessels. Using conventional kiln-drying schedules to dry 1¾-inch aspen lumber, Ward (1976) found that it took 90 hours to dry sapwood, 115 hours to dry heartwood, and 179 hours to dry wetwood.

Aspen wood is usually conditioned at the end of drying to reduce the effects of tension wood and case hardening. To accomplish this, a dry-bulb temperature of 180 °F is typically used. The wet-bulb temperature used varies based on the desired final moisture content (Wengert et. al 1985). Although the conditioning time required to relieve stresses in 1-inch boards varies, 6 to 12 hours is usually adequate.

Aspen wetwood is difficult to dry, requiring more time. Ward (1976) attributed this to higher moisture content and bacteria slime occluding the vessels of the wood. Numerous defects, including collapse, honeycomb, and ring failure, can occur as aspen wetwood is dried. Collapse is commonly associated with aspen wetwood. Collapse can occur during both air drying (Clausen et al. 1949) and kiln drying (Ward 1976).

Warp is a common defect associated with drying normal aspen wood. Warp occurs because aspen has a high tangential-to-radial shrinkage ratio and the presence of tension wood, which can be abundant in aspen. Rasmussen (1961) reported that the amount of warp experienced during drying can be minimized by using proper stacking practices.

The saw-dry-rip (SDR) curing process has been used to dry aspen studs (Maeglin 1979). In this process, logs are initially sawed into 1¾-inch flitches. The flitches are kiln-dried to the desired moisture content and then sawn into studs. This method eliminates most of the warp that usually occurs when drying aspen. However, when using the SDR method to process aspen, sorting is necessary to select optimum log diameter and to remove logs with wetwood (Boone 1990).

Machining

Machining includes sawing, planing, shaping, boring, turning, and sanding. Generally, aspen machines easily. The power consumption required to machine aspen is relatively low and tools dull slowly. Under appropriate conditions, good quality turnings, borings, and planed and sanded surfaces can be produced with aspen wood (Wengert 1976; Wengert et. al. 1985).

Numerous factors are known to affect the quality of machined surfaces (Davis 1962). Moisture content of wood can dramatically affect the quality of planed and sanded surfaces. Aspen wood should be machined at a moisture content of less than 12% and preferably less than 6%. Specific gravity can also be a factor. Wood species such as aspen with low specific gravity tend to yield poorer turning quality. Machine settings and processing conditions affect quality. The quality of planed surfaces are affected by knife angle, feed rate versus cutter head speed, and cutting depth. Based on data presented by Davis (1962), knife angles should be maintained at 25 to 30 degrees when machining aspen. A slow feed rate and a high cutter head speed (peripheral speed above 5,000 feet per minute) that maintains at least 22 cuts per inch should be used. Final cutting depth should be shallow, approximately 1⁄32-inch. When boring, a slow axial feed should be used.

One common defect that commonly occurs when planing or sanding aspen is "fuzzy" or "whiskered" grain. This occurs because aspen fibers often do not sever cleanly. This is partly due to the presence of tension wood. Wengert (1976) also concluded, based on limited personal observation, that wetwood machines poorly in comparison to normal wood. Sanding aspen with fine grit sand paper increases the severity of the fuzziness. Wengert (1976) suggested using special abrasives, anti-fuzz sealer, or a wash coat of sizing prior to final sanding.

Gluability

Aspen is one of the easiest types of wood species to glue. It bonds well with a variety of wood adhesives under a wide range of bonding conditions (USDA 1999). Because aspen wood has good absorptive properties, rapid assembly is usually required to avoid glue-starved joints (Wengert et. al. 1985). Additional water is also needed with some water-based adhesives to prevent premature drying.

Preservative Treatment

Both the heartwood and sapwood of aspen have little natural decay resistance. Because of this, aspen wood must be treated prior to use in applications where conditions are favorable for decay. Generally, only the sapwood is readily treatable, and small diameter aspen logs comprised almost entirely of sapwood usually treat best (Wengert et. al. 1985). Aspen is generally considered a relatively refractory species because heartwood has low permeability. Wetwood also has low permeability. Because of this, Cooper (1976) found that it was difficult to get uniform preservative penetration using a pressure treatment. However, double diffusion treatments have proven to treat aspen to satisfactory levels. Puetmann and Schmidt (1997) were able to adequately treat aspen boards with water-soluble borate preservatives that were applied using traditional dip-diffusion methods.

Finishing

Aspen holds paint well and is one of the best hardwoods to paint. Fiest (1994) reported that aspen accepts finishing, including stains and paint, similar to softwoods such as fir, pine, hemlock, and spruce. Aspen also absorbs stains readily, although absorption can occur unevenly causing a "blotchy" appearance. Wengert et al. (1985) suggested using a sealer or wash coat before staining to alleviate this problem. Aspen accepts ink well and can be printed using the direct application of ink on the wood.

Weathering

Aspen is moderately resistant to weathering (USDA 1999). Aspen weathers to a light gray color. The weathered wood tends to have moderate sheen. Weathering checks are usually small and inconspicuous. Testing conducted by Fiest (1994) revealed that aspen weathering characteristics are comparable to those of softwoods such as ponderosa pine, fir, hemlock, and spruce. Generally, finished rough-sawn surfaces weathered better than finished smooth surfaces and two coats performed better than one. Acrylic latex paint gave the best protection after 10 years of service. Semitransparent oil-based stains and solid-color stains also performed well. Transparent stains provided the least protection against weathering. Long-term weathering tests conducted on finished aspen waferboard by Carll and Fiest (1989) showed that finished panels generally had good weathering resistance, although evidence of decay was present in over 20% of vertically exposed painted panels tested in Mississippi and Wisconsin after 7 years.

Wood Products

Sawn Products

Quaking aspen logs have been processed into boards, dimension lumber, and timbers at sawmills in Colorado and the Rocky Mountain Region. Although some aspen is manufactured into studs, most aspen lumber is used to produce secondary products. End uses include construction framing (studs), pallets, boxes and crates, paneling, mine timbers, furniture, toys, and lumber core. Significant amounts of aspen have been used to produce studs, pallets, paneling, and mine timbers in Colorado.

Because aspen has a low specific gravity and correspondingly low strength and stiffness, aspen studs are not suitable for many structural applications and are used primarily for light frame construction (Thompson 1972). In addition, aspen studs are difficult to dry defect free. This is because of the high ratio of radial to tangential shrinkage and the abundance of tension wood and wetwood found in aspen. As a result, aspen is not a preferred species for stud manufacturing.

Virtually all Colorado pallet manufacturers consider aspen to be a suitable raw material for building pallets (Mackes and Lynch 1997). Aspen can be used to manufacture both permanent reusable pallets and expendable one-trip pallets. No special nailing is required if aspen is used only for deckboards. However, even though the majority of Colorado manufacturers said they would use aspen to build pallets if available at competitive prices, aspen currently constitutes less than 1% of the 50 million board feet used to build pallets annually in Colorado (Mackes and Lynch 1997).

Aspen is utilized to produce paneling. Aspen paneling is typically ½-inch thick, 4 to 6 inches wide, and cut to random length. Green aspen boards of various grades are normally used. No wane or rot is allowed. The boards are dried, usually in a kiln. After drying, the wood must be resawn, planed, shaped, cut to length, and in some instances stained. Paneling is marketed nationally either stained or natural.

Another use for aspen paneling is in saunas (Koepke 1976). Aspen is used as a substitute for redwood. Aspen is desirable because it does not readily splinter, stain in the presence of sweat, or undergo significant dimensional change with variations in environment. It is also more economical than redwood.

Products used in mines, including cribbing, caps, and wedges, can be made from aspen lumber. These tend to be applications where bending and resiliency is desirable. Mines prefer dry wood, but may accept green low-grade material (Koepke 1976). This material can have discoloration, some rot, and large knots.

Veneer and Plywood

Two principal types of plywood are manufactured: hardwood and decorative plywood, and construction and industrial plywood (USDA 1999). Aspen can be used to make both types. Hardwood and decorative plywood must conform to American National Standard ANSI/HPVA-1-1994 (HPVA 1994). Construction and industrial plywood is covered in Product Standard PS-1-95 (NIST 1995). Under this standard, aspen is classified as a Group 4 species based on strength and stiffness. Although quaking aspen from the Rocky Mountain West is considered suitable for making plywood, no aspen from Colorado forests is currently used for this purpose.

In addition to plywood, other products can be produced from aspen veneer. These include containers, matchsticks, and chopsticks. Material for chopsticks, for example, must be completely free of defect and very white in color to be offered for sale in the Japanese market. In our research (unpublished) of aspen product potential, we found that this rigid demand for quality and the tremendous quantity of wood required to service this market made Colorado aspen an unlikely supply source. Nearly all chopsticks are made from Canadian aspen. Aspen veneer is also used to manufacture stamped veneer products, including tongue depressors, spoons, and ice cream sticks.

Troxell (1976) summarized characteristics that make aspen desirable for veneer products. Aspen wood has relatively low density, soft texture, good machining properties, and dimensional stability. It is easily glued, has a lack of characteristic odor, and has good appearance. Important factors limiting aspen use were also given. These included small average log size, relatively low veneer yield, relatively high harvesting and processing costs, and low strength properties compared to most other veneer species.

Particleboard

Numerous types of particleboard, having a wide range of properties, are produced for a variety of end uses identified in the *Wood Handbook* (USDA 1999). Particleboard can be used for furniture cores. It can also be used in flooring systems, manufactured housing, stair trends, and underlayment. Thin panels of particleboard can be used as a paneling substrate.

Aspen wood is an excellent raw material for manufacturing particleboard. Aspen can be mixed with softwoods and other hardwoods to make particleboard (Gertjejansen et al. 1973; Stayton et al. 1971). Because aspen particles are low in density and bond well at relatively low pressure, aspen is particularly well suited for making low density boards that are strong and durable. Aspen particleboard is also produced with sufficient density and working properties, including adequate smoothness, dimension stability, machinability, and screw-holding capacity, for use in furniture and cabinet manufacture. Another desirable characteristic of aspen is its light color that is aesthetically appealing for particleboard.

Oriented Strandboard

Oriented strandboard (OSB) is a structural composite board (flakeboard). OSB has gained acceptance as a substitute for plywood in sheathing, decking, and decorative applications. Flakes or strands forming the panel are bonded together parallel to the plane of the panel. The strands forming OSB are longer than they are wide and are oriented in alternate layers that are perpendicular to each other. Typical strand size is 4.5 to 6 inches long, 0.5 inches wide, and 0.023 to 0.027 inches thick (USDA 1999). This differs from waferboard where flakes are approximately as long as they are wide and have random orientation in the panel.

Aspen is a preferred species for producing OSB in the United States. Because of its relatively low density, waferboard and OSB produced from aspen wood has a high compression ratio (Geimer 1976). This results in high bending strength and low porosity. Other wood properties that make aspen desirable include absence of resinous extractives and straight grain (Wengert et. al. 1985).

Pulp Products

Aspen wood is easily pulped by all commercial processes (Perala and Carpenter 1985). With regards to fiber morphology, aspen has an excellent length-to-diameter ratio, and fiber wall thickness is characterized as thin to medium. Aspen pulp is used to produce book, newsprint, and fine printing papers. The highest quality groundwood pulps are produced from aspen. Aspen pulp is also well suited for enhancing the structure of fine papers produced from kraft and sulfite pulps. Chemimechanical pulps produced from aspen are used primarily for hardboards and fiberboards. Because aspen has a relatively low density, it is desirable for producing low- to medium-density fiberboards.

Although used extensively for pulp in the Lake States and Canada, practically no aspen from Colorado forests is pulped. Wengert (1976) concluded that aspen pulping technology used in the Lake States and Canada is generally applicable to aspen from the Rocky Mountain Region; therefore, the lack of technology and basic research should not be a barrier to pulping aspen from Colorado forests. Barriers are more likely the result of marketing, economic, and/or environmental factors.

Excelsior

Excelsior is composed of long curly strands of wood that have been mechanically shaved from dry blocks of aspen. Aspen is the preferred species used to manufacture excelsior products. Excelsior is used primarily in evaporative cooler pads, packaging, erosion control mats for reseeding along highways, archery targets, and decorative material. Aspen wood is desirable for excelsior because it is lightweight and easily processed. Good absorbency properties, lack of characteristic odor, and neutral color are also beneficial.

Posts and Poles

Aspen is not a preferred species for posts and poles. However, some aspen is utilized for these types of products, including corral poles. As noted previously, aspen has little natural decay resistance and must be treated for most exterior applications. Because the heartwood is difficult to treat, small-diameter logs comprised primarily of sapwood are most commonly treated.

Animal Bedding

Aspen is an excellent choice for animal bedding and litter for many household pets, with the exception of ferrets, and is considered superior to both pine and cedar products. Curiously, aspen bedding is not available in retail pet stores. Pine and cedar products have gained acceptance in these markets and currently dominate. Both pine and cedar emit aromatic hydrocarbons that tend to mask animal odors. Pine currently dominates the horse and turkey bedding markets as well, although some aspen and cottonwood is used to bed horses.

Aspen is the preferred wood for use as bedding and litter for small laboratory mammals. Aspen is preferred to cedar and pine bedding products commonly found in retail pet stores because of health considerations and the potential impact of these considerations on test results. The wood of cedar contains plicatic acid and pine contains abietic acid. Prolonged exposure to these aromatic hydrocarbons can contribute to respiratory diseases such as asthma and liver or kidney disease.

Once dried, aspen has no characteristic taste or odor even after subsequent exposure to moisture. In addition, the wood is relatively neutral in color. It is low in specific gravity (light) with good absorbency. Toxicology studies conducted on aspen products reveal that the wood is typically low in biological toxins (fungi, aerobic plate counts, and coliform). The wood is also normally absent of pesticides and low in heavy metals such as arsenic, lead, mercury, and cadmium.

Animal Food Supplements

Wood and bark from species of the genus Populus have been used as an animal feed. Baker (1976) estimated the digestibility of aspen wood by ruminants at 35%. If properly supplemented, aspen can effectively be the equivalent of medium-quality hay. As part of ongoing research being conducted at Colorado State University, the use of aspen bark as a food supplement for captive wild and domestic animals is being investigated (Irlbeck et al. 2000).

Fuel

Although aspen is used extensively for fuel in the Lake States, fuel use in the Rocky Mountain Region is relatively low due to the lack of industrial users. Fuel use in this region is limited primarily to a few wood processors and home fireplaces.

Aspen has a heating value of approximately 8,000 BTUs per bone-dry pound (Lowry 1976). Harder and Einspahr (1976) reported a heating value of 8,897 BTUs per pound for quaking aspen bark. Because aspen has a relatively low specific gravity (0.37) compared to denser eastern hardwoods, a greater volume of aspen is required to yield the same amount of heat. Because of its low natural decay resistance, storing large amounts of aspen in piles for extended periods of time can cause problems, including a reduction in the heating value of the wood.

Moisture content has a significant impact on recoverable heat from combustion (Ince 1979). Moisture in the wood evaporates and absorbs heat of combustion. As a result, green aspen wood does not burn well. Panshin et al. (1950) reported that 3,440 pounds of green aspen wood yielded 10.3 million BTUs compared to 2,160 pounds of air-dried wood that yielded 12.5 million BTUs. This emphasizes the benefits of properly seasoning aspen wood prior to combustion.

Tourist and Gift Items

At least three firms are manufacturing and marketing tourist and gift products made from Colorado aspen (Lynch and Mackes 2000). These products are usually handcrafted from the wood of standing dead aspen. They are typically turned, sawed, or left in the round. Products such as candleholders, artwork, boxes, turned vases or bowls, and jewelry are common items. Although aspen has good working properties, the main reason that aspen is the preferred wood for novelties is because it sells, and primarily for emotional reasons (Koepke 1976). People (primarily tourists) relate these products to the positive experience of visiting the Rocky Mountains.

Summary and Conclusion

Although widely distributed, quaking aspen continues to be an underutilized species in Colorado and the Rocky Mountain West. Aspen has relatively low density and correspondingly low strength and stiffness. As a result, aspen is not well suited for many structural applications. However, because aspen is lightweight and has adequate strength it is desirable for many applications. Combined with other characteristics such as straight grain, resistance to splintering, neutral color, lack of characteristic odor (nonresinous), and good processing characteristics, aspen is a preferred wood species for many products. These include paneling, veneer products, including matchsticks and chopsticks, waferboard and OSB, fiberboard, pulp, excelsior, pallets, research animal bedding, animal food supplements, and tourist or gift items.

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