Part 3. Products, Uses, Economics

Using Eucalypts in Manufacturing[1]

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Abstract: Eucalypts have a number of characteristics affecting processing and utilization that distinguish them from other woods. The major current interest in the eucalypts is as a fuel. Possible demand as a chemical feedstock, for pulpwood, panel products, lumber or round timbers should be considered in initial planning and management as a hedge against changes resulting from economic, political or environmental pressures. In general, returns to the grower will be maximized by concentration on maximum yield (cubic volume x specific gravity) for energy, chemical feedstock and pulpwood uses. Specific gravity, as an indicator of strength, is also important for sawn products, round products and some panel products although processing considerations such as internal stresses and drying characteristics are important. Permeability of the wood for penetration by pulping chemicals or preservative solutions is important to pulpwood, and to sawn and round products. Characteristics such as specific gravity and fiber length can be manipulated to a considerable degree by species and seed source selection as well as by silvicultural manipulation.

The implications of these and other characteristics for utilization will be reviewed.

The eucalypts as a group are attractive because of their rapid growth. This results in very high yields on a volume basis and in combination with the comparatively high specific gravities, the yields of dry fiber can be truly impressive. Maximum yield of dry fiber is the logical goal when the anticipated use is for fuel, or as a chemical feedstock for processes such as destructive distillation. However, for solid wood products such as lumber and veneer, high specific gravity and the more complex anatomical structure may be quite disadvantageous when compared with softwoods.

The softwoods as a group are more efficient as a structural material, with a quite high strength to weight ratio. This superior rating relative to the hardwoods is not a consequence of any differences in chemical composition or relative amounts of cellulose and lignin present. The softwoods are composed almost entirely of a single cell type, the tracheid, with a length roughly 100 times the diameter. Hardwoods on the other hand have a more diverse anatomy (for oaks, 20 percent vessels, 40 percent fibers, 25 percent rays and 15 percent parenchyma). The fibers are the longest but length is generally one-third to one-eighth that of the softwood tracheids and with a poorer length to diameter ratio (only 40:1). In addition, other properties of the hardwoods make them more difficult to process.

The eucalypts, in addition to these general hardwood characteristics, typically contain high internal stresses and are prone to excessive shrinkage and distortion on drying. The net effect of these is to severely reduce the yield of usable material. Nonetheless, there are opportunities for the use of these woods for other products than energy or chemicals. They should be considered in planning any eucalyptus plantation since choices made then can substantially affect alternate use potential. Pulpwood is already in established use in California, as well as elsewhere. However, use in solid products such as sawn lumber and plywood and in round form for poles and piling, is not.

Use for Energy

The fuel value of woody cell wall substance is relatively independent of species, with a potential yield of between 8000 and 8500 BTU per dry basis. The differences between species result largely from the character of the extractives; those with a cyclic molecular structure are higher in value than straight chain structures such as sugars and starches. Burning characteristics generally improve with specific gravity although any hardwood above about 0.5 seems to burn very well when dry. Industrial fuel is sold on a dry weight basis and income will be maximized by concentrating on the yield of dry fiber. Cordwood for home heating is sold on a volume basis so income will be maximized by concen-

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trating on yield on that basis, as long as the specific gravity is high enough so it is perceived to be a "quality" fuel.

The eucalypts characteristically exhibit interlocked grain, in which the stem alternates between left hand and right hand spiral grain. While this has no significance for heat content, it does increase the effort required in splitting cordwood and also will result in rough look pieces that are somewhat more difficult to handle. Wetwood occurs in the heartwood of mature trees and drying is made more difficult. This may not be a problem in plantations where the young stems will be substantially sapwood.

Chemical Feedstocks and Charcoal

Although neither of these are at present a particularly viable primary product the possibility exists that either economics or process technology may change so that these could become attractive. The best strategy for maximum raw material value is the same as for industrial fuel, maximum yield on a dry weight basis. However, if the process eventually adopted requires penetration of the wood by a solution, the species should be one that does not develop tyloses in the sapwood cells after felling in order that the process liquor may penetrate the wood.

Pulpwood

It is well established that young eucalypts are well suited for pulping by a full range of processes to yield pulps suitable for a wide range of end uses. Pulps from high density species are often blended with those from low density species or softwood to yield high quality pulps. In short, the potential for young eucalypts to provide good quality pulpwood appears to be very attractive.

Panel Products

The different panel products that are manufactured of wood are usually classified as plywood, hardboard, particleboard and insulation board, although the distinctions between these classes have become blurred as technology has advanced.

High quality hardboard is produced in volume from the mature wood of a large number of eucalypt species. This indicates that, at least for wet process production, the eucalypts in general are well suited. Eucalypts can also be used for insulation board manufacture without excessive problems, but species of lower specific gravity are generally preferred.

Panels of intermediate density in the range of 40-60 pcf are usually classed as particleboards although they may also be described as medium density fiberboards and hardboards. E. saligna is used commercially for production of particleboard at one plant in Brazil. In general, the eucalypts are not as well suited for particleboard production as lower density species, especially softwoods. However, it should be noted that technology is advancing rapidly in this area and, at the 1982 annual meeting of the Forest Products Research Society, the keynote speaker observed that "It is now possible to manufacture panels whose properties are more dependent upon the process used than upon the species." Under this circumstance, the potential of the eucalypts should not be underestimated.

A small but significant portion of Australian plywood production is based on veneer from mature trees of several eucalypt species. Specific gravities below about 0.65 are required as is careful control of cutting parameters. Collapse and other forms of abnormal shrinkage are a problem and recovery of usable veneer is relatively low. Specific adhesive formulations and careful control are necessary to achieve good glue bond quality. "Excessive" end splitting of veneer logs, along with high shrinkage losses and kino defects, has contributed to the low veneer recovery from fast-grown young eucalypts. The wood makes a strong panel for structural use but appearance quality panels are not generally produced. Veneer for use green in wire-bound produce crating was successfully produced in Santa Cruz, California from E. globulus for a number of years.

Lumber

Eucalyptus lumber is widely used by the Australians for the equivalent of our structural light framing. However, there is some preference for radiata pine because it is less prone to warp. Some of the characteristics of the eucalypts that affect lumber manufacturing have been noted earlier Internal stresses lead to splitting, brittleheart and shake in the log, change in shape of the log during sawing and to warp of the sawn lumber. Kino, in pockets or veins, is a defect that is peculiar to the eucalypts and the wood of many species characteristically exhibits excessive cracking, shrinkage and collapse on drying.

Quite a bit of information has been developed on drying techniques to minimize degrade in timber from both mature and fast-grown young stands. However, checking, warp, shrinkage and collapse are all reported to be more severe in material cut from young trees.

Round Timber

Utility and construction poles, marine and foundation piles, posts and rails are all produced from eucalypts in other countries and these applications certainly represent potential markets in California. The characteristics of young, fast-grown timber of each species need to be examined carefully for suitability. The splitting of log ends and development of circular checks or shake, both due to growth stresses, are a serious defect that is commonly reported. Maximum sapwood thickness is a desirable goal and thin sapwood species are unsuited. Ease of preservative treatment is critical and so, while sapwood is generally presume to be treatable, this needs to be verified. Soft

rot attack of eucalypt poles well treated with arsenical salts is a problem of widespread concern and investigation. Heartwood of high durability is a plus and the higher strength of the eucalypts in comparison to the currently used softwoods is also very attractive.

Management to Improve Utilization Opportunities

A number of basic properties have been noted as being important for their effect on utilization potential and are to some degee [sic] under the control of the forest manager. These include wood density, cell dimensions, sapwood thickness and permeability, and growth stresses. Seed source is often but not always related to density and does not appear to be an important factor in fiber length. Seed source seems very important to growth stress intensity. Increased growth rate achieved by fertilization results in decreased fiber length and vessel diameter, a decrease or no change in density, no change in growth stresses, and an increase in sapwood thickness. When increased growth rate is achieved by thinning, fiber length and growth stresses are increased. Higher environmental temperatures improve fiber dimensions (longer and more slender) and frost may increase the occurrence of kino. Longer rotations decrease the percentage of product lost in conversion due to growth stresses. High soil moisture during harvest can result in higher residual stresses and techniques to reduce tree vigor in advance of harvest will reduce them.

These generalizations are based on observations of a large number of workers on a range of species in diverse areas of the world and should not be considered as certainties for any given species and cultural practice.

SUMMARY

The eucalypts are very attractive for their potential to augment wood supplies. There is little or no problem in their use for fuel or pulpwood and they have been shown to make excellent hardboard. There are impressive difficulties in conversion to solid wood products such as lumber and plywood but generally these problems can be managed at some cost. For those species with a wide and permeable sapwood, use as roundwood products represents an excellent opportunity provided that end splitting can be controlled.

The potential of the eucalypts for utilization in California has been clouded by the choice of E. globulus as the principal species for planting, since it is one of the more difficult species to process. Establishment of other, more readily processed, species will lead to a change in attitudes and in use. However, none of the species can be considered to be easily converted to solid wood products.

REFERENCE

Hillis, W. E.; Brown, A. G., eds. Eucalypts for wood production, Part G. East Melbourne, Australia: Commonwealth Scientific and Industrial Research Organization; 1978. 434 p.