Manufacturing Particleboard from Eastern Redcedar

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Gregory Lockwood and Mary Cardamone

Abstract:

Redcedar Problem in Oklahoma
Eastern redcedar, a species of juniper, is a low-quality wood that is considered a nuisance in Oklahoma. It is proliferating rapidly and is difficult to control.

Attempts to Control Redcedar
Extraction is a feasible approach but it entails significant costs.

A Possible Solution
In Oklahoma making particleboard out of redcedar appears to be the most economical and environmentally beneficial way to remove redcedar. This study analyzes the economic feasibility of this plan and the quality of redcedar particleboard.

Economic Feasibility of Supplying Redcedar to Manufacturers
Landowners can make use of state and federal programs that fully subsidize the cost of extracting redcedar from their property. The cost of transporting redcedar to particleboard manufacturers is usually less than what manufacturers will pay for redcedar furnish.

Procedure
To determine the suitability of redcedar furnish, single-layer panels comprised of round wood furnish and whole tree furnish were prepared to ASTD specifications.

Results and Discussion
The round wood particle board exceeded all ASTD standards. Whole trr particle board was just 2% below ASTD standards for internal bond strength and would very likely meet ASTD standards if just a small percentage of the bark and needles were removed.

Conclusions
Redcedar can be transported to particleboard manufacturers at a cost well below what they normally pay for other furnishes. Therefore, landowners can potentially extract their redcedar and sell it to manufacturers.

The Redcedar Problem in Oklahoma

1} Eastern redcedar is actually a member of the Juniper genus.

2} Redcedar is considered a nuisance in Oklahoma. It is low-quality wood and competes with vegetation needed by wildlife.

3} Redcedar has been proliferating for two decades.

4} Redcedar is highly adaptable.

5} Redcedar's greatest expansion is in Southwest and Northwest Oklahoma.

{ 1 Eastern redcedar (Juniperus virginiana L.) is not a true cedar but is a member of the Juniper genus. It is one of 13 juniper species native to the United States. It is a small evergreen tree, commonly 10 to 35 feet tall, with a pyramidal shape that becomes more round with age. Its distinctive bright red and brown heartwood is moderately soft.

{ 2 Currently redcedar is considered a nuisance in Oklahoma. Because eastern redcedar is a low-quality wood, it cannot be used for lumber. Furthermore, many wildlife species that need open range also are affected negatively by eastern redcedar because redcedar competes with more desirable forms of vegetation.

{ 3 Eastern redcedar has been proliferating in Oklahoma for over the last two decades. According to a 1996 report by Bidwell, the number of acres invaded by eastern redcedar increased from 3.5 million acres in 1985, to over 6 million acres in 1994.

{ 4 Eastern redcedar grows in many soils and under varying climatic conditions. This adaptability has enhanced redcedar's recent spread into areas where it was formerly rare or absent. A 1993 survey found that there were 30 million $ft.^3$ of redcedar in 18 eastern Oklahoma counties, namely Delaware, Mayes, Adair, Cherokee, Sequoyah, Latimer, Pushmata, McCurtain, Atoka, Coal, Bryan, Muskogee, McIntosh, Haskell, Le Flore, Pittsburgh, Choctaw, and Ottawa.

{ 5 The greatest areas of expansion have been in the southwestern part of the state, characterized by an arid climate and rocky soil, and the northwestern part of the state, primarily open prairie land dissected by waterways. In fact, state biologists are now concerned that encroaching redcedars may someday take over the tall grass prairies in northern Oklahoma.

Attempts to Control Redcedar

6} There are problems with the removal methods: (a) controlled burns, (b) spraying with chemicals, and (c) chaining and cutting (extraction). Extraction entails significant costs but otherwise is often the most feasible approach.

{ 6 Landowners try to control redcedar on their land using removal methods such as controlled burns, spraying with chemicals, chaining, and cutting. All of these methods present problems.

{ a Controlled burns are used to clear the redcedar infestation in large open areas. However, population growth and land development have decreased the frequency of this method. **{**

b Chemical application is a common method for managing areas of small and young tree growth, but it is not practical for large trees.

Redcedar can also be extracted using various methods. Large areas of very small trees and seedlings may be controlled through regular **{ c** cutting via brush hog mowers. Chaining is a method in which a large anchor chain is dragged between two bulldozers in a U-shaped pattern to catch the trees, generally those less than 8 feet in height, and pull them out by their roots. For areas with trees larger than 8 feet high, cutting by means of chainsaws, rotary saws, or hydraulic shears is the most common methods for tree extraction.

The cost for these extraction methods varies by landscape and tree density. Utilizing 1999 costs and custom rate prices, Stritzke and Bidwell found considerable differences in extraction costs for trees larger than 8 feet on acres with varying levels of tree densities per acre. For land with an average of 8 such trees per acre, cutting costs varied from $2.25/acre for using a rotary saw or hydraulic shears, to $5.28/acre for total tree extraction including roots using a hydraulic grubber. Chainsaw costs were approximately $2.56/acre on the lower end of the spectrum. However, using an average number of 154 such trees per acre from Stritzke and Bidwell's survey, the costs for chainsaw extraction grew considerably to $32.34/acre. On the other hand, costs were estimated as $15.55/acre and $16.50/acre for rotary saw or hydraulic shear and a hydraulic grubber, respectively. Besides the costs of extracting the trees, landowners in Oklahoma are still faced with the problem of piling and burning the trees, or otherwise removing them from their property.

A Possible Solution

7} Wood composition panels such as particleboard are commodity products manufactured in great quantities in the United States and are primarily used in the furniture industry.

8} The manufacturers of reconstituted wood products in Oklahoma utilize over $26.2 million in materials to produce $41.4 million of products.

9} In Oklahoma, making particleboard appears to be the most economical and environmentally beneficial way to remove redcedar.

10} This study analyzes the economic feasibility of this plan and the quality of redcedar particleboard.

{ 7 Wood composition panels such as particleboard are commodity products manufactured in great quantities in the United States and are primarily used in the furniture industry. According to the U.S. Census Bureau, the United States has 108 manufacturers that produce various types of reconstituted wood products such as particleboard, oriented strandboard, and medium density fiberboard. These manufacturers utilized over $2.9 billion in materials to produce almost $5.3 billion of reconstituted wood products in 1997. Some of these manufacturers use lumber mill by products such as chips, sawdust, and planer shavings. Others use non-foliage trees (round wood) or whole trees.

{ 8 Fourteen of these manufacturers [of reconstituted wood products] are located in Oklahoma. These establishments utilized $26.2 million in usable materials, primarily oak, pine, and hickory, to manufacture approximately $41.4 million of products in 1997.

{ 9 Using eastern redcedar in to manufacture particleboard appears to have the most economic and environmental advantages out of all means of removing redcedar in Oklahoma. A costly land management problem could potentially become a value-added product. **{ 10** The feasibility

of this plan, however, depends on the quality of the manufactured redcedar particleboard. It also depends upon the supply costs: the expense to landowners for cutting and delivering redcedar must not exceed what manufacturers are willing to pay for it.

The present study, therefore, consists of both an economic analysis of supply costs and experiments to determine the properties of particleboard produced from redcedar. To our knowledge, neither of these issues has been studied previously.

Economic Feasibility of Supplying Redcedar to Manufacturers

11} State and federal programs fully subsidize the cost of extracting redcedar. Landowners are only responsible for the cost of transportation.

12} Transportion costs—shown in Table 1—are about $9.25/ton, assuming a 100-mile delivery trip and no-cargo return trip.

13} Because manufacturers pay between $12.50 and $15.00 per ton for any form of acceptable particleboard furnish—which can potentially enable landowners to cover their transportation costs.

{ 11 Currently landowners can make use of state and federal programs that fully subsidize the cost of extracting or otherwise removing redcedar from their property. Therefore, the cost to landowners of supplying redcedar to manufacturers consists almost entirely of transportation costs. **{ 12**Transportation costs will vary for each landowner depending upon the vehicle load, distance to the manufacturer, and the costs of gasoline. Our estimate, however, is that most landowners can deliver round wood or whole tree redcedar to a manufacturer for approximately $9.25/ton, assuming a 100 mile delivery trip and a no-cargo return trip. Table 1 shows the specific assumptions that comprise this estimate.

TABLE 1. COST BREAKDOWN OF TRANSPORTING REDCEDAR TO MANUFACTURERS

Truck capacity (weight limited)	20 tons
Transportation time	6 hours
Loading and unloading time	1 ½ hours
Driver's wage (with benefits) Oklahoma Bureau of Labor Statistics	$17
Fuel cost (diesel)	$1.62 gallon
Mileage	9 miles/gallon
Maintenance costs	0.35/mile

Oklahoma particleboard manufacturers use various kinds of furnish, primarily lumber mill byproducts, and other kinds of wood waste. **{ 13**They **[manufacturers]** pay between $12.50 and $15.00 per ton for any form of acceptable particleboard furnish. We believe, therefore, that if redcedar proves to be a suitable furnish, landowners, in most instances, can more than cover their costs transporting extracted redcedar to a nearby particleboard manufacturer.

Procedure

14} Three redcedar trees were harvested. Two were limbed and their trunks were chipped. The third was chipped with branches and foliage.

15} The two limbed trees were used as the raw material for round wood particleboard furnish while the third tree was used for whole tree furnish. See figure 1.

16} We made 18 single-layer particleboard panels from the round wood furnish and 18 single-layer panels from the whole tree furnish.

17} Test samples were prepared based on ASTM D-1037 specifications.

{ 14 Three eastern redcedar trees with an average of 10.3-inch diameter at breast height (DBH) were harvested in Goldsby, Oklahoma. Two of the trees were limbed and only their trunks were chipped. The third tree, after being bucked into smaller segments, was chipped with branches and foliage using a commercial chipper. The chips were reduced into particles using a laboratory-type hammer mill without screening. Later, the furnish was dried to 5 percent moisture content in a 30-ft.^{3}capacity dryer.

{ 15 The two limbed trees were the raw material for round wood particleboard furnish. The other tree was used for whole tree furnish. Both kinds of furnish are shown in Figure 1.

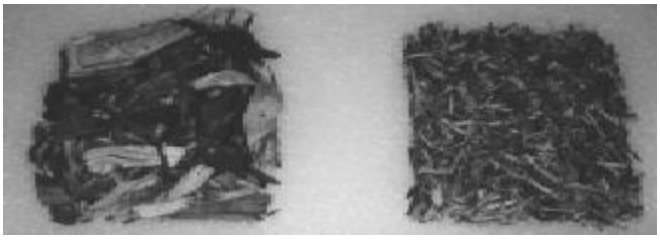

Figure 1. Whole tree and round wood furnish.

{ 16 Thirty-six single-layer mats with dimensions of 20 x 22 x 0.5 inches were manually formed in a frame prior to being pressed into particleboard panels. Eighteen mats were composed of round wood furnish and 18 were composed of whole tree furnish. Urea-formaldehyde resin with a solids content of 65.8 percent was used as binder for the panels. The furnish for each panel was mixed with 7 percent resin in a rotating-drum mixer for 5 minutes. No wax was used in this process.

{ 17 Test samples were prepared based on ASTM D-1037 specifications and conditioned at a temperature of 70 degrees Fahrenheit and 55 percent relative humidity before any tests were carried out. Modulus of elasticity (MOE) and modulus of rupture (MOR) were determined on a Titus Universal system and a Comten tensile tester was employed for internal bond strength (IB) tests.

Results and Discussion

18} Modulus of elasticity (MOE) values, modulus of rupture values (MOR), and internal bond strength (IB) were ascertained (Table 2). The round wood particleboard exceeded ASTD specifications. The IB values for the whole tree particleboard were just 2% below ASTD standards.

19} It appears that by removing a small amount of bark and needles during manufacture, the whole wood furnish would also meet ASTC specifications.

{ 18 As shown in Table 2, the average MOE and MOR values for round wood furnish were 346,386 psi and 2,344 psi, respectively. The average MOE and MOR values for whole tree furnish were 329,651 psi and 1,848 psi, respectively. These values exceed ASTD specifications. Although MOE and MOR values of the panels made from whole tree furnish were 4 and 9 percent lower than those of the round wood panels, these differences are not statistically significant.

The IB values for the round wood furnish were 172 psi, thereby exceeding ASTD specifications. The IB values for the whole tree furnish were 148 psi, 13 percent lower than the values for whole wood and 2 percent below ASTD specifications.

{ 19 The whole tree furnish, however, was not screened to eliminate any bark or needles during the panel manufacturing. It appears that by screening a small percentage of the furnish, the IB value would meet ASTD specifications.

TABLE 2. TEST RESULTS COMPARED WITH ASTD MINIMUM STANDARDS FOR PARTICLEBOARD.

Test	Round wood Furnish	Whole tree Furnish	ASTD Minimum Standards
Modulus of Elasticity (MOE) (in psi)	346,386 (54,014)*	329,651 (32,651)*	*320.000*
Modulus of Rupture (MOR) (in psi)	2,344 (341)*	1,848 (335)*	*1,700*
Internal Bond Strength (IB) (in psi)	172 (24)*	148 (26)*	*150*

*Standard deviations

Conclusions

20} Redcedar can be transported to manufacturers at a cost well below what manufacturers normally pay for other furnishes, round wood furnish can be used to manufacture particleboard.

21} Further studies should focus on increasing the IB values of whole tree furnish and three-layer panels should be tested.

22} Potentially, the use of redcedar in the manufacturing of particleboard could motivate landowners to extract more redcedar from their land.

{ 20 Economic analysis shows that round wood and whole tree red cedar can be transported to particleboard manufacturers for a cost well below what these manufacturers typically pay for other kinds of furnish. Furthermore, round wood furnish is suitable for use as particleboard.

{ 21 Further studies should focus on means to increase the IB value of whole tree furnish, either through screening to eliminate bark or needles during manufacturing or through other means. Three-layer panels should also be tested. **{ 22** Potentially, the use of redcedar in the manufacturing of particleboard could motivate landowners to extract greater quantities of redcedar from their land.

Reference List

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