NC-144
RP
C.2

DA FOREST SERVICE
SEARCH PAPER NC-144

SECONDARY WOOD

RESIDUE: Production, Use, and Potential In The TWIN CITY Area

EUGENE M. CARPENTER

NORTH CENTRAL FOREST EXPERIMENT STATION
FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

North Central Forest Experiment Station
John H. Ohman, Director
Forest Service — U. S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108
Manuscript approved for publication May 12, 1977

1977

CONTENTS

Page
Study Methods 1
Amounts and Kinds of Residue 2
Disposal 3
Trends 4
Potential Uses 4
Summary 5
Literature Cited 6

SECONDARY WOOD RESIDUE: PRODUCTION, USE, AND POTENTIAL IN THE TWIN CITY AREA

Eugene M. Carpenter, *Market Analyst*
Duluth, Minnesota

Manufacturing wood products from lumber, plywood, and particleboard inevitably produces sawdust, shavings, and trim. Much of this waste material is discarded, and little has been done to investigate potential salvage opportunities. Salvage of this waste material could augment the supply of wood fiber, alleviate the environmental impact and reduce the cost of solid waste disposal, and help overcome the energy crisis.

To get a better understanding of the wood waste problem and the salvage potential we set out to investigate the amounts and kinds of wood residue developed by secondary wood product manufacturers in a selected metropolitan manufacturing area, to determine what disposal was made of the material, and to identify physical characteristics, location, costs, and potential markets.

STUDY METHODS

The Area

The study encompassed the Minneapolis-St. Paul metropolitan area, and included the Counties of Anoka, Dakota, Hennepin, Ramsey, and Washington (fig. 1). Although this area is approximately 50 miles wide by 60 miles long, the bulk of the residue produced is within a 20-by-30-mile area in Hennepin, Ramsey, Washington, and northern Dakota Counties.

Data Collection

Data from firms generating less than 1 ton of wood residue per week were collected by telephone. Information was requested on volume by species and kind of residue, moisture content, contamination, methods of disposal with resulting income and/or costs incurred, and anticipated changes in any of these factors in the near future. Firms producing a ton or more of wood residues a week were visited in person. At that time samples of the coarse and fine residues were obtained where possible. Fine residue is sawdust, shavings, sander dust, and router chips; coarse residue is the solid trim from lumber, plywood, and particleboard.

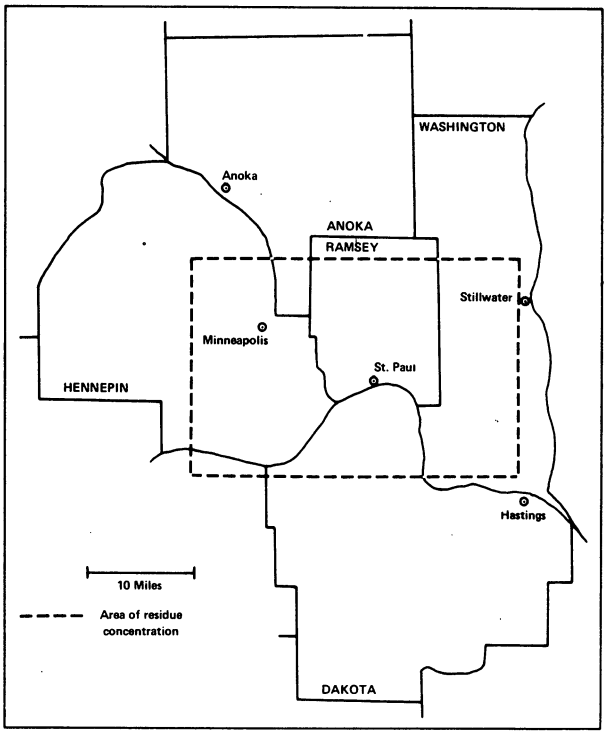

Figure 1.-*Map of Minneapolis-St. Paul, the Study Area.*

Residue estimates were collected from 91 firms in selected Standard Industrial Classes (SIC) that are considered secondary wood product manufacturers:

Product Description	*SIC*	*Number of Plants*
Hardwood dimension and flooring	2426	6
Millwork and related products	243	54
Wood containers and pallets	244	9
Miscellaneous wood products	249	5
Furniture	251	3
Fixtures	254	14
		91

The samples of fine residue were evaluated by placing the material in a drum with a perforated, weighted, floating lid. The drum was dropped and shaken to simulate the compaction that might be achieved by treading the material while loading a truck. One cubic foot of the compacted material was weighed, placed in a moistureproof bag, and taken to the laboratory for screen analysis and moisture content determination. The fine residues were screened through a Williams Standard Pulp Testing Apparatus with six 24-inch square trays. After being shaken for 5 minutes the trays were weighed, then shaken for another minute, and reweighed. Only minor changes were recorded from the additional shaking. Sieve sizes were 1 inch, 1/2 inch, 1/4 inch, 1/8 inch, 1/16 inch, 1/32 inch, and dustpan.

An estimate was made of the size of the coarse residue pieces, and samples were bagged for moisture content determination. Moisture contents are reported on a green basis for both fine and coarse residues.

AMOUNTS AND KINDS OF RESIDUE

About 32,000 tons of residue were generated in 1974 by all secondary wood product manufacturers in the study area. Of this, 10,295 tons were used for fuel, 10,101 tons were dumped or given away, and 11,836 tons were sold.

Five millwork firms burned their residue for plant or process heat and hence did not estimate amount generated. All indicated that none of their residue would be available for another use. We estimated that these firms generated about 9,500 tons annually, but these data are not included in the following analysis.

Fine Residue

Forty-two firms generated 12,785 tons of fine residues annually. These fine residues were kept separate from other residues and trash. Twenty of the 42 firms produced 50 tons or more annually and accounted for 98 percent of the total amount of fine residue produced.

We classified the fine material as hardwood or softwood based on botanical origin, that is, from broadleafed trees or conifers, and not on the density of the wood, and as shavings, sawdust, or a mixture of the two.

Of the 12,785 tons of fine residue, 80 percent is hardwood sawdust or shavings, nearly all mixed together by 16 firms. Two firms have small amounts of hardwood shavings, and three firms have small amounts of hardwood sawdust. The remaining 20 percent is a conglomerate of hardwood and softwood sawdust and shavings mixed together, produced by 19 firms.

The weight of mixed shavings and sawdust ranged from 6.0 to 17.5 pounds per cubic foot as collected, and 5.4 to 16.2 pounds per cubic foot ovendry (table 1). Sawdust ranged from 14.1 to 15.4 pounds green, and 8.8 to 14.0 pounds ovendry. Green shavings weights were 4.5 to 16.6 pounds, ovendry were 3.8 to 7.9 pounds.

About two-thirds of the fine residue had a moisture content of 10 percent or less, and 22

Table 1.—*Average weight and size characteristics for fine residue samples*

Kind of material	Samples	Weight per cubic foot		Size of material[1]	
		Green	Dry	<1/8 inch	1/8 inch+
	Number	*- Pounds -*		*- - - Percent - - -*	
Sawdust and shavings	12	12.1	10.5	68	32
Sawdust	3	14.7	10.0	99	1
Shavings	2	10.5	5.8	17	83

[1]Sample percents were weighted by annual volume to derive the table value.

percent was from 10 to 25 percent. Only 13 percent had a moisture content between 40 and 55 percent, green basis. The wettest material came from wood container and pallet firms.

Nearly all the mixed samples, passed through the 1/2-inch screen, and none had as much as 1 percent of material 1 inch or larger. Less than 2 percent of the shavings samples stayed on the 1-inch screen.

Contamination was not a problem in the fine residues.

Coarse Residue

Seventy-one firms generated 9,947 tons of coarse wood residues in 1974. Twenty-eight of these firms produced more than 50 tons annually; the top five yielded slightly more than half the total amount. Mixtures of fine and coarse residues were classed as coarse. Only small amounts of fines were included in these mixtures. Most of the coarse residue is either hardwood lumber trim or a mixture of lumber, plywood and/or particleboard (table 2). A small amount of hardboard is included in the mixed categories.

Trimmed blocks, strips, and edgings of lumber, plywood, and particleboard from 1/2- by 1/2- to 4- by 6-inch widths in lengths of 1/2 inch to 16 feet were discarded. The wider lumber waste is generally less than 3 feet long with 6 to 10 inches common. Most of the longer material is less than 8 feet long, mostly thin strips. Occasional pieces of plywood or particleboard were found with surface areas up to 200 square inches; they were in every imaginable configuration.

Table 2.—*Distribution of coarse residue by species and kind of material*

Kind of material	Number of firms	Tons	Percent
Lumber--Hardwood	13	4417	44
Lumber--Hardwood and softwood mixed	3	1341	13
Plywood--Hardwood and softwood mixed	1	17	([1])
Particleboard--Hardwood and softwood mixed	2	142	1
Mixed solid[2]--Hardwood and softwood mixed	27	3282	33
All mixed[3]--Hardwood and softwood mixed	25	748	8

[1]Insignificant amount.
[2]Mixture of lumber, plywood, and/or particleboard.
[3]Includes both fine and coarse residues.

More than 70 percent of the coarse residue had a moisture content less than 15 percent; a small amount was in the 20-percent range, and about one-quarter was in the 50-percent range.

Contamination was minor for coarse residue. The firms who mixed their residue with other trash said foreign materials could easily be kept separate if markets were found for the wood portion. Occasionally paint or other finishes were found, but the most serious contaminants were vinyl overlays or high density laminates. However, these were extremely rare.

DISPOSAL

Fine Residues

Most of the fine residues were used. Eleven firms reported dumping the material, but they accounted for less than 1 percent of the total volume. Four percent of the total was used for plant fuel by two firms.

Seventy-six percent of the fines were sold and 19 percent were given away, mostly for animal or poultry bedding. At least four sawdust and shavings dealers operate in the study area, but several firms dealt directly with local farmers.

The market was generally unorganized. Price was negotiated on an individual basis, and depended somewhat on dryness, volume, and loading facilities. Prices reported ranged from $0.22 to $2.86 a cubic yard, with $0.75 an approximate average. Those firms giving away their fine residues seemed satisfied to have the material removed regularly at no cost.

Coarse Residues

Disposal of coarse residues was generally a problem. Sixty-three percent was dumped or burned as waste by 62 firms. Most firms contracted to have material hauled away; a few used their own trucks. Thirteen percent was given away for fire wood or youth group woodworking projects. Two percent was used for plant or process heat by three firms, and 22

percent was sold to charcoal manufacturing plants by two firms.

Annual disposal costs reported ranged from zero to $9,000, with a dozen firms indicating annual expenses of more than $1,000. Costs averaged about $2.25 per cubic yard. Many of these firms had investigated alternative disposal methods including chipping and fuel. However, investment requirements were too high to justify installing necessary processing equipment for the amount of residue generated.

Although almost all firms would welcome an alternative to dumping the residue, surprisingly few considered disposal to be a big problem. Many firms that paid several hundred dollars per year for disposal probably did not consider this an exorbitant amount relative to their costs of doing business.

TRENDS

Most of the 91 firms interviewed indicated they did not expect any significant change over the next 3 years in the amount or kind of residue produced. Three firms had definite expansion plans and estimated a doubling of residue production. A few firms commented that their business activity was slightly depressed and they would expect moderate increases only if the economy improved. A few others expressed the contrary view that business was good during the study period. Thus, there was no consensus to suggest residue volumes were adversely influenced by the state of the economy for the groups studied.

None of the firms expected to substitute other materials for the wood components in their products or processes. Also, none indicated they planned to change the methods they were using. For example, none planned to increase the use of cut-to-size or prefinished parts, which might shift residue accumulation outside the study area.

POTENTIAL USES

Fiber Potential

The current extensive use of the fine wood residues for animal and poultry bedding will continue. And, although the market in the study area is presently somewhat unstructured, demand is strong and will compete with any attempt to divert material to other uses.

Minnesota's status as a leading producer of turkeys creates a market for 5 to 6 million cubic feet of loose litter annually. In addition, the broiler chicken industry requires about a million cubic feet. Bark-free, dry shavings are preferred for this use. An attempt by a local processing firm to convert coarse lumber trim to shavings for animal bedding was unsuccessful.

Specialty markets for pet and laboratory animal bedding exist. These products command relatively high prices, but require special processing, including sterilization.

The manufacture of wood flour from dry wood residue is described by Reineke (1966). Primary uses are in the manufacture of linoleum, explosives, and plastics. Total consumption is not large, and consumer requirements are rather exacting.

The manufacture of floor sweeping compounds from dry sawdust is usually a sideline for firms engaged in other wood processing activity or by small specialty firms with local or regional distribution (USDA 1966).

The coarse material has poor potential for use as a pulp furnish because of the low moisture content, mixture of species, and the problem of developing a suitable pulp chip from the conglomerate of trim. One exception might be as a furnish for the less particular roofing-felt market. Some of the fine material has been used for this product.

Both fine and coarse residue can be used for particleboard manufacture because dry material is usually preferred. However, no local market exists, and the supply is too limited, to support an efficient particleboard mill. Transportation costs prevent the shipment of all but the highest quality dry shavings to regional particleboard markets.

Charcoal manufacture offers a potential market for the half of the coarse residue that is hardwood. However, charcoal producers are located outside the study area and transportation costs are probably prohibitive for most accumulations.

Fuel Potential

The use of secondary plant wood residues for fuel offers a real potential because of the low moisture content of the material. There are several types of burning systems available, many requiring a homogeneous furnish with particles less than 1/8 inch in size. Thus, the fine residues would need only minor processing. The coarse residues would need chipping or coarse hammermilling in addition to further reduction in a fine hammermill. Fluidized bed boilers are available to burn unprocessed coarse material, although processing increases efficiency.

An average of 8,500 Btu's per pound is a commonly used "higher heating" value for ovendry wood. Using this base, and adjusting for average as-fired moisture content, it is estimated there are approximately 309 billion Btu's potentially available from the wood residue in the study area, excluding the amount now being burned for plant fuel.

Fuel Comparisons

Assuming that No. 6 fuel oil produces 150,000 Btu's per gallon, costs 32¢ per gallon, and has an 80 percent combustion efficiency, the cost of fuel to produce steam would be $2.67 per million Btu's. To equal this cost burning wood as a fuel, the producer could afford to pay as much as $13.60 per ton for green wood and $28.87 per ton for dry (Arola 1975). (Green wood is estimated to yield 4,250 Btu's per pound and a combustion efficiency of 60 percent; dry wood yield is 7,735 Btu's per pound and a combustion efficiency of 70 percent.) This comparison does not consider that capital costs for wood burning equipment are higher than for oil fired units. But, where residue is available at low cost, payback periods are encouragingly short. A similar comparison for western soft coal, assuming 8,600 Btu's per pound, a cost of $21.50 per ton, and a 70 percent combustion efficiency, shows a cost of $1.79 per million Btu's. To equal this cost, the producer could pay as much as $9.11 per ton for green wood and $19.34 per ton for dry.

Weighting the wood residue not now being used for fuel by its moisture content and related combustion efficiency, we estimate the material has a fuel value of nearly $500,000 as a substitute for oil.

SUMMARY

A large portion of the wood residue in the Minneapolis-St. Paul area is produced by a few firms. The largest individual accumulations were at hardwood dimension, millwork, and pallet plants. The bulk of the material was concentrated in the central part of the study area.

Disposal of fine residues is not a problem for study area firms: nearly all of this material is being used. A large portion is sold for animal bedding or burned for heat. On the other hand, coarse residues are costly to dispose of, and nearly two-thirds are discarded as waste.

The residues have several desirable characteristics. Most have a low moisture content and are free of bark. A high percentage of the fine residue are less than 1/8 inch in size, which is desirable for suspension burning. Contamination is not a serious problem, even for most of the coarse residue.

The mixture of species or kinds of material is detrimental for some uses, and low value makes sorting impractical. This is not a problem for fuel, and is the reason this use may be worthwhile considering. Also, it may not be practical to consider manufacturing a product for markets now satisfied from other sources simply because the residue exists.

Because these residues are centrally located, and currently being placed in mechanized dumping containers, it would seem logical the material could be trucked to a central processing station at little additional cost. If used to produce fuel at an existing wood products plant it would then be feasible to invest in processing and boiler equipment. The disposal cost would likely be eliminated for most firms. More importantly, the resource would be utilized.

Now that information is available on amounts, location, and disposal of the material, careful economic analyses can be made for each potential use as prospective utilization opportunities are identified.

LITERATURE CITED

Reineke, L. H. 1966. Wood flour. USDA For. Serv., For. Prod. Lab. Res. Note FPL-0113, 13 p. Madison, Wisconsin.

U. S. Department of Agriculture, Forest Service. 1966. Sawdust floor sweeping compounds. USDA For. Serv., For. Prod. Lab. Res. Note FPL-0115, 4 p., Madison, Wisconsin.

Arola, Rodger. 1975. How to compare fuel values. USDA For. Serv., 7 p., North Cent. For. Exp. Stn., St. Paul, Minnesota.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1977--767588/42 REGION NO. 6

Carpenter, Eugene M.
1977. Secondary wood residue: production, use, and potential in the twin city area. USDA For. Serv. Res. Pap. NC-144, 6 p. North Cent. For. Exp. Stn., St. Paul, Minnesota.

Presents volume, characteristics, disposal, and uses for wood residues from secondary wood manufacturing plants in Minneapolis-St. Paul, Minnesota.

OXFORD: 839.8(776). KEY WORDS: wood waste, waste disposal, energy, fuel, wood products.

Carpenter, Eugene M.
1977. Secondary wood residue: production, use, and potential in the twin city area. USDA For. Serv. Res. Pap. NC-144, 6 p. North Cent. For. Exp. Stn., St. Paul, Minnesota.

Presents volume, characteristics, disposal, and uses for wood residues from secondary wood manufacturing plants in Minneapolis-St. Paul, Minnesota.

OXFORD: 839.8(776). KEY WORDS: wood waste, waste disposal, energy, fuel, wood products.

Sing along with Woodsy and help stop pollution.