MILL RESIDUES - WHAT ARE THEY REALLY WORTH?

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This morning I'd like to talk to you about a subject that I think you will find quite interesting. Most of you are already using mill residues to fire your hog fuel boilers. For those few of you that aren't doing so yet, I'm sure that your management is probably in the process of evaluating a waste fired system of some sort.

The purpose of my talk is to give you some insight regarding the economics of residue utilization. I'll discuss with you the alternative uses for each type of residue; what we've found out about how much of each type you're likely to be producing; and how much it's worth in its various uses. I'll also show you the relationships we've found between the use of residues for plant fuel and the percent of lumber production which is kiln dried. Finally, I'll discuss briefly the system features which your management has indicated they would like to have in a waste fired system.

Approximately four years ago, Moore Oregon embarked upon a course of action, the objective of which was to become a major factor in the field of wood residue energy conversion systems. This objective seemed to dovetail nicely with our historic operations which have been involved with the seasoning and drying of lumber and veneer through the application of heat energy under controlled conditions, and with machinery to increase the efficiency with which lumber and plywood are handled as they pass through various stages of their manufacturing cycles.

At each stage of manufacture, residue is generated which must be disposed of in one of four ways. It can be sold, burned, landfilled, or used for plant fuel. The determining factors which dictate which of these four alternatives will be selected are (1) the availability of residue markets, (2) the distance to those markets, (3) environmental regulations, and (4) the cost and availability of alternative fuels, mostly natural gas and oil.

During the past year, especially, mill owners have seen dramatic changes, both in the availability of residue markets and in the market value of their residue products. Chip prices, for example, skyrocketed from under $20 a unit in early 1974 to over $60 later in the year. Recently, however, in some areas, it's been tough just getting rid of chips at any price. Many mills, with the flexibility to do so, have switched to cedar rather than add to their already bulging chip inventories. In other areas, curtailments in particleboard production have forced sawmills to cut back operations in order to avoid being swamped with shavings. At the same time, air and water pollution regulations have all but eliminated the residue disposal options of burning and landfilling. This brings us to the last alternative: plant fuel.

Let's take a look now at wood residue as plant fuel.

In August, 1973, Stanley Corder of the Forest Research Laboratory at Oregon State University, published a research bulletin called Wood and Bark as Fuel. In his fuel cost comparison table, he listed some prices for various fuels. Wood and bark residue was quoted at $2 to $4 a unit. The average cost per therm of all of the residue types listed was just over 2.6¢. The price of these residues has remained essentially stable. In the meantime, the price of oil, quoted then at $4.20 to $4.80 per barrel has nearly tripled, and gas prices, quoted at 4.4¢ to 4.8¢ per therm have risen over 250%.

Payback periods in the three year range were cited by Mr. Corder on wood fired systems versus gas and oil fired equipment. Recent proposals we made had payout periods of less than a year. In many cases, we found that by leasing residue fired equipment, the monthly lease payments are substantially less than former fuel costs.

To illustrate the real value of wood residue in terms that you, as kiln owners and operators can relate to quite easily, I've prepared a little example. Let's say, for instance, that you have $120 to spend to dry some lumber, so you go down to your local fuel dealer to buy some oil. For your $120, he'll sell you 10 barrels of oil, delivered to your plant, and with this oil you can dry about 21 mbf of lumber. Your fuel cost in this case is just under $6.00/mbf. Well, that seems a little high, so you walk across the street to the gas company. There you find that your $120 will buy you enough gas to dry around 35 mbf. That's better. Your fuel cost is down to $3.42/mbf. The only trouble is that the gas company can't guarantee to deliver the gas when you need it, so you drive on back to your mill. As you're driving along, wondering what to do, a truck passes you carrying a load of hog fuel. So you rush back to the office and discover that you're selling hog fuel at $3/unit. At that rate, your $120 would buy enough fuel to dry 160 mbf. . . nearly five times as much as you could have dried with gas for the same price, which you couldn't get anyway; and almost eight times what you could have dried with 10 barrels of oil. Your fuel cost for your kilns is down to 75¢ per mbf.

We thought this was pretty interesting, too, so we designed a survey to try to find out all we could about sawmill residues. The survey covered 79 mills in Oregon and California. Mills were chosen on the basis of location, size and the availability of a management person to be interviewed. Geographically, the areas we covered are shown in Figure 1 and 2. They correspond with the major lumber producing areas of each state. The annual lumber production of the mills we interviewed was nearly four billion board feet (Figure 3). This is about 30% of the two state total. The reason for choosing Oregon and California for our survey is that they are, by far, the two largest lumber producing states in the country. Together, they represent some 35% to 36% of all lumber produced in the United States.

Of the mills in all size classes drying more than half their production in kilns, nearly 95% are already using wood residue fired boilers. The situation is reversed for mills drying less than 50% of their production, with something like 70% using gas or oil fired boilers (Figure 4).

Bark residue, (Figure 5) as you might expect, was most commonly used for plant fuel. Nearly half the mills contacted used an average of almost 80% of their bark in this manner. The second most popular use for bark was to sell it for hog fuel. Livestock bedding and mulch accounted for an average 3/4 of the bark residue from just under 30%

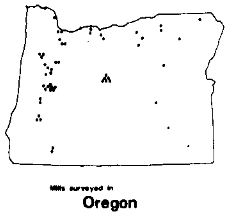


Figure 1

Figure 2

MILL SIZE	NUMBER CONTACTED	NUMBER IN SIZE CLASS	PERCENT CONTACTED	ANNUAL PRODUCTION · MMBF	
				CONTACTED	D.O.C.
Under 40 Mbf/shift	2	95	2 %	11	—
40 - 79	9	103	9 %	253	—
80 - 119	24	124	19 %	769	—
120 and over	44	154	29 %	2,850	—
Totals	79	476	17 %	3,883	13,471

Figure 3

BOILER FUEL	PRODUCTION—KILN DRIED	
	OVER 50%	UNDER 50%
HOG FUEL	35	5
GAS/OIL	2	12
TOTAL	37	17
MILLS USING DRY KILNS	54	
WITHOUT DRY KILNS	20	
TOTAL MILLS REPORTING	74	

Figure 4

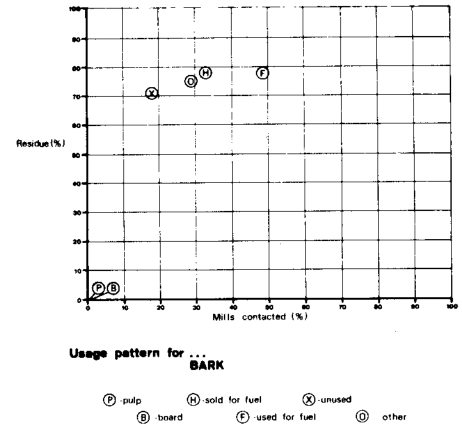


Figure 5

of the mills. Nearly 20% of the mills surveyed reported unused bark residue. None was sold for pulp or board products.

The price for bark as fuel was very low, averaging only $2.85 per unit (Figure 6). According to Stanley Corder at Oregon State University, the dry weight in a green unit of Douglas-fir bark is in the neighborhood of 2600 pounds.

The heating value of a dry pound of bark of this species is approximately 10,500 BTU per dry pound. Even after deducting the heat loss to evaporate the moisture in a unit of Douglas-fir bark, the theoretical value per therm (100,000 BTU) is just over one cent! By way of comparison, coal, in trainload quantities, delivered to an electrical generating facility in Washington, costs 4¢ per therm.

Only 13 mills had any data on bark production. The average was 0.30 units/MBF, which would be equivalent to between 630 and 780 pounds (Figure 7). This is somewhat higher than has been reported by others. The most likely explanation is that the terms bark and hogged fuel are sometimes used synonymously. Hogged fuel would tend to include some amount of white wood in addition to the pure bark content.

Sawdust, Figure 8, was also used extensively for plant fuel. Thirty-five percent of the mills reporting used an average of 80% of their sawdust in their boilers. No strong market demand appeared in any other uses for sawdust. Pulp and board mills absorbed nearly equal amounts from about the same number of mills. A few mills, all cutting redwood, reported no use at all for their sawdust.

With 17 mills responding, the average amount of sawdust produced was 0.224 units/MBF (Figure 9). The units referred to here are 200 cubic foot units of varying weight, depending upon moisture content. In general, a unit of sawdust would contain about 1700 to 1900 pounds of dry wood fiber.

The revenue picture for sawdust is a confusing one (Figure 10). As fuel, it's value is very close to the one we just saw for bark, with about the same range. In the pulp market, however, prices were reported all the way from $3/unit to $15/unit. . . a 5 to 1 spread. This probably reflects the spread between contract and spot sale prices during 1974. In the "other" catagory I've shown 2 figures. The average value per unit for other uses, mostly agricultural uses, was $5.80. The median value was only $3.00/unit, however, which means that there were just as many sellers in the $1 to $3 area as there were in the $3.00 to $12.00 range.

The strongest market for shavings, Figure 11, was for board products, as expected. The next most popular use, however, was for plant fuel. This might explain the fact that, of all the residue classes, shavings was the only one in which nothing was left unused.

Shavings (Figure 12) also shows the highest average value per unit: $4.50. Comparing dollars per unit between residue catagories can be misleading, however. A unit, defined as 200 cubic feet, of dry planer shavings only contains about 1600 pounds of oven dry material. So, whereas it appears that the average dollar value of a unit shavings is about 60% higher than the value of a unit of hogged bark (bark being @ $2.85/unit), the actual dollar value per unit of heating value is something like 330% higher. At $4.50/unit, dry shavings will bring 3 1/3¢/ therm compared to bark at a penny.

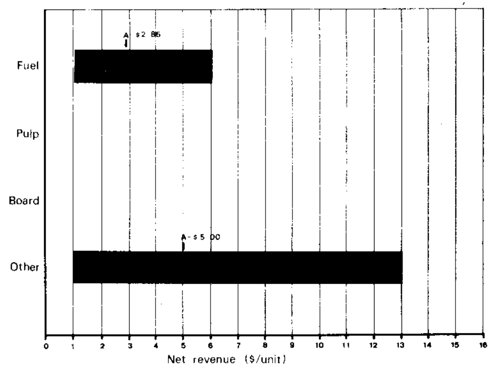
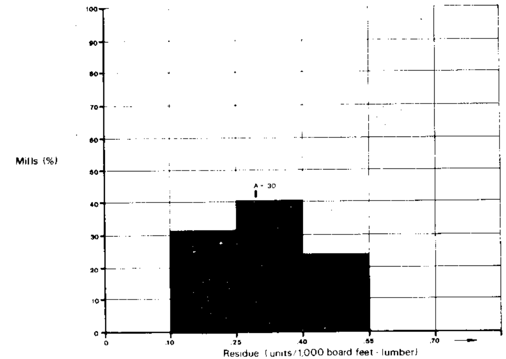


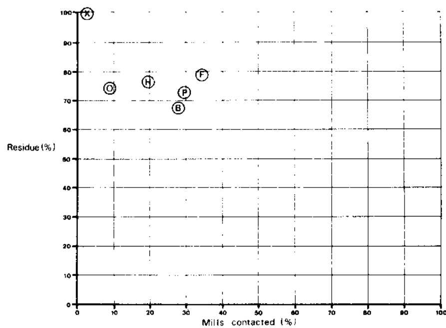
Figure 6

Revenue pattern for . . .
BARK



Production pattern for . . .
BARK

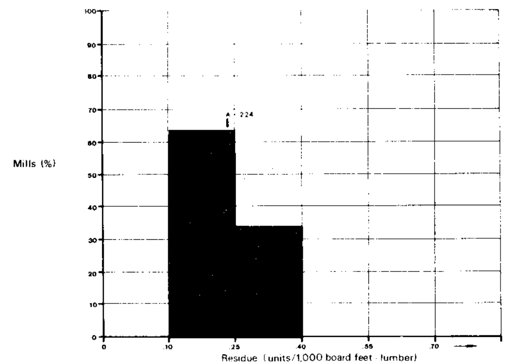
Figure 7



Usage pattern for . . .
SAWDUST

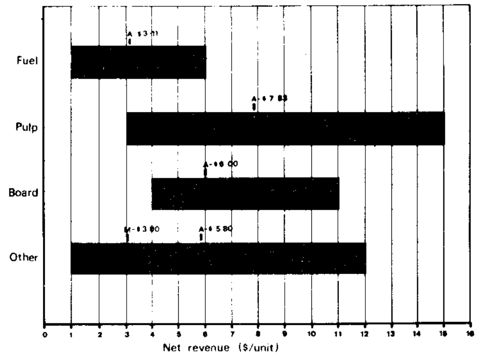
Figure 8

(P) pulp (H) sold for fuel (X) unused
(B) board (F) used for fuel (O) other

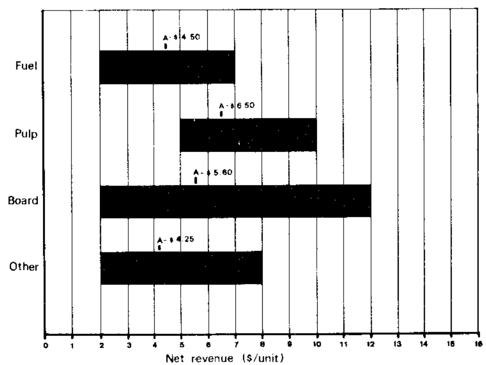


Production pattern for . . .
SAWDUST

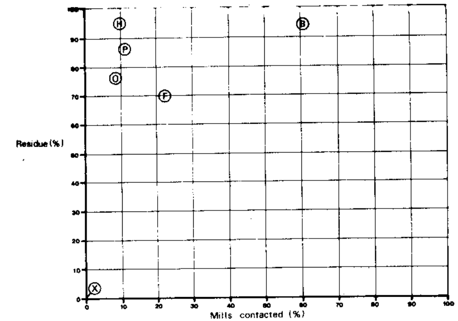
Figure 9



Revenue pattern for ... SAWDUST Figure 10

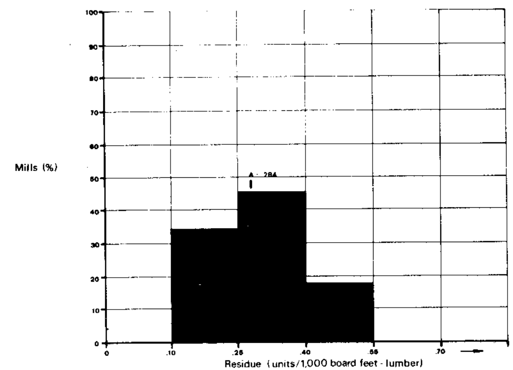


Revenue pattern for ... SHAVINGS Figure 12



Usage pattern for ... SHAVINGS Figure 11

Ⓟ -pulp Ⓗ -sold for fuel Ⓧ -unused
Ⓑ -board Ⓕ -used for fuel Ⓞ -other



Production pattern for ... SHAVINGS Figure 13

The high average value of $6.50/unit in the pulp category is somewhat misleading also. What usually happens here is that the shavings are hammermilled and sold along with sawdust to the pulp mills.

Revenue per unit from board mills averaged $5.60 with most respondents in the $5 to $6 range. Eighteen mills reported an average 0.284 units of shavings/MBF lumber tally (Figure 13). By weight, this would amount to between 350 to 450 pounds. This figure is very close to the one reported by Stanley Corder at Oregon State University, whom I referred to earlier.

Coarse residue is defined as slabs, edgings, sawmill trim, and planer trim. Nearly all of the coarse residue produced was sold as chips to pulp mills (Figure 14). A very small number of mills (7%) reported some small amount of waste in this category; usually less than 10% of the amount generated. Less than 1 mill in 10 used some of their coarse residue for plant fuel or sold it as fuel to others.

Reported net revenues varied widely on chips, Figure 15, with the majority falling into the $30 to $45 per bone dry unit (BDU) range, mostly on old contracts. The upturn at the high end of the scale is significant, however, and reflects the upward price trend of late 1974.

Even at an average $36.50/BDU, pulp chips are not returning their fuel equivalent value as compared to oil.

The average production of coarse residue, with 25 mills responding, was 0.405 bond dry units/MBF lumber tally (Figure 16). This figure is <u>exactly</u> the same as the one arrived at recently by Mr. James Howard, Forest Survey Resource Analyst with the Pacific Northwest Forest and Range Experiment Station of the U. S. Forest Service! (His figure is .486 tons/MBF which, converted to units on the basis of 2400 pounds/bone dry unit, equals <u>exactly</u> .405 bone dry units/MBF).

Of the entire survey, perhaps the most interesting insight came from the responses to our "attitude towards features" section. In it we listed 19 energy conversion system features taken from a list which we felt represented the positive features of a number of different kinds of systems. Each respondent was asked to check one of three (3) boxes next to each question. The boxes were labeled "very important," "Important", and "not important". We tabulated the responses according to the percent responding in each category to each question and assigned weights of 3, 2, and minus 1 respectively to each category. Then we converted the score to scale of 1 to 10. Here are the results (Figures 17, 18, 19).

The top seven features had less than a 1 point spread on our scale. Of particular interest was the fact that waste disposal ranked highest. Initially, we had felt that most mills probably wouldn't have much waste, as indeed they don't). A desire for the flexibility, however, to be able to dispose of excess residues during times when they do accumulate could account for this high rating.

The ability to use mill-run residue, pretty much as it comes from the mill, also seems to rate fairly high on the scale as evidenced by the 7.7 score for question 5 and the 6.0 score for question 8. Capital cost and maintenance are what one might call "motherhood" questions, but they do tend to calibrate the other responses because we would expect them to be at the top of the list. On an unweighted basis, however, they tied for fourth place. Question 1 was still at the top, followed by question 5, second; and question 6, third.

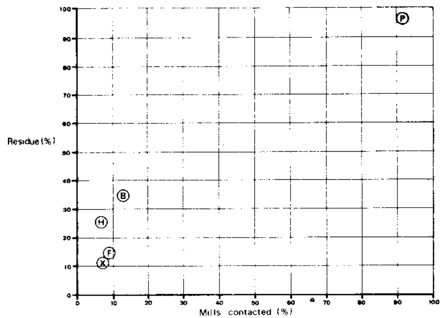


Figure 14

Usage pattern for . . .
COARSE RESIDUE – Slabs, edgings, sawmill & planer trim

(P) - pulp (H) - sold for fuel (X) - unused
(B) board (F) used for fuel (O) other

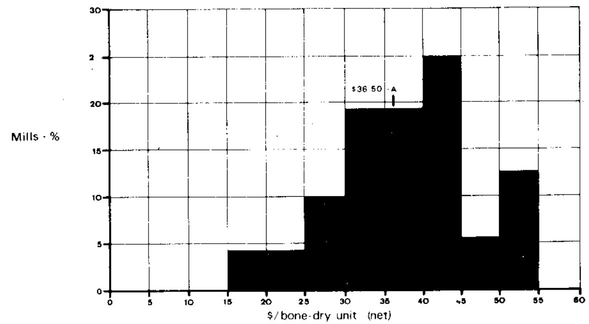
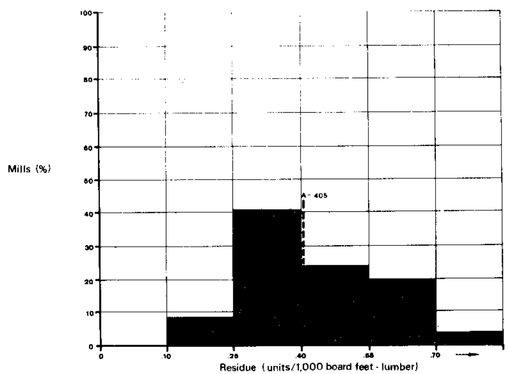


Figure 15

Revenue pattern for . . .
COARSE RESIDUE – to pulp mills



Production pattern for . . .
COARSE RESIDUE

Figure 16

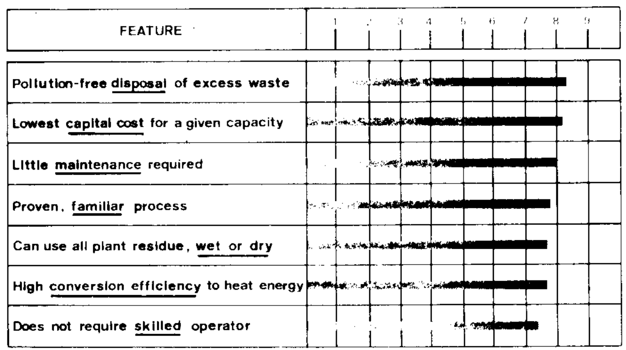


Figure 17

Toward the bottom of the list were such items as multiple fuel fired, small physical size and output can be used to generate electricity.

I did run statistical checks to try to find more hidden correlations in the data we had. The question about generating electricity did show up as having a very high correlation between positive responses and larger than average mill size, as one might expect.

The mass of data that we had to analyze to generate these findings was rather imposing. In fact it fills one full file drawer. I'm sure there are probably some other "nuggets" of insight still buried there. There were a number of correlations we had hoped to find that weren't there, however. Many statistical checks just led to blind alleys and were discarded as not worth reporting.

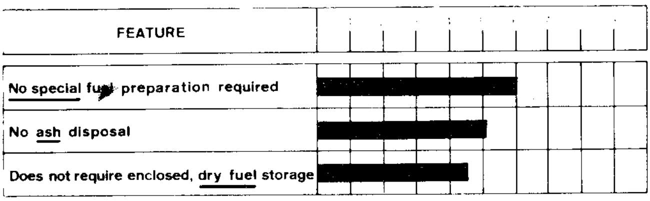


Figure 18

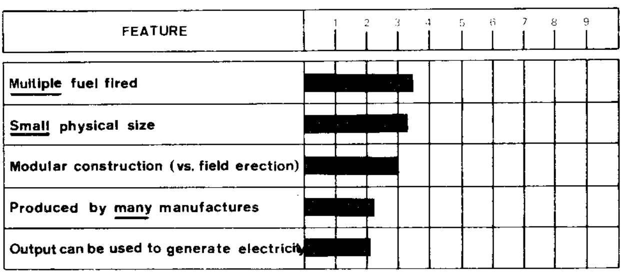


Figure 19