Size of Particles

from SAWS and PLANERS at MILLS in the WILLAMETTE VALLEY

by S. E. Corder
Tom Scott

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OREGON FOREST RESEARCH CENTER

Two State programs of research are combined in the Oregon Forest Research Center to improve and expand values from timberlands of the State.

A team of forest scientists is investigating problems in forestry research of growing and protecting the crop, while wood scientists engaged in forest products research endeavor to make the most of the timber produced.

The current report stems from studies of forest products.

Purpose . . .

Fully utilize the resource by:

developing more by-products from mill and logging residues to use the material burned or left in the woods.

expanding markets for forest products through advanced treatments, improved drying, and new designs.

directing the prospective user's attention to available wood and bark supplies, and to species as yet not fully utilized.

creating new jobs and additional dollar returns by suggesting an increased variety of salable products. New products and growing values can offset rising costs.

Further the interests of forestry and forest products industries within the State.

Current Program . . .

Identify and develop uses for chemicals in wood and bark to provide markets for residues.

Improve pulping of residue materials.

Develop manufacturing techniques to improve products of wood industries.

Extend service life of wood products by improved preserving methods.

Develop and improve methods of seasoning wood to raise quality of wood products.

Create new uses and products for wood.

Evaluate mechanical properties of wood and wood-based materials and structures to increase and improve use of wood.

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INTRODUCTION

When a log is cut into lumber, half the volume remains as residue. Twenty-five per cent of the residue is sawdust, and 15 per cent is planer shavings. Uses for sawdust and shavings exist, but large quantities remain unused.

New and improved uses for sawdust and shavings may depend on distribution of size of particles. This study shows distribution of size of particles from various types of saws and planers in the Willamette Valley of Oregon during 1954 and 1955.

No attempt was made to relate size of particles to different operating variables. Variables affecting size of sawdust particles include kerf, sharpness, diameter, and speed of saw; feed rate and size, quality, and species of lumber being sawed. This investigation was not concerned with effects and relationships of these variables, but with relationship of size of particles to type of saw.

Variables affecting size of planer shavings include width of planed face, diameter of cutting head, speed and sharpness of knives, feed rate of lumber, and thickness of material removed in planing. No attempt was made to evaluate and relate these variables.

PROCEDURE

Sawdust and planer shavings of Douglas-fir were sampled from sawmills in the Willamette Valley within 50 miles of Corvallis.

Sawdust

Investigation of size of sawdust particles was divided into two phases to study relationship of size of particles to type of saw between mills and within a mill at different times of day.

Sampling

In the first phase of study, a specimen of 10-15 pounds was obtained from a particular type saw at each sawmill. Sawdust was obtained from a conveyor as close as possible to the saw. When convenient, specimens were obtained from several types of saws at a sawmill. Number of specimens of sawdust from a particular kind of saw ranged from 3 for gangsaws, to 8 for circular headsaws.

In the second phase of study, intensive sampling was made of sawdust from each of several particular saws at different times during one operating day. Two sawmills were selected for this phase. Specimens of sawdust from circular headsaw and circular edger were obtained from a sawmill with daily capacity of about fifty thousand board feet. Specimens of sawdust from band headsaw, band resaw, and gangsaw were obtained from a sawmill with capacity over one hundred thousand board feet a day. Specimens of about 20 pounds each were taken from each saw at intervals of about one hour during one day. Ten specimens were obtained from each circular saw, and 6 specimens were obtained from each band saw and gangsaw.

Screening

Specimens were brought to the laboratory to determine distribution of sizes of particles. Two lots of 50 grams were taken from each

original specimen to be screened in undried condition. Average of the two lots is reported in results. Tyler screens of 4, 6, 10, 16, 28, and 60 mesh were used. Dimensions of Tyler screens are shown in Table 1.

Table 1. Dimensions of Tyler Screens.

Mesh	Diameter of wire	Opening of screen
	Inches	Inches
4	0.065	0.185
6	.036	.131
10	.035	.065
16	.0235	.039
28	.0125	.023
60	.0070	.010

Shavings

Variation in distribution by size was studied between mills, but variation in distribution at various times in an individual mill was not studied for shavings.

Specimens of shavings were obtained from 14 mills. Half of the mills were planing undried lumber, and half were planing kiln-dried lumber. Shavings from undried lumber and shavings from kiln-dried lumber were studied separately.

Sampling

A specimen of 10-20 pounds was taken at one time from each planing mill. Size of lumber being planed ranged from 1 by 6 inches to 3 by 12 inches.

Screening

Specimens were brought to the laboratory, where two lots of 50 grams were taken from each specimen to be screened. Tyler screens with openings of 1.05, 0.742, 0.371, 0.185, 0.065, and 0.023 inches were used.

Measuring

Because of irregular shape, linear measurements were taken of large particles to describe their size. A 10-gram lot was taken from each specimen. This lot was screened through openings of 0.371 inch; particles not passing this screen were measured individually. Measurements of maximum length and thickness, and of average width and thickness, were taken. Average width and thickness were obtained by estimating the point where average measurements should be made.

RESULTS

Data collected were not analyzed statistically, but have been reported as found, with means given to aid interpretation.

Sawdust

Distribution of sawdust particles by size appeared to range among the several mills much as when collected at various times in a single mill.

Particles were shaken on a 60-mesh screen, but, as in no test did more than one per cent pass through, the values were not included in the tables. Representative samples are shown in Figure 1.

Between mills

Results of the first phase of study in several mills are shown in Table 2 and are illustrated in Figures 2 and 3. Examination showed similarity in distribution of size of particles from band headsaws and resaws, and of particles from circular headsaws and edgers. Wide kerf accounted for large particles from circular saws.

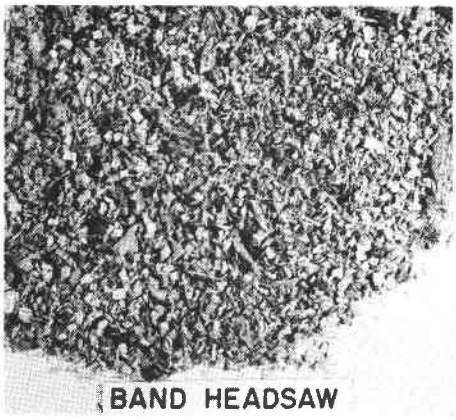
Within a mill

Results of the second phase of study showing hourly distribution of size of sawdust particles during one day are shown in Table 3. Average

Table 2. Particle-Size Distribution of Douglas-fir Sawdust From Various Mills in the Willamette Valley.

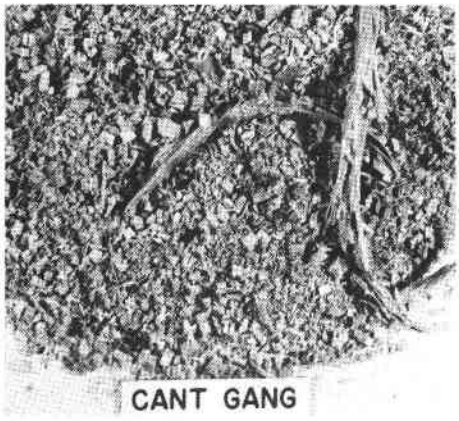
Saw kerf	Sawdust passing through given mesh screen*				
	4	6	10	16	28
In.	%	%	%	%	%
Circular head					
22/64	75	56	28	11	4
22/64	77	63	31	14	4
22/64	51	34	11	3	1
20/64	89	75	41	17	6
20/64	79	62	31	13	5
24/64	57	46	24	10	4
24/64	68	45	13	3	1
24/64	87	77	38	10	2
Avg	73	57	27	10	3
Circular edger					
22/64	70	60	25	8	2
24/64	69	53	19	7	2
28/64	41	22	5	2	1
24/64	83	71	27	9	2
24/64	60	41	13	4	1
24/64	83	66	31	12	3
28/64	62	39	12	4	1
Avg	67	50	19	7	2
Band head					
16/64	96	94	50	15	3
16/64	88	71	28	10	2
16/64	96	89	40	9	1
12/64	96	95	59	18	4
16/64	87	78	36	11	3
Avg	93	85	43	13	3
Band resaw					
10/64	97	93	35	7	2
12/64	96	94	75	28	4
12/64	95	87	39	13	2
12/64	91	83	37	10	1
Avg	95	89	47	14	2
Gangsaw					
12/64	89	70	29	11	3
12/64	78	61	24	7	1
16/64	84	80	45	11	2
Avg	84	70	33	10	2

* Per cent by weight.

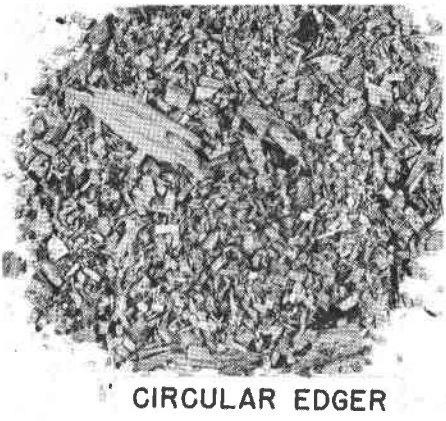


BAND HEADSAW

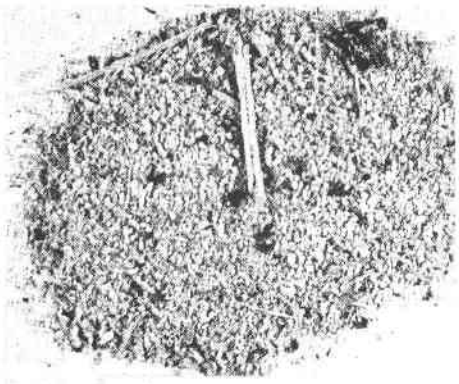
CIRCULAR HEADSAW



CANT GANG



CIRCULAR EDGER



BAND RESAW

Figure 1. Representative samples of Douglas-fir sawdust collected from various saws.

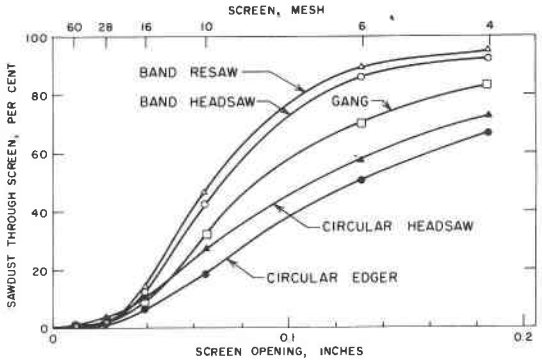


Figure 2. Average particle-size distribution of sawdust from various Douglas-fir sawmills in the Willamette Valley.

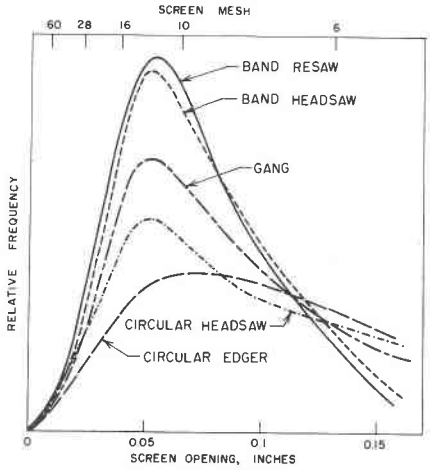


Figure 3. Frequency distribution, by weight, of sawdust particles from various Douglas-fir sawmills in the Willamette Valley.

Table 3. Variation of Distribution of Size of Douglas-fir Sawdust Particles Within a Sawmill During a Day.

Time	Sawdust passing through given mesh screen*				
	4	6	10	16	28
	%	%	%	%	%
Circular head (22/64 In.)					
8:00	81	58	9	3	1
9:00	70	51	17	7	2
10:00	74	53	10	3	1
11:00	82	67	14	4	1
12:00	53	34	10	3	1
1:00	82	56	7	2	1
2:00	83	61	12	4	1
3:00	65	44	15	6	2
4:00	68	45	9	3	1
5:00	77	55	10	3	1
Avg	74	52	11	4	1
Circular edger (22/64 In.)					
8:00	88	76	24	8	2
9:00	88	74	21	5	1
10:00	90	77	22	5	1
11:00	92	86	35	7	2
12:00	86	70	19	5	1
1:00	87	75	21	6	1
2:00	84	71	17	5	1
3:00	90	78	20	6	2
4:00	79	64	16	4	1
5:00	85	73	21	6	1
Avg	87	74	22	6	1
Band head (15/64 In.)					
9:45	97	93	43	12	3
10:45	94	88	32	10	2
11:45	94	81	24	7	2
1:20	95	91	32	14	3
2:20	97	91	37	14	4
3:20	95	93	54	22	6
Avg	96	90	37	13	3
Band resaw (12/64 In.)					
9:40	98	96	35	10	1
10:40	98	95	31	7	1
11:40	93	81	42	18	6
1:10	92	79	39	19	7

Table 3 (Cont'd.)

Time	Sawdust passing through given mesh screen*				
	4	6	10	16	28
	%	%	%	%	%
2:10	98	97	37	9	1
3:10	99	96	32	15	3
Avg	96	91	36	13	3
Gangsaw (12/64 In.)					
9:30	89	61	21	8	3
10:30	94	77	18	4	1
11:30	93	81	42	18	6
1:00	92	79	39	19	7
2:00	92	74	19	4	1
3:00	92	75	36	15	6
Avg	92	75	29	11	4

* Per cent by weight.

distribution is illustrated in Figures 4 and 5.

Results show distributions of size of sawdust within a mill were not greatly different from averages of several mills. The study within a mill showed sawdust from a circular edger to have large proportion of small particles than the average of several mills. Curves of distribution of frequency show that highest frequency occurred between 8 and 12 mesh.

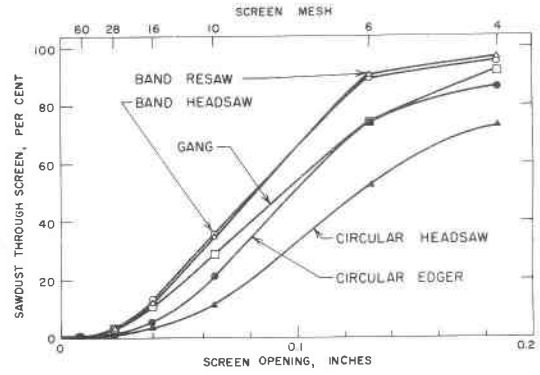


Figure 4. Average particle-size distribution of sawdust from a single saw of each type during a day at a Douglas-fir sawmill in the Willamette Valley.

Figure 6. Finest and coarsest specimens of shavings from kiln-dried lumber.

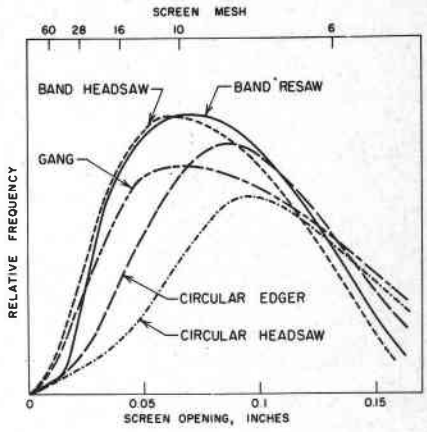


Figure 5. Average frequency distribution of sawdust from a single saw of each type during a day at a Douglas-fir sawmill in the Willamette Valley.

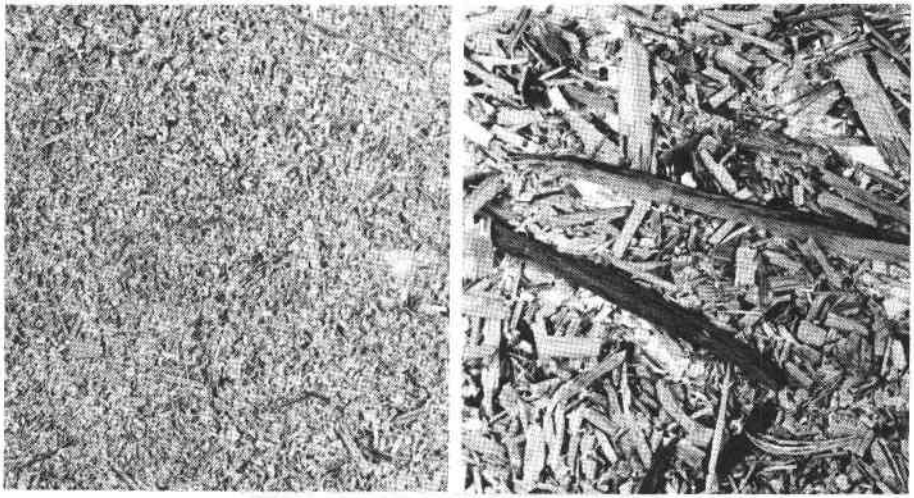
Shavings

Shavings were screened to judge sizes, and a representative assortment of shavings that did not go through the largest mesh were measured.

Screening

Distribution of size of planer shavings obtained by screening is given in Table 4. Averages are shown graphically in Figure 8; in Figure 9, averages of distribution of frequency are shown. Planer shavings from kiln-dried lumber contained more small particles than did shavings from undried lumber. An average of 74 per cent of dry shavings passed a screen with openings of 0.185 inch; only 25 per cent of undried shavings passed this screen. Note that a large difference existed in individual specimens, as seen in Figures 6 and 7.

Figure 7. Finest and coarsest specimens of shavings from undried lumber.


0 1 2 3 4
INCHES


0 1 2 3 4
INCHES

Table 4. Distribution of Particle Size of Douglas-fir Planer Shavings From Mills in the Willamette Valley.

Mill	Shavings passing through given screen opening*					
	1.05 in.	0.742 in.	0.371 in.	0.185 in.	0.065 in.	0.023 in.
	%	%	%	%	%	%
Undried shavings						
1	99	98	84	53	14	1.7
2	95	72	40	14	2	0.4
3	79	65	36	11	1	0.3
8	100	98	58	23	2	0.1
12	100	97	70	32	5	0.6
13	98	91	37	12	1	0.4
14	100	99	61	32	6	0.7
Avg	96	89	55	25	4	0.6
Kiln-dried shavings						
4	100	100	100	98	61	10.4
5	100	100	97	85	51	9.9
6	100	100	99	72	13	0.8
7	95	88	74	46	7	0.4
9	99	86	63	38	7	0.7
10	100	100	100	99	77	17.1
11	100	100	99	82	34	3.4
Avg	99	96	90	74	36	6.1

* Per cent by weight.

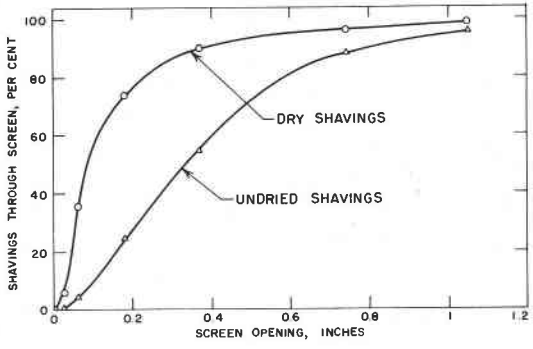


Figure 8. Average particle-size distribution of planer shavings from mills in the Willamette Valley.

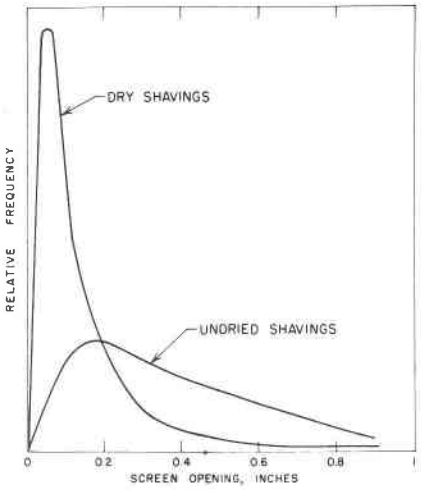


Figure 9. Average frequency distribution of planer shavings from mills in the Willamette Valley.

Measurement of size

Results of individual measurements of a 10-gram specimen of shavings that did not pass a screen with openings of 0.371 inch are given in Table 5.

An average of about one-third of each specimen from undried lumber did not pass the screen. Particles from these groups were measured. About 39 particles were measured in each specimen of undried shavings. Maximum length and thickness, and average width and thickness of particles are presented in Table 5.

Three of the 7 specimens of dry shavings had no shavings retained on the screen, but two lots had a higher percentage of particles retained on the screen than the average for undried shavings.

Table 5. Size of Planer Shavings by Physical Measurement of Particles, In 10-Gram Specimens, Not Passing a Screen With Openings of 0.371 Inch.

Mill	Length		Width		Max thickness		Avg thickness		Part of total specimen	Particles measured
	Range	Avg	Range	Avg	Range	Avg	Range	Avg		
	In.	In.	In.	In.	In.	In.	In.	In.	%	
Undried shavings										
1	0.6-2.1	1.1	0.2-0.7	0.4	0.013-0.224	0.056	0.007-0.140	0.036	35	12
2	.5-1.5	0.7	.2-1.1	.5	.010- .148	.035	.008- .100	.021	44	39
3	.6-2.4	1.1	.2-1.1	.5	.022- .148	.061	.008- .110	.043	50	28
8	.4-1.2	0.8	.3-0.8	.5	.017- .070	.036	.010- .047	.022	20	34
12	.6-1.7	1.1	.2-0.8	.4	.021- .122	.049	.011- .200	.040	25	21
13	.5-1.8	1.0	.2-1.0	.5	.009- .145	.028	.007- .060	.016	43	85
14	.4-1.6	0.8	.2-0.9	.4	.012- .032	.019	.008- .026	.012	25	55
Avg		0.9		0.5		0.042		0.027	34	39
Kiln-dried shavings										
4	-	-	-	-	-	-	-	-	0	0
5	-	-	-	-	-	-	-	-	0	0
6	.5-0.9	0.7	.2-0.5	.4	.056- .131	.093	.051- .110	.077	5	5
7	.5-5.6	1.6	.1-0.5	.3	.096- .263	.139	.057- .225	.113	44	10
9	.4-2.9	1.0	.2-1.0	.5	.010- .116	.032	.004- .082	.021	39	39
10	-	-	-	-	-	-	-	-	0	0
11	.5-1.1	0.7	.2-0.6	.4	.010- .020	.014	.005- .007	.006	1	3
Avg*		1.0		0.4		0.069		0.054	-	-

* Averages include only specimens that had particles retained on screen with openings of 0.371 inch.

CONCLUSIONS

Band headsaws and band resaws generated sawdust with similar distribution of size of particles. Sawdust from circular headsaws had a distribution of particles similar to that of sawdust from circular edger saws. Since band saws make a narrow kerf, sawdust from band saws had smaller particles than sawdust from circular saws. Sawdust from gang-saws had distribution of size between that of band saws and that of circular saws. Size of particles occurring most frequently was between 8 and 12 mesh for all types of sawdust.

Planer shavings from kiln-dried lumber contained more small particles than did shavings from undried lumber.

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