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EFFECT OF SPRAY PRESSURE ON LUMBER CHLOROPHENATE
RETENTIONS USING A SAWMILL, LONGITUDINAL
SPRAY TUNNEL

by

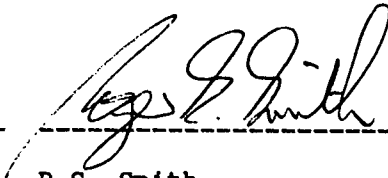
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April 1988

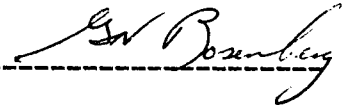
Project No. 17-43-K-208



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SUMMARY

This experiment was done to test the findings of research at Forintek which indicated that increasing the pressure in a hydraulic spray system would not result in proportionally similar increases in deposition of the chemical on the wood surface. The objective was to test the effect of varying spray pressure on the retentions of antisapstain chemical on lumber and to determine the variability of retentions on different faces of lumber treated in a typical industrial spray system.

The volume of liquid delivered by the four spray nozzles at three pressures was measured to establish the relationship between pressure and delivery. The delivery of the nozzles fitted the expected relationship where the delivery volume varied inversely with the square root of the pressure. Increasing the spray pump pressure from 175 to 225 psi gave only half the spray delivery which resulted from an increase in pressure from 125 to 175 psi.

At each of the spray pressures thirty treated pieces of lumber were selected from the throughput of the system. Each of the thirty boards was sampled on all four faces at mid-face approximately in the middle of the board. Each sample was analyzed for the chlorophenol retention on the wood surface using Forintek's standard HPLC method. Despite the large range in the individual chemical retentions different levels of treatment were detected on the four lumber faces: the difference between the top and bottom faces was not statistically significant but both were higher than the left and right edges. Of the latter, the right edge received lower retentions than the left edge. Such differences were independent of the spray pressure.

There was a significant overall increase in the average retentions when the pressure was changed from 125 to 175 psi (40 to 55 micrograms/cm²) but not from 175 to 225 psi (56 micrograms /cm²) This fits with the spray delivery data. The percentage of samples with retentions less than 50 micrograms/cm² was significantly more at the lowest spray pressure tested.

Overall the sawmill data confirms earlier laboratory work and indicates that increasing the spray pressure produces diminishing returns in terms of higher retention of chemical.

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1.0 INTRODUCTION

This work was done to test the findings of research at Forintek which indicated that increasing the pressure in a hydraulic spray system would not result in proportionally similar increases in deposition of the chemical on the wood surface. Crown Forest's Fraser Mills at New Westminster, B.C. volunteered to take part in a test in which the spray pressure would be varied. Treated wood was then to be sampled to determine the retention of chlorophenols on the surface.

At Fraser Mills there are four similar longitudinally-oriented spray boxes. These are located alongside each other at a point where all the rough cut lumber converges from various lines and just prior to the grading stations. The boxes are about three feet wide to cope with the range in size of lumber and the varying position on the rollers of pieces to be treated. Because of the location the lumber comes through the boxes very irregularly, sometimes with pieces overlapping. Each of the boxes is of the same design with five nozzles - four placed diagonally and one vertically downwards. The box chosen for the test was the second one from the western wall of the sawmill. Before the test was done the mill staff maintained and checked the system.

2.0 OBJECTIVE

To test the effect of varying spray pressure on the retentions of antispainstain chemical on lumber and to determine the variability of retentions on different faces of treated lumber.

3.0 SPRAY SYSTEM DELIVERY

The first item was to establish the relationship between the delivery of the spray nozzles at different spray pump pressures. Three pressures - 125, 175, and 225 psi - were selected for testing. These pressures are in the range in which the mill would normally operate. The upper right (looking from the box entrance) nozzle of the chosen spray box was tested because it was the most accessible; all five nozzles were reputedly the same. The nozzle was turned off, removed from the box and then sprayed into a graduated cylinder for a known length of time (about 20 seconds). This was repeated to obtain an average but the initial results were irregular. However after allowing the contents of the cylinder to settle for 15 minutes repeatable results were obtained; the earlier anomalies had been caused by air being trapped within the liquid in the cylinder.

3.1 Results

The average spray deliveries at each pressure were:

125 psi	1.30 litres/minute
175 psi	1.61 litres/minute
225 psi	1.76 litres/minute

Note that the difference in delivery between 175 and 225 psi is only 50% of the difference between 125 and 175 psi. Figure 1 shows graphically the relationship between spray pressure and nozzle delivery. In a hydrostatic nozzle the delivery volume varies inversely with the square root of the pressure. The data from the present test fits such a relationship.

One noticeable effect of pressure increase is a reduction in the size of the drop produced by the spray. This is also indicated by the more persistent chlorophenol smell around the system when operating at high pressures which probably result from drift of the fine droplets.

Overall the results are similar to those found by Forintek staff for the spray system at the Laboratory.

4.0 EVALUATION OF THE CHLOROPHENOL TREATMENT ON THE LUMBER

At each of the three test spray pressures thirty treated pieces of lumber were selected from the throughput of the system. To keep the number of variables down we selected only pieces of 2 x 8 in. and 2 x 10 in. stock which came individually through the box and approximately centred. This would probably give the most even coverage of the boards that the system was capable of giving.

Each of the thirty boards was sampled on all four faces at mid-face approximately in the middle of the board. The sampling was done with a punch which removes a 6.55 cm² sample. Each sample was placed in a vial and later, at the laboratory, analyzed for the chlorophenol retention on the wood surface using Forintek's standard HPLC method.

Additionally the solution being sprayed was sampled at the beginning and at the end of each of the three runs. The concentrations of these solutions were also determined by HPLC.

4.1 RESULTS

As is normally the case with industrial treatments there was a large range in the individual results which are listed in Appendix 1. The data is summarised in Table 1 where the averages, range and standard deviations are given. Statistical analysis of the data was done to determine whether the differences observed were statistically valid (discussed below). The averages by face and pressure are also shown in Figure 2.

Different levels of treatment were received by the four lumber faces and these differences were relatively consistent between the three pressures (Table 1, Fig. 2). The difference between the top and bottom faces was not statistically significant but both were higher than the left and right edges. Of the latter, the right edge received statistically lower levels of treatment than the left edge.

There was a significant overall increase in the retention when the pressure was changed from 125 to 175 psi but not from 175 to 225 psi. This fits with the delivery data shown in Figure 1. Overall the average retentions for each pressure were:

125 psi	40.3 micrograms/cm ²
175 psi	54.8 micrograms/cm ²
225 psi	56.3 micrograms/cm ²

For chlorophenols, 50 micrograms/cm² is a common goal for protection of lumber.

In terms of the overall number of samples with retentions less than 50 micrograms/cm² at the three pressures the results were:

125 psi	69% less than 50
175 psi	57% less than 50
225 psi	53% less than 50

Analytical results of the solution being sprayed gave the same result each time - 1.81% chlorophenols or 1.99% chlorophenates.

5.0 CONCLUSIONS

As the spray system pressure was increased from 125 to 175 psi, so the actual chlorophenate solution delivered increased by about 24%, which in time was reflected in an increase in average retention on the lumber of 36%. However, when the spray pressure was increased again, to 225 psi, the increase in solution delivered was only about 9% and there was no significant increase in chlorophenate retention on the lumber.

At all pressures the top and bottom faces received higher chemical treatment than did the sides, while the left side was more highly treated than the right side.

Overall the sawmill data confirms earlier laboratory work and indicates that increasing the spray pressure produces diminishing returns in terms of higher retention of chemical.

TABLE I

Summary of chlorophenol retentions (in micrograms/cm²) on different faces of lumber treated at 125, 175 or 225 psi spray pressure.

	<u>Lumber Face</u>			
	<u>Top</u>	<u>Left</u>	<u>Bottom</u>	<u>Right</u>
125 psi -				
Average	60.5	32.4	51.7	17.0
Minimum	35	8	17	7
Maximum	160	62	111	46
SD	25.2	13.2	24.4	8.7
175 psi -				
Average	67.4	52.9	78.9	20.4
Minimum	28	4	21	0
Maximum	208	148	233	110
SD	41.8	31.6	55.0	30.1
225 psi -				
Average	73.9	49.5	79.7	22.3
Minimum	35	20	18	2
Maximum	160	108	193	104
SD	36.5	19.1	43.3	19.9

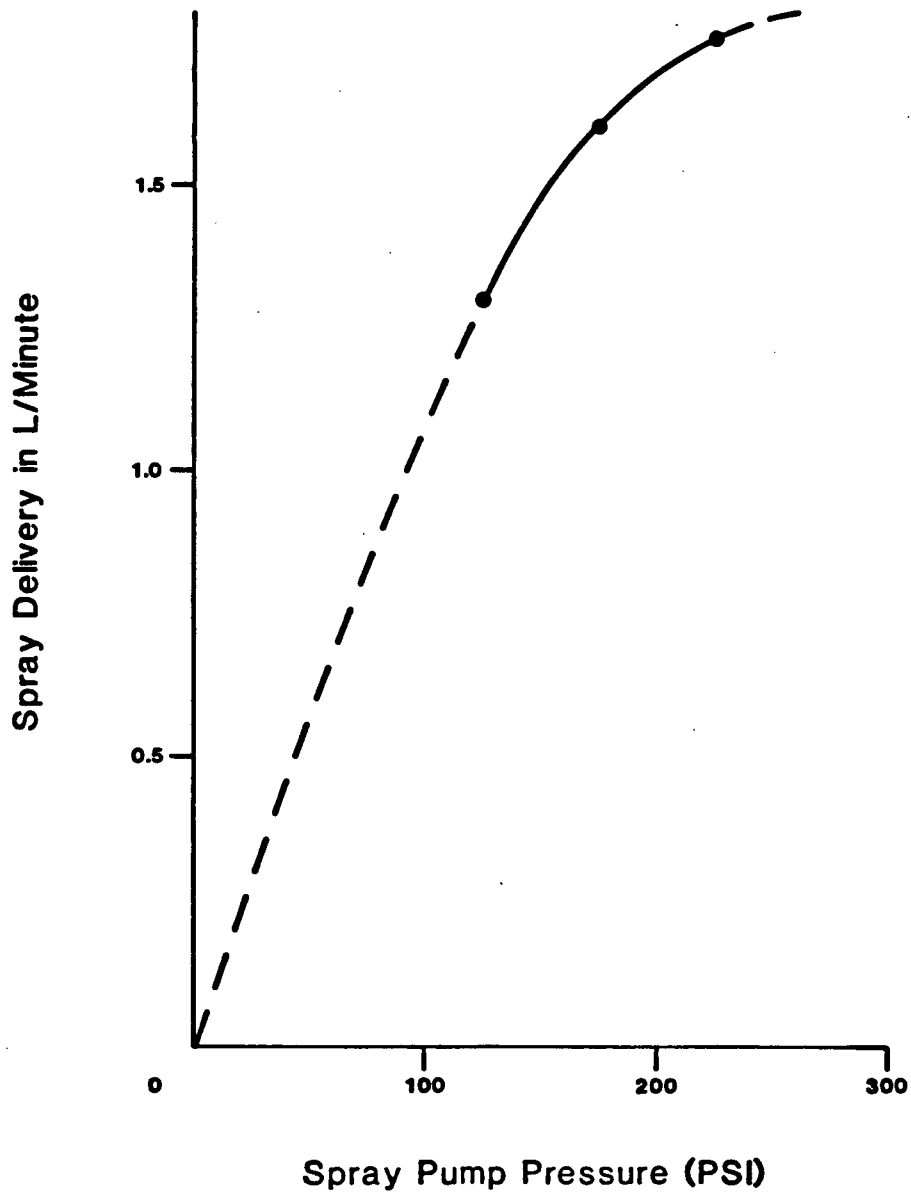


Figure I - Relationship between spray nozzle delivery and pump pressure - Fraser Mills Spray Box, September 1987

Average Chlorophenate Retention

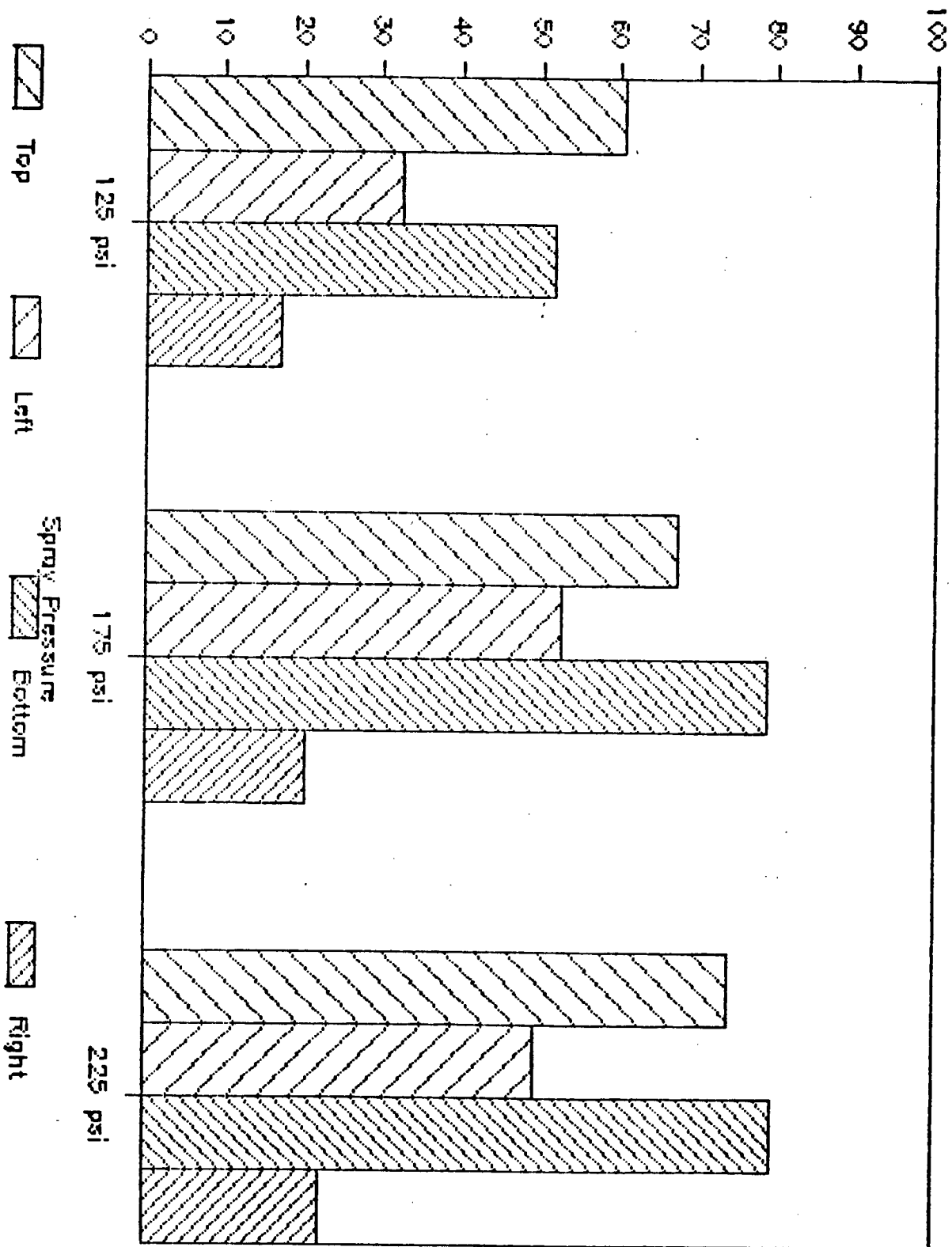


Figure 2 - Relationship between Average Chlorophenate retention and face retentions at different pressures - Fraser Mills Spray System

APPENDIX 1

Retentions of chlorophenols (in micrograms/cm²) measured on different faces of lumber treated at 125, 175 or 225 psi spray pressure.

BOARD #	PRESSURE	Lumber Face			
		TOP	LEFT	BOTTOM	RIGHT
1	125	35	8	61	36
2	125	40	36	82	8
3	125	82	28	27	12
4	125	102	62	61	12
5	125	44	12	21	26
6	125	74	34	59	19
7	125	44	42	76	7
8	125	41	38	25	10
9	125	39	15	36	11
10	125	58	23	62	17
11	125	60	34	35	8
12	125	63	47	39	23
13	125	46	41	52	8
14	125	50	26	92	19
15	125	61	30	86	12
16	125	83	25	89	22
17	125	87	51	19	14
18	125	87	44	55	26
19	125	41	41	70	13
20	125	60	31	17	17
21	125	65	26	29	14
22	125	62	24	37	30
23	125	160	37	111	46
24	125	38	19	29	12
25	125	52	20	64	21
26	125	35	26	50	14
27	125	48	48	38	11
28	125	52	18	65	13
29	125	63	23	23	16
30	125	44	62	41	12
31	175	50	36	36	2
32	175	47	33	39	8
33	175	208	80	233	55
34	175	78	90	37	2
35	175	161	97	200	110
36	175	131	113	127	30
37	175	85	44	115	9
38	175	45	35	85	3
39	175	71	27	40	1
40	175	57	65	37	2

APPENDIX I (Cont'd)

Board #	Pressure	Lumber Face			
		Top	Left	Bottom	Right
41	175	37	61	65	2
42	175	33	21	52	6
43	175	76	39	105	67
44	175	55	41	87	2
45	175	40	148	34	12
46	175	46	32	37	5
47	175	141	108	212	92
48	175	102	25	78	74
49	175	50	4	39	60
50	175	85	66	129	32
51	175	33	22	49	6
52	175	54	39	34	2
53	175	28	60	61	2
54	175	54	42	118	10
55	175	44	57	21	0
56	175	28	26	48	5
57	175	45	25	54	4
58	175	45	58	70	1
59	175	48	56	25	0
60	175	42	35	100	6
61	225	55	54	110	16
62	225	148	67	113	35
63	225	123	78	97	33
64	225	59	20	25	50
65	225	45	41	53	25
66	225	96	42	61	24
67	225	42	63	70	10
68	225	53	70	154	12
69	225	46	38	131	21
70	225	66	48	46	8
71	225	45	60	56	12
72	225	35	37	96	5
73	225	47	28	85	18
74	225	101	108	150	27
75	225	60	75	44	17
76	225	155	65	193	58
77	225	160	44	131	104
78	225	62	47	54	41
79	225	45	68	77	17
80	225	40	40	44	7
81	225	55	33	52	7
82	225	127	24	32	2
83	225	64	24	81	14
84	225	57	27	46	11
85	225	109	47	18	18
86	225	43	38	53	6
87	225	62	33	85	13
88	225	106	46	154	28
89	225	40	62	42	7
90	225	70	57	38	23

ACKNOWLEDGEMENTS

The authors wish to acknowledge the co-operation and assistance of Mr. Rob Johnson, Quality Control Supervisor, Crown Forest Fraser Mills, New Westminster as well as the excellent analytical services provided by Mr. R. Daniels, Wood Science Department, Forintek Canada Corp.