A REVIEW OF THE PERFORMANCE OF PRESERVATIVE TREATED SPRUCE

by

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SUMMARY

This report reviews the performance of preservative treated spruce based upon information developed primarily in Europe and North America. Stake test data indicates, that when treated with a non-leachable, effective preservative, spruce performs well.

Even in the small heartwood stakes, decay readily occured due to the variable treatment and limited penetration. Fenceposts provided better performance, since most of those in service are round with a reasonable depth of sapwood. However, where sapwood was limited, the service life was greatly reduced. Pre-conditioning of the fenceposts was considered essential in order to maximize the performance and service lives in excess of 50 years were reported. Utility poles were another commodity for which spruce was reported to give excellent performance. It is the use of treated sawnwood products where the limited preservative penetration is a serious limitation. Railway ties were found to check much more severely than pine, causing a reduction in service life.

Spruce window joinery treated with organotin compounds using a double vacuum process performed as well as hemlock joinery. It was also noted that it did not absorb moisture during service as readily as Scots pine joinery. The principal problem associated with the potential of spruce as siding material was its dimensional instability. Its checking was much worse than either western redcedar or lodgepole pine. Cupping was also a problem with spruce when tested on racks with a southern exposure. The problems of dimensional instability in spruce siding did not appear to be overcome by treatment with a novel ammoniacal zinc formulation.

It was concluded that where dimensional movement is not a requirement, then well treated spruce will give excellent performance. However where excessive checking in a commodity is unacceptable, as it would be in dimensional material such as siding and decking, then additional processes must be developed to eliminate or greatly reduce the movement of the wood during seasonal changes. A second problem associated with the use of spruce is the identification of appropriate pretreatment processes (such as drying and incising) which improve the preservative treatment of sawnwood without causing unacceptable surface degrade.

INTRODUCTION

Considerable research has been reported on the difficulties of impregnating spruce with preservatives and procedures designed to improve the quality of the treatment. Much less information is available on the performance of treated spruce, particularly with respect to product durability. The objective of this review is to provide a comprehensive survey of the available data on the performance of treated spruce from research papers and reports, in order to assess the relative merits of expanding the utilization of this species in Canada.

STAKE TESTS

U.S. FOREST PRODUCTS LABORATORY

Saucier and Madison, U.S.A.

The U.S. Forest Products Laboratory (USFPL) maintains field test sites at Saucier, Mississippi and at Madison, Wisconsin. The two sites provide different exposure conditions. In particular the soil types differ markedly, being a Poarch fine sandy loam in an area cleared of trees at Saucier, while at Madison the site consists of a clay loam soil. Consistent with the USFPL practice, 5 x 10 cm (2 x 4) stake material has been used in these tests.

Considering first the solid wood stakes, data for two preservatives, CCA and ACA, is shown for incised and unincised material. No information is available on the incising pattern. Control stakes failed with an average life of 3.3 years at Saucier and 7.5 years at Madison. After nine years exposure, the CCA and ACA treated stakes (both incised and unincised) are, with one exception, in 100% sound condition. One stake at Saucier is showing some decay.

Similar tests are in progress at the two sites using Engelmann spruce plywood (1.8 x 8.8 cm or 0.75 x 3.5 in.) stakes 46 cm in length. Some stakes were cut first and then pressure treated with either CCA or ACA, while other stakes were cut from sheets of plywood pressure treated with these preservatives. Although the controls have failed in 2.6 annd 3.2 years, the CCA and ACA treated material is still, all 100% sound, after nine years.

Reference:

Gjovik, L.R. and D.I. Gutzmer. 1986. Comparison of Wood Preservatives in Stake Tests. (1985 Progress Report). USDA Forest Service. Research Note FPL-02. 100 pp.

SAUCIER, MISSISSIPPI
MADISON, WISCONSIN

ENGELMANN SPRUCE — CCA - TYPE C, ACA

INCISED AND UNINCISED

5 x 10 cm (NOMINAL) — 9 YR. DATA

1.8 x 8.8 PLYWOOD

SAUCIER, MISSISSIPPI — DURATION - 9 YEARS

CONTROLS — 100% FAILED — AVGE. LIFE 3.3 YRS.

CCA	RETENTION (kg/m^3)	STAKE CONDITION
UNINCISED	5.0	100% SOUND
	8.0	90% SOUND, 10% DECAYED
	10.2	100% SOUND
INCISED	6.4	100% SOUND
	10.6	" "
	16.3	" "

MADISON, WISCONSIN — DURATION - 9 YEARS

CONTROLS — 100% FAILED — AVGE LIFE 7.5 YRS

CCA	RETENTION (kg/m^3)	STAKE CONDITION
UNINCISED	3.4	100% SOUND
	6.4	" "
	7.7	" "
INCISED	4.5	" "
	9.0	" "
	13.8	" "

SAUCIER, MISSISSIPPI — DURATION 9 YEARS
MADISON, WISCONSIN

ALL ACA-TREATED STAKES, INCISED AND UNINCISED, ARE 100% SOUND

RETENTIONS RANGE FROM 3.2 kg/m^3 TO 16.5 kg/m^3 (UNINCISED)
AND 4.8 kg/m^3 TO 25.6 kg/m^3 (INCISED)

SAUCIER, MISSISSIPPI

PLYWOOD CONTROLS 100% FAILED AVGE. LIFE 2.6 YRS.

ALL CCA-TREATED PLYWOOD STAKES ARE 100% SOUND AFTER 9 YEARS

INCLUDES:
- STAKES TREATED AFTER MANUFACTURE (11.4-32.5 kg/m^3)
- STAKES CUT FROM TREATED PLYWOOD (8.6-28.2 kg/m^3)
- STAKES CUT FROM TREATED PLYWOOD AND EDGES BRUSHED WITH 4.5% CCA (8.6-28.2 kg/m^3)

MADISON, WISCONSIN

PLYWOOD CONTROLS 100% FAILED AVGE. LIFE 3.2 YRS.

ALL CCA-TREATED PLYWOOD STAKES ARE 100% SOUND AFTER 9 YEARS

INCLUDES:
- STAKES TREATED AFTER MANUFACTURE (11.2-29.1 kg/m^3)
- STAKES CUT FROM TREATED PLYWOOD (8.6-28.2 kg/m^3)
- STAKES CUT FROM TREATED PLYWOOD EDGES AND BRUSHED WITH 4.5% CCA (8.6-28.2 kg/m^3)

SAUCIER, MISSISSIPPI
MADISON, WISCONSIN

ALL ACA-TREATED PLYWOOD STAKES ARE 100% SOUND AFTER 9 YEARS

ACA RETENTIONS TESTED 10.4 - 32.3 kg/m^3

THE INTERNATIONAL RESEARCH GROUP ON WOOD PRESERVATION

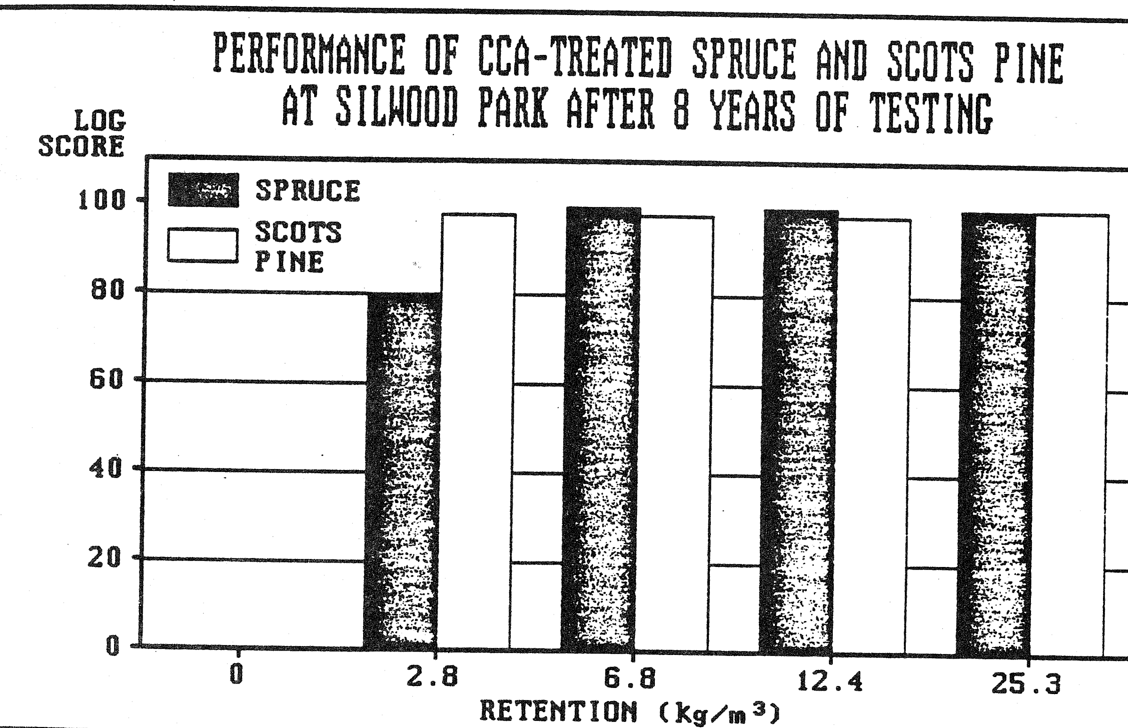
Silwood Park, U.K.

In 1976, the International Research Group on Wood Preservation established an international field experiment at some thirty test sites around the world. The test program at two sites, one in Holland and a second at Silwood Park, U.K. included *Picea abies* (spruce). The preservative used was CCA ($K_2Cr_2O_7$, 45%; $CuSO_4 5H_2O$, 35%; and $As_2O_5 2H_2O$, 20%). The stakes were pressure treated using a full cell process to refusal (initial vacuum 62.5 cm Hg for 30 minutes, pressure 1250 kPa for 4 hours). Treating solution strengths of 0.39, 0.9, 1.78 and 3.3% w/w based on oxides (or 0.66, 1.53, 3.01 and 5.60 based upon salts). At the Silwood Park site, the first untreated stakes failed within four years and all failed in six years. The Scots pine stakes at the same site showed an identical failure pattern. Using the log score (AWPA) method of reporting stake performance, the Scots pine reached an average log score of 70 (i.e., failure) in just over two years, whereas the spruce took between two and four years to reach a similar score. After eight years of testing, the spruce stakes at the lowest retention have reached a log score of 80, while those of the pine remain almost 100% sound.

This would indicate that as the test progresses, the treated spruce will not perform as well as the treated Scots pine sapwood, due presumably to an inadequate penetration. The stakes were not incised.

Reference:

Dickinson, D.J. and S.M. Gray. 1986. Hardwood Field Experiment: Progress Report 1977-1986. International Research Group on Wood Preservation. Document No. IRG/WP/3391. 44 pp.



PRINCES RISBOROUGH LABORATORY (PRL)

Princes Risborough, U.K.

In response to the difficulty in treating spruce (whitewood), Banks developed various incising patterns which improved the treatment of the spruce. To measure the improvement in the performance of the treated spruce as a consequence of the incising, a test using Russian spruce (Picea abies) was established at the Princes Risborough Laboratory test site. Three staggered incising patterns were tested. Each used incisions which were 8 mm in length and 1 mm wide. Incisions in any row were 36 mm apart, while the distance along the board between incisions (centre to centre) in adjacent rows was 8 mm. Two lateral separations were used, 3 and 4.5 mm, together with two incision depths (6 and 9 mm). Two preservatives, CCA and creosote, were applied using a full cell process. The preservative retentions ranged from 0.1 to 0.2 kg/m^3 in the unincised stakes, and from 1.7 to 6.0 kg/m^3 CCA and 34 to 89 kg/m^3 creosote in the incised stakes. After eight years there have been no failures in the unincised or incised stakes treated with 1.8% CCA.

References:

Baines, E.F. 1986. The current status of commercial waterborne preservative treatment of spruce. Record of Annual Convention of British Wood Preserving Association. In press.

Purslow, D.F. 1975. Results of stake tests on wood preservatives. (Progress report to 1974). Building Research Establishment Current Paper. CP86/75. 30 pp.

INCISING PARAMETERS*

TYPE	LENGTH	WIDTH	SEPARATION: LONGITUDINAL (IN LINE)	SEPARATION: LONGITUDINAL (ADJACENT)	SEPARATION: LATERAL	DEPTH
I	8	1	36	8	3	6
II	8	1	36	8	4.5	6
III	8	1	36	8	3	9

* ALL UNITS mm

TREATMENT PARAMETERS

CCA	FULL CELL		
	INITIAL VACUUM	70 cm Hg	1 h
	PRESSURE	860 kPa	2 h
	TEMPERATURE	AMBIENT	
CREOSOTE	FULL CELL	70 cm Hg	1 h
	PRESSURE	1035 kPa	2 h
	TEMPERATURE	71 C°	

AVERAGE RETENTIONS (kg/m³) OF INCISED AND UNINCISED STAKES

PRESERVATIVE		UNINCISED	INCISED I	INCISED II	INCISED III
0.05%	CCA*	0.1	0.2	0.2	0.2
1.8%	CCA	1.7	4.1	4.0	4.1
3%	CCA	2.1	6.0	-	-
CREOSOTE		34	89	-	-

* CCA SOLUTION CONCENTRATIONS AND RETENTIONS CONVERTED TO OXIDE BASIS

SUMMARY

AFTER 8 YEARS
- NO FAILURES OF UNINCISED/INCISED STAKES TREATED WITH 1.8% CCA
- NO DIFFERENCE IN PERFORMANCE OF UNINCISED AND INCISED STAKES TREATED WITH 0.05% CCA

SWEDISH WOOD PRESERVATION INSTITUTE (SWPI)

Simlangsdalen and Bogesund, Sweden

A field experiment was set up in 1952 in Simlangsdalen and Bogesund which included both Scots pine and spruce stakes. The Boliden salts TV and TV50 were used. Boliden TV contains only the zinc salt, while the TV50 contains 50% each of the zinc and copper salts. The performance of the preservative treated spruce and Scots pine after 32 years exposure for the stakes treated to various retentions used, is shown in the accompanying tables.

All stakes have now failed. Stakes treated with the preservative TV50 using the oscillating pressure method (OPM) were recorded to have an increased average life of two to threefold for spruce sapwood and three to fourfold for pine sapwood. A similar treatment of spruce heartwood did not increase its average life. However, the retentions used were very low. It should also be noted that the retentions shown refer to total salt content which is the usual practice in Sweden.

The second experiment using spruce sapwood and heartwood was set up in 1960 in Simlangsdalen and comprised 90 stakes. Two concentrations of a CCA formulation (Boliden K33) were used and the time of the oscillating pressure treatment was eight hours.

The figure shows the original stake retentions and the results of the evaluation after 24 years. All the stakes have now been rejected. The average life for untreated spruce sapwood and heartwood respectively, was almost the same, about two years. The Boliden K33-impregnated sapwood stakes gave an average life which was approximately double the average life of the K33-treated heartwood stakes. Nevertheless the retention was somewhat higher in the heartwood than in the sapwood stakes. (It should be noted that the retentions shown are on a salt basis. Without details of the formulation used, it was not possible to convert them to an oxide basis.) Clearly the variability in the heartwood treatment in these unincised stakes has resulted in their poor performance.

<u>Reference</u>:

Bergman, O. and F. Mazur. 1986. Field tests with wood preservatives. Revised in 1984. Swedish Wood Preservation Institute. Report No. 156. 102 pp.

BOGESUND (B) SCOTS PINE
SIMLÅNGSDALEN (S)

PRESERVATIVE	RETENTION* Kg/m³	AVERAGE LIFE (YEARS) (B)	(S)
UNTREATED	0	5.0	3.8
BOLIDEN TV	8.0	8.1	8.7
	11.3	7.3	8.4
BOLIDEN TV 50	8.5	16.2	11.8
	14.6	18.4	15.6

* SALTS BASIS
TV=ZINC SALT; TV 50=COPPER AND ZINC SALTS

BOGESUND (B) SPRUCE
SIMÅNGSDALEN (S)

	PRESERVATIVE	RETENTION* (Kg/m³)	AVERAGE LIFE (YEARS) (B)	(S)
SAP.	UNTREATED	0	4.6	3.8
HEART.	"	0	7.3	6.8
SAP.	BOLIDEN TV	6.8	7.5	7.4
		8.3	7.0	6.6
HEART.	" "	2.0	7.7	7.8
		2.3	7.0	6.7
SAP.	BOLIDEN TV 50	7.1	12.9	10.0
		10.7	12.1	13.7
HEART.	" " "	1.5	7.9	7.9
		3.7	9.7	8.2

* SALT BASIS
TV=ZINC SALT; TV 50=COPPER AND ZINC SALTS

SIMLÅNGSDALEN SPRUCE
CCA (BOLIDEN K33)

	RETENTION* (Kg/m³)	AVERAGE LIFE (YEARS)
SAPWOOD	0	2.0
	1.9	17.5
	2.8	16.0
HEARTWOOD	0	2.1
	2.1	5.6
	3.9	8.7

* SALTS BASIS

DENMARK PERFORMANCE OF RED SPRUCE AFTER 8 YEARS

PRESERVATIVE	RETENTION* (Kg/m³)	LOG SCORE**
BOLIDEN K33	7	97
	10, 13, 21, AND 25	ALL 100
TANALITH C	8	97
	12, 14, 27 AND 31	ALL 100
UNTREATED	-	AVERAGE LIFE 3.3 YEARS

* SALTS BASIS ** 100 = SOUND, 0 = FAILURE

WOOD PRESERVATION LABORATORY

Tåstrup, Denmark

A field stake test of preservative treated spruce (*Picea abies*) was established in Denmark. Seven preservatives, chromated-copper-fluoride (CFK), Celcure A, KP-Cuprinol, Creosote, Tanalith C (CCA-type C), Boliden K33 (CCA-type B) and chromated-copper-borate, are being evaluated. After eight years in test, the average life of the untreated spruce stakes (2.5 x 5.0 x 50 cm) was 3.3 years. This may be compared with an average life of 5.1 years for untreated Scots pine stakes. The chromated-copper-fluoride stakes are showing signs of decay at several retention levels up to 22 kg/m^3. The Celcure A is also decaying at 12 kg/m^3 but at 13 kg/m^3 and above, all stakes are sound. A log score of 90 for creosote at 169 kg/m^3 was recorded, but all stakes at 202 kg/m^3 were sound. The chromated-copper-borate showed decay at retentions of 34 kg/m^3 (log score 97). The best performance was provided by the two CCA formulations. A small amount of decay (log score 97) was observed at 7 kg/m^3 (5.3 kg/m^3 oxides) for Boliden K33 and 8 kg/m^3 (4.7 kg/m^3 oxides) for Tanalith C. All stakes at 10 kg/m^3 (7.5 kg/m^3 oxides) Boliden K33 and 12 kg/m^3 (7.1 kg/m^3 oxides) Tanalith C were sound. (It should be noted that for the waterborne preservatives, the retentions were described in the original report on a total salt basis. These are generally much higher than the corresponding values on an oxide basis. For example Boliden K33 oxide retentions are 75.4% of the total salt retentions, while Tanalith C oxide values are 59% of the salt retentions.)

The results for CCA-treated spruce compare favorably with those for Scots pine. In the latter a small amount of decay (log score 95) was recorded at the 10 kg/m^3 (salts) retention level.

Reference:

Borsholt, E. 1982. Water Absorption Measurements on Danish Red Spruce, (*Picea abies*). Traeteknik Tecknologisk Institut. 58 pp.

CONSIGLIO NAZIONALE DELLE RICERCHE (CNDR)

Florence, Italy

A series of field tests of wood preservatives using several wood species have been reported by Gambetta and Orlandi. Stakes (2.5 x 2.5 x 60 cm) were treated with PCP in an organic solvent and an aqueous chrome-fluoride preservative. The control stakes quickly decayed for both the spruce and pine, falling to a log score of 70, or less, in one to two years. The Scots pine stakes treated with the chrome-fluoride to retentions of 7 to 10 kg/m^3 performed well requiring almost 10 years to reach a failing log score. The spruce stakes, also at a retention of 7 to 10 kg/m^3, performed in a similar manner, reaching a log score of 70 in 11 years. The average lives for each treatment and wood species are shown in the figure, and confirm the similar performance of these two woods in this test. It is also of interest to note that the PCP at a retention of 2.5 kg/m^3 provided equivalent average lives for the two wood species (10 to 11 years Scots pine and 12 to 13 years spruce). Since the fluoride preservative is unlikely to be well fixed, the CCA preservative would be expected to provide a superior performance under similar test conditions.

Reference:

Gambetta, A. and E. Orlandi. 1982. Evaluation of Wood Preservatives in Stakes and Pole Tests. II Report. Consiglio Nazionale Delle Ricerche. Instituto per la Ricerca sul Legno. Firenze. Contributi Scientifico-Practici XXX:31-43.

STAKE TEST | TEK. INST.

DENMARK — PERFORMANCE OF SCOTS PINE AFTER 8 YEARS

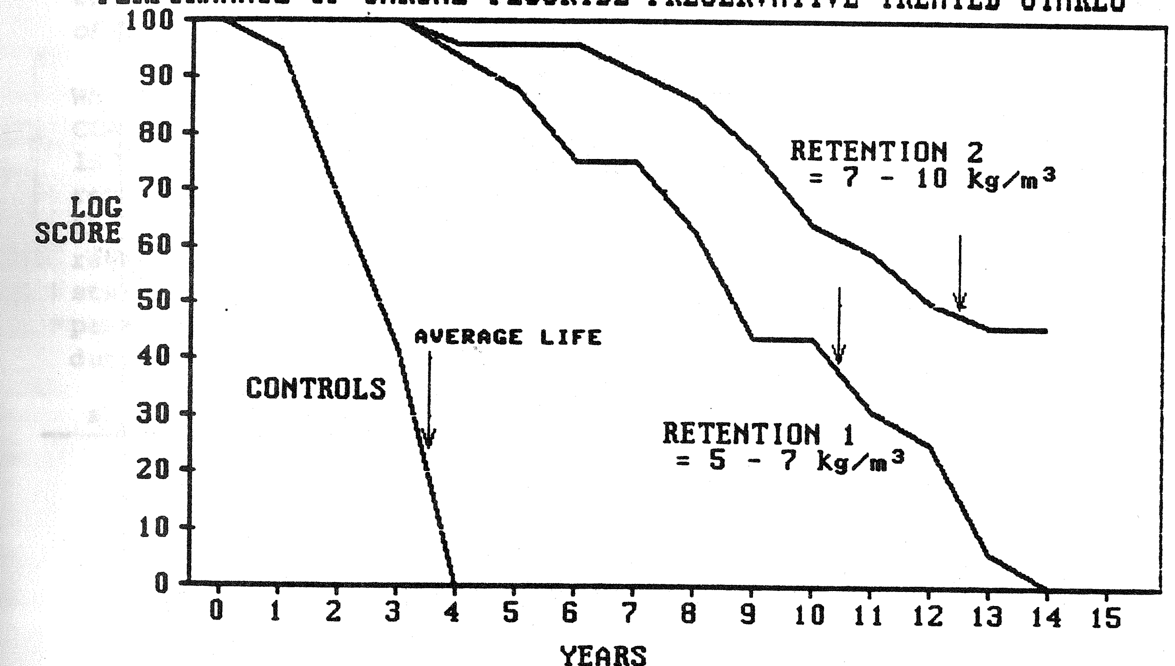
PRESERVATIVE	RETENTION* (kg/m³)	LOG SCORE**
CCA	7	85
	10	95
	13, 20 AND 27	ALL 100
UNTREATED	-	AVERAGE LIFE 5.1 YEARS

* SALTS BASIS   ** 100 = SOUND, 0 = FAILURE

STAKE TEST | CNDR

FLORENCE — SCOTS PINE

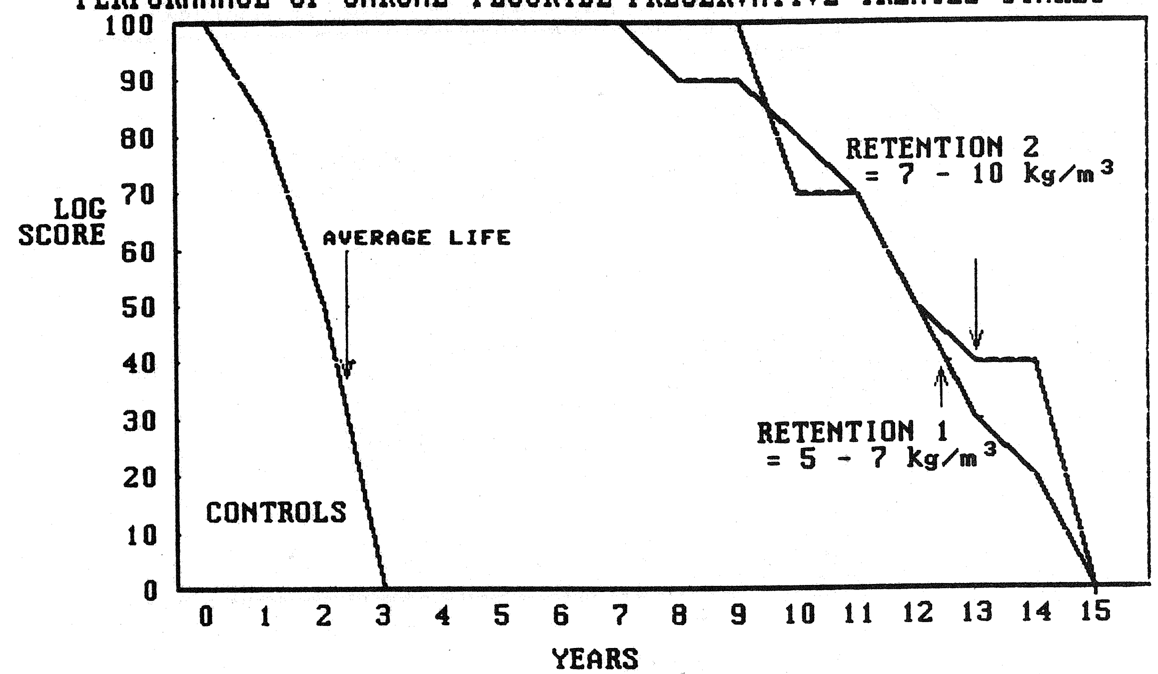
PERFORMANCE OF CHROME-FLUORIDE PRESERVATIVE TREATED STAKES



STAKE TEST CNDR

FLORENCE SPRUCE

PERFORMANCE OF CHROME-FLUORIDE PRESERVATIVE TREATED STAKES



FORINTEK CANADA CORP.

Petawawa, Canada

White spruce stakes (35 x 35 x 762 mm) pressure treated with ACA were installed in the Petawawa test plot in Ontario. Untreated controls were also installed as reference. At the time of the latest inspection in 1985, the average life of the untreated controls (which had all failed), was 4 to 5 years, although within one year all had achieved a log score of 70. The treated stakes remain 90% sound after six years of testing.

White spruce plywood stakes (16 x 19 x 660 mm) pressure treated with CCA-type C, to retentions of 12.3 and 16.0 kg/m^3 were placed in test in 1979. A further set of stakes (16 x 50 x 660 mm) with an average retention of 12.8 kg/m^3 were installed one year later. In 1985, one of the stakes at the higher retention had failed and all others at that retention were showing signs of decay. At the lower retention three stakes had failed. The poor performance can be related to the poor penetration achieved in the plywood. Control stakes generally failed during the first three years of test.

STAKE TEST FORINTEK

PETAWAWA

ACA TREATED WHITE SPRUCE

ACA	5.9 kg/m³	90 % SOUND AFTER 6 YRS.
	11.5 kg/m³	90 % SOUND AFTER 6 YRS.

Reference:

Doyle, E.E. and R. Dubois. 1986. Forintek Canada Corp. Unpublished data.

U.S. FOREST PRODUCTS LABORATORY

Saucier and Brooklyn, U.S.A.

Posts used in this test are of usual fencepost size (1.8 m long and 7.6 to 15 cm in diameter) and were air-seasoned prior to treatment. The average life was calculated from mortality curves and was based upon the failure of at least 60% of the test posts.

Untreated Engelmann spruce posts had an average life of 3.1 years at Saucier. Pressure treatment (using an oscillating pressure method) with Boliden S-25 ($ZnO + As_2O_5 + CrO_3 + CuO$) to retentions of 4.5 and 15.2 kg/m^3 proved successful, in that after 15 years all posts remained in test. Creosote-coal tar pressure treatment to a retention of 56 kg/m^3 was less successful, with two posts being removed. Their projected average life was 17 years.

Round Norway spruce posts, treated with PCP in used crank case oil by a cold-soaking process to retentions of 27 and 26 kg/m^3, provided average service lives of 12.5 and 19.6 years respectively.

Reference:

Gjovik, L.R. and H.L. Davidson. 1976. Service records on treated and untreated fenceposts. (1975 Revised) U.S.D.A. Forest Service. Research Note FPL-068. 44 pp.

PERFORMANCE OF ROUND FENCEPOSTS AT SAUCIER, MISSISSIPPI AND BROOKLYN, WISCONSIN

	TREATMENT	RETENTION (kg/m^3)	AVERAGE LIFE (YR.)
ENGELMANN SPRUCE			
UNTREATED	-	0	3.1
BOLIDEN S25	PRESSURE	4.5	ALL IN TEST AT 15 YEARS
	"	15.2	" " " " " "
CREOSOTE	"	56	17
NORWAY SPRUCE			
PENTACHLOROPHENOL IN OIL	COLD SOAK (96 h)	27	12.5
"	COLD SOAK (168 h)	26	19.6

PETAWAWA

PERFORMANCE OF FENCEPOSTS TREATED BY A SAP DISPLACEMENT PROCESS

PRESERVATIVE	WOOD SPECIES	RETENTION (kg/m^3)	SERVICE LIFE
CZC	JACK PINE	6.72-19.06	100% AFTER 20-23 YEARS
	WHITE SPRUCE	11.69-27.87	95%-100% AFTER 20-23 YEARS
CCZC	JACK PINE	18.10	100% AFTER 23 YEARS
	WHITE SPRUCE	26.11	100% AFTER 23 YEARS

CZC - CHROMATED ZINC CHLORIDE
CCZC - CHROMATED COPPER ZINC CHLORIDE

PETAWAWA

PERFORMANCE OF FENCEPOSTS TREATED BY A SAP-DISPLACEMENT PROCESS

PRESERVATIVE	WOOD SPECIES	RETENTION (Kg/m³)	SERVICE LIFE
FCAP(A)	JACK PINE	9.93	100% AFTER 23 YEARS
	WHITE SPRUCE	10.89	100% AFTER 23 YEARS
ACC	JACK PINE	13.78	100% AFTER 20 YEARS
	WHITE SPRUCE	15.06	90% AFTER 21.5 YEARS

FCAP(A) - FLUOR-CHROME-ARSENIC PHENOL (TYPE A)
ACC - ACID COPPER CHROMATE

PETAWAWA

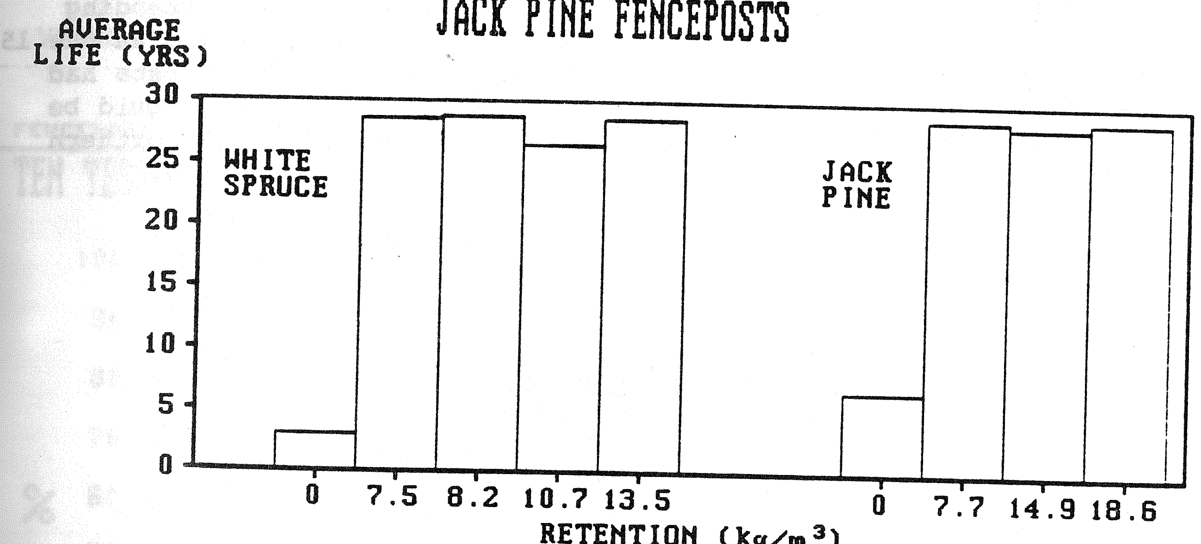
PERFORMANCE OF SPRUCE AND JACK PINE POSTS TREATED WITH CREOSOTE BY A THERMAL PROCESS

WOOD SPECIES	RETENTION (Kg/m³)	SERVICE LIFE (YEARS)
BUTT ONLY		
BLACK SPRUCE	18	36
WHITE SPRUCE	30	35
JACK PINE	117	37
FULL LENGTH		
BLACK SPRUCE	29*	55% IN SERVICE AFTER 37 Y
WHITE SPRUCE	27*	75% IN SERVICE AFTER 39 Y
JACK PINE	107*	100% IN SERVICE AFTER 41 Y

* kg OF CREOSOTE PER POST

PETAWAWA
CCA (GREENSALT)

PERFORMANCE OF TREATED AND UNTREATED WHITE SPRUCE AND JACK PINE FENCEPOSTS



FORESTRY COMMISSION (F.C.)

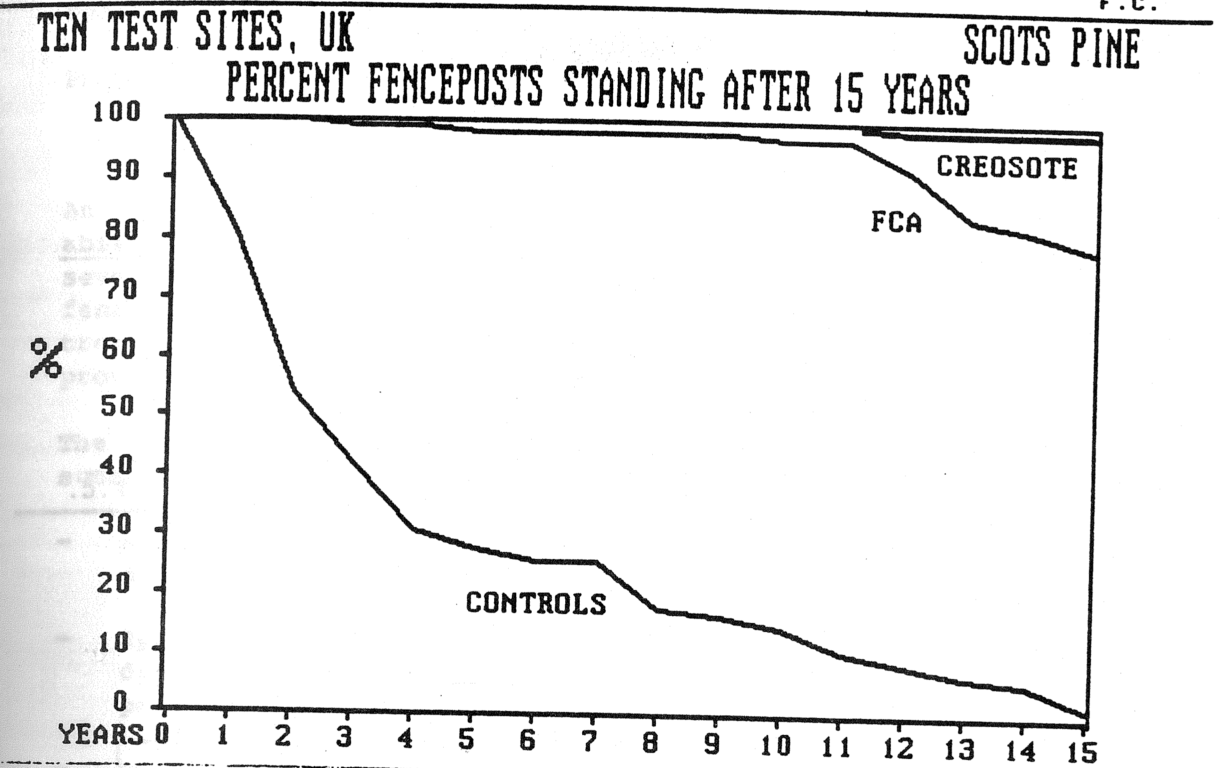
Various sites, U.K.

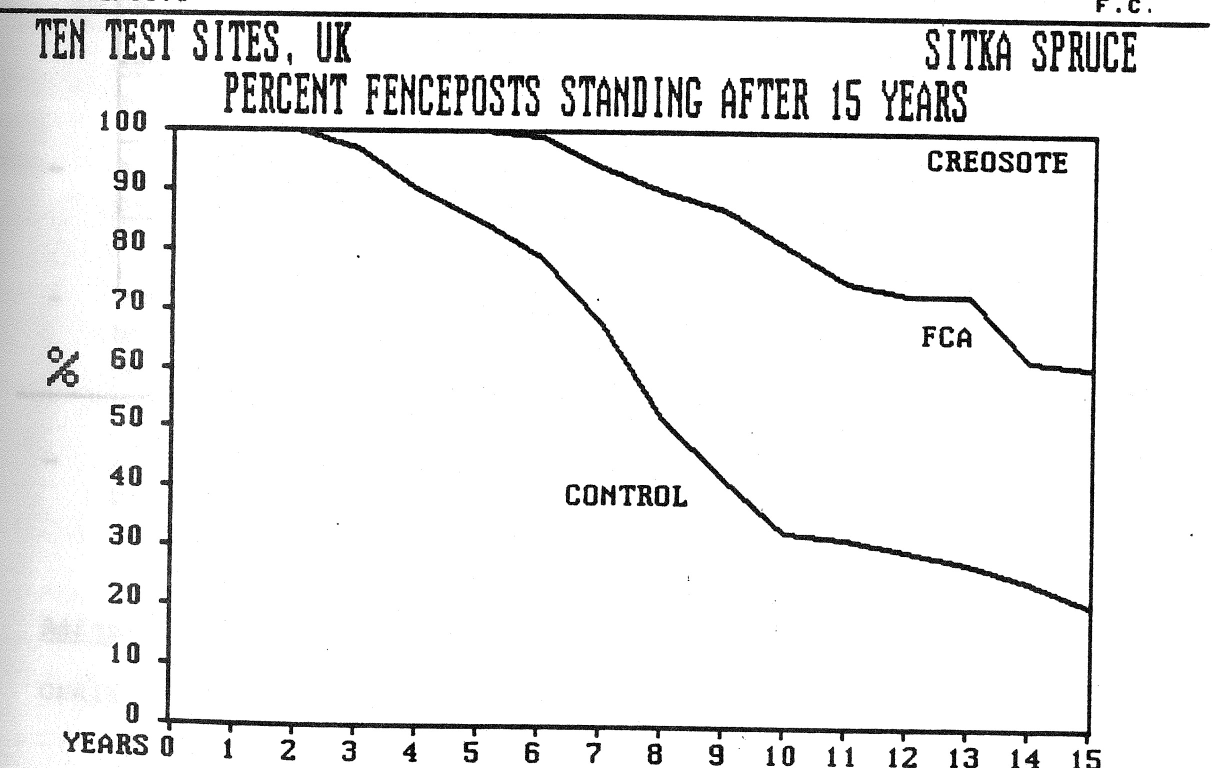
Round posts 1.7 m long and 7.5 to 10 cm in diameter were peeled, pointed and stacked under cover for at least eight weeks before open tank treatment with coal tar-creosote and a fluor-chrome-arsenate (FCA) waterborne preservative. The posts were placed in test in ten of twenty sites mostly in Scotland or Northern England. They were placed in a plot 9 x 10 m in groups of four of the same treatment and species. Over a 15 year period each post was subject annually to a horizontal pull of 22.6 kg at the top of the post. The average precipitation at the test sites was 750 to 1000 mm.

For the untreated Scots pine, 60% of the posts were removed in three years. Both the FCA and creosote significantly improved this performance. (Approximately 20% and 15% of the FCA and creosote posts, respectively, had been removed.) The untreated sitka spruce posts reached a 60% failure in nine years, and over 20% remained standing after 15 years. All the creosote treated posts were standing at the 15 year inspection while approximately 40% of the FCA treated posts had been removed. Some differences in the test site conditions would be anticipated with the spruce being evaluated in Scotland and Northern England, while the Scots pine were tested in Southern England.

Reference:

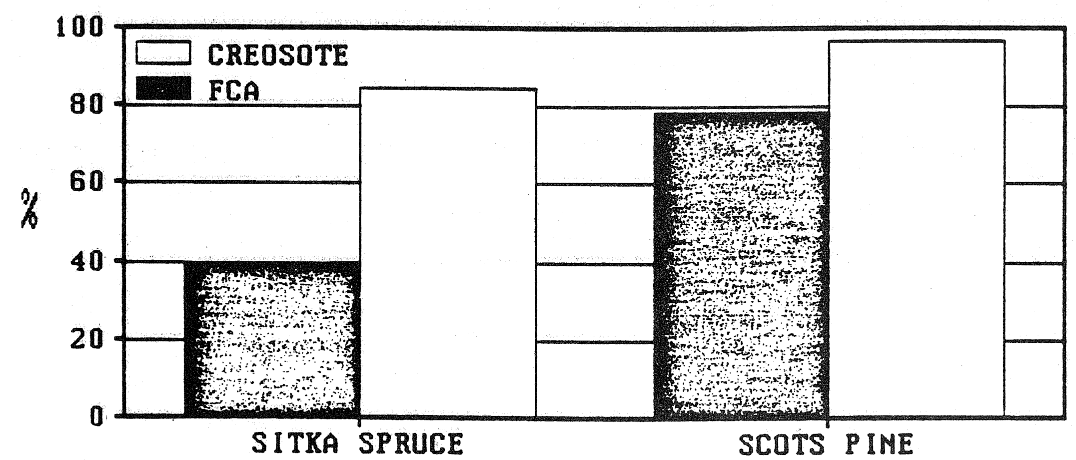
Clarke, J.E. and R.C. Boswell. 1976. Tests on Round Timber Fence Posts. Forestry Commission. Forest Record No. 108. 44 pp.





TWENTY TEST SITES, U.K.

PERCENT INCREASE IN DURABILITY DUE TO TREATMENTS AFTER 15 YEARS OF TESTING



PRINCES RISBOROUGH LABORATORY

Princes Risborough, U.K.

An appraisal was made by R. Orsler of the use of Norway spruce (Picea abies) and Sitka spruce (P. sitchensis) for fenceposts. He reviewed several factors influencing the treatment of spruce for use as fenceposts. He reported that field tests have shown that creosote treatments using full cell, empty cell or thermal processes are able to provide long term protection for round spruce posts.

The salient features in the utilization of spruce for fencing were summarized as follows:

- Spruce timber is non-durable and when used in ground contact situations must be pressure treated with a suitable preservative.
- Spruce plantation thinnings are very suitable for use as fenceposts, due to their relatively high proportion of sapwood which is more permeable than heartwood.
- Spruce posts, derived from thinnings and treated with creosote by the full cell, empty cell or the hot and cold open tank processes have remained sound in field trials for nearly fifty years. Unfortunately, comparable data for CCA treatments does not exist, but it is possible that suitably prepared material, treated to the British standard will provide a prolonged service life.
- Processes such as debarking, pointing and drilling should be carried out prior to treatment, to ensure that all exposed surfaces are thoroughly permeated with preservative.
- It is extremely important to ensure that the wood is properly dried before treatment. The wood must be at, or below, a moisture content of 25 to 30% in order to provide a satisfactory loading of preservative.
- Additional processes, such as ponding or incising, can be used to improve the penetration and distribution of the preservative.

Reference:

Orsler, R.J. 1976. Spruce for fencing posts. The Timber Grower. 60:25-28.

- ROUND SPRUCE POSTS TREATED WITH CREOSOTE BY FULL CELL, EMPTY CELL, AND HOT AND COLD OPEN TANK IN 1928 WERE STILL STANDING AFTER 47 YEARS

R.L. ORSLER:

- ROUNDWOOD MORE EFFECTIVELY TREATED THAN SAWNWOOD, DUE TO SAPWOOD
- IF WELL TREATED, SPRUCE ROUNDWOOD CAN GIVE A SERVICE LIFE IN EXCESS OF 50 YEARS
- SPRUCE MUST BE PROPERLY DRIED TO 25-30% M.C. BEFORE TREATMENT
- INCISING WILL BE ESSENTIAL FOR ADEQUATE TREATING OF LUMBER

PRINCES RISBOROUGH LABORATORY

Princes Risborough, U.K.

A survey of fenceposts and major freeways in England was conducted by the Princes Risborough Laboratory. The principal wood species used were Scots pine (Pinus sylvestins), larch (Larix sp), Douglas-fir (Pseudotsuga menziesii) and oak (quercus sp). Of the wood species not allowed under the fencepost specifications, but which nevertheless were identified in the posts removed from service, 6% were spruce. Twenty-five percent of the creosote treated fenceposts removed from the M1 motorway contained internal decay and these were all spruce. The internal decay was considered to be due to the poor treatment characteristics of this wood species.

Reference:

Cockroft, R. 1976. A survey of motorway fencing in England. Building Research Establishment. Current Paper CP61/76. 7 pp.

NATIONAL TIMBER RESEARCH INSTITUTE

South Africa

Fifty thousand white spruce [Picea glauca (Moench) Voss] poles, imported into South Africa from Cottrelo, Canada were pressure treated with a 5% PCP solution, using a full cell process. After 24 years of service, a further ten years of service life is expected from 90% of the poles.

The use of PCP in paraffin and diesel oil resulted from difficulties in obtaining adequate penetration, because of the narrow sapwood band.

Reference:

Coetzee, P.F. and G.S. Vermaak. 1975. The effectiveness of pentachlorophenol treatment of Canadian Picea poles. Forestry in South Africa. 17:65-67.

GREAT KAROO

CANADIAN WHITE SPRUCE

- 50,000 POLES PRESSURE TREATED WITH 5% PCP FORMULATED IN 5% ROSIN, 70% PARAFFIN AND 20% DIESEL OIL

- TREATED WITH FULL CELL PROCESS
  VACUUM 30 MIN -74 kPa
  PRESSURE 4.5 h 827 kPa
  TEMPERATURE 32-43°C
  AVERAGE RETENTION 5.6 kg/m^3

CANADIAN WHITE SPRUCE

PERFORMANCE
- AFTER 24 YEARS, ALL POLES ARE IN SERVICE
- A FURTHER 10 YEARS LIFE IS EXPECTED FOR 90% OF THE POLES

WESTERN EUROPEAN INSTITUTE FOR WOOD PRESERVATION (WEI)

Puisserguier, France; Sturzelberg, West Germany; Simlangsdalen, Sweden

The Western European Institute for Wood Preservation established a co-operative test to investigate the durability of treated wood. In 1953 tests of preservative treated poles were started. Three test sites, in France, Germany and Sweden were established. In 1961-62 the program was expanded to include Norway spruce poles from Germany and France. The German poles were treated with several preservatives and processes including CCA (Boliden K33) using a vacuum pressure schedule. The results are shown in the table. For comparison, data from the same study for Scots pine similarly treated with CCA is shown. After approximately nine years, log scores for the spruce are all 100. This is equivalent to that for Scots pine tests in Germany and Sweden, but is somewhat better than the performance of Scots pine in France.

Average retentions were 5.9 kg/m^3 (salt) for the Norway spruce in Germany and 6.7 kg/m^3 and 5.9 kg/m^3 for the Scots pine in France and Sweden respectively. The authors concluded that spruce gave "rather good results" at relatively low retentions. They also concluded that CCA afforded good protection against soft-rot.

Reference:

van Groenov, H.B. and B. Henningsson. 1976. European field trials with preservative treated wooden poles. Material und Organismen. 11(4):253-272.

TEST SITES IN FRANCE, GERMANY AND SWEDEN

PERFORMANCE OF CCA (BOLIDEN K 33) TREATED* POLES AT EACH SITE

	RETENTION** (kg/m^3)	LOG SCORE FRANCE 9 YRS	LOG SCORE GERMANY 9 YRS	LOG SCORE SWEDEN 10 YRS
NORWAY SPRUCE (GERMANY)	5.3	95	100	100
SCOTS PINE (FRANCE)	6.7	70	100	100
SCOTS PINE (SWEDEN)	5.8	85	100	100

* ALL TREATMENT BY VACUUM-PRESSURE METHOD ** SALT BASIS

CONCLUSIONS:

1. CCA TREATED NORWAY SPRUCE GAVE GOOD PROTECTION EVEN AT RELATIVELY LOW RETENTIONS

2. PERFORMANCE OF CCA-TREATED POLES IN THE FRENCH TEST WAS NOT AS GOOD AS WOULD BE EXPECTED

UNIVERSITY OF BRITISH COLUMBIA/FORINTEK CANADA CORP.

Westham Island, Canada

In 1977, 62 white spruce pole sections were installed at the Western Forest Products Laboratory's Westham Island field test site in British Columbia. They had been commercially pressure impregnated with ammoniacal copper arsenate (ACA) or pentachlorophenol (PCP). Twenty-four of the ACA treated spruce poles were studied to determine the influence of preservative penetration, retention, and nitrogen level on decay resistance of spruce poles after seven years of field testing. Such information will be valuable in establishing treated spruce as viable pole material in Canada.

After seven years in test, the average preservative penetration (based upon tests using chrome azurol S indicator) of 2.90 cm was generally greater than that required by Canadian standards. Analysis using energy-dispersive X-ray spectrometry showed that the mean ACA retention of 8.06 kg/m^3 was less than the 9.6 kg/m^3 required by the CSA standard. It was also found the copper content was greater than that of the arsenic, even though the original treatment contained equal quantities.

In microbiological studies, a total of 71 fungal isolates belonging to 17 genera and four taxa were identified to genus, with 15 of these identified as to species. Unlike the untreated control poles, true wood-decaying basidiomycetes were not found associated with the ACA treated spruce poles.

It was concluded from this study that even though the original ACA retentions were low, these ACA treated spruce poles are performing extremely well, with no signs of decay.

<u>Reference</u>:

Kim, W.J. 1985. Influence of Preservative Treatment on the Durability of ACA Treated White Spruce Poles. M.Sc. Thesis. University of British Columbia. 195 pp.

EIDGENOSSISCHE MATERIALPRUFUNGS- UND VERSUCHSANSTALT

Switzerland

A report was prepared on the causes of early failures of treated poles. It was noted that since poles are usually unseasoned when treated by oscillating pressure and section-trough methods, subsequent checking exposes untreated heartwood. However they have been preferred for treating spruce which is more difficult to impregnate after drying. Factors which were identified as affecting the treatment were: (a) storage conditions which allowed fungal infections; (b) removal of excess sapwood during debarking; and (c) checking of the poles during service. The preservatives in use in Switzerland included chrome-fluoride, chrome-fluoride-arsenic, chromated-copper-fluoride, chromated-copper-borate and CCA. Recommendations for improving the performance of the spruce poles included the use of incising to enhance penetration and pressure treatment to improve uniformity of preservative distribution.

<u>Reference</u>:

Walchli, O. 1978. Causes of early losses by decay of impregnated timber with ground contact. IUFRO Division V. Subject Group on Wood Protection. Mexico. 27 pp.

The authors investigated differences in the preservative penetration characteristics in spruce (<u>Picea excelsa</u> L) and pine (<u>Pinus sylvestris</u> L) poles. They found that in spruce poles pressure treated with a chrome-fluoride-arsenic preservative the concentration of the preservative decreases markedly in spruce with increasing distance from the wood surface. This was not so with pine, where the concentration gradient was much more gradual. In pine the concentration was constant in the last 10 mm. Using a 1% solution for the pine poles, 10 kg/m^3 of CFA salt was present in the outer 0 to 1 cm, 5 kg/m^3 in the 1 to 2 cm zone and 1 to 2 kg/m^3 in the last 1 cm zone before the heartwood. Penetration in spruce averaged about 2 cm. Using a 3.3% solution for the spruce poles the concentration in the outer 0 to 1 cm zone was 15 kg/m^3. In the 1 to 2 cm zone the retention fell to 5 kg/m^3. The authors also commented upon the much greater variability in the treatment of spruce compared to pine.

<u>Reference</u>:

Gersonde, M. and G. Becker. 1965. Absorption, penetration depth and quantitative distribution of a chromium-fluorine-arsenic preservative salt mixture in spruce and pine poles after pressure impregnation. Holz als Roh- und Werkstoff. 23(9):369-381.

GERSONDE/BECKER

DIFFERENCES BETWEEN PERSERVATIVE DISTRIBUTIONS IN SPRUCE AND PINE POLES

- CFA PRESERVATIVE CONTENT FALLS MUCH MORE RAPIDLY IN SPRUCE THAN IN SCOTS PINE, WITH INCREASING DISTANCE FROM THE POLE SURFACE
- IN PINE POLES THE PRESERVATIVE RETENTION IN THE LAST 10 mm IS CONSTANT IN DIFFERENT POLES
- GREATER VARIABILITY IN TREATMENT OF SPRUCE THAN SCOTS PINE

FORINTEK CANADA CORP.

Virden, Manitoba and Sault Ste. Marie, Ontario

It is believed that this installation in a CPR mainline track at Virden, Manitoba was the first service life test established in Canada of pressure creosoted railway cross-ties. No large scale treating plants existed in Canada at the time the tests were started, therefore, the Rueping treatment of 166 ties was carried out at two plants in the U.S.

The treated ties were installed during the fall of 1905 and also in 1906. This track was single tangent track on an embankment with good drainage. The service life was calculated on the assumption that the ties were installed in 1906.

The average service of this test was 32.9 years. One hundred sixty-two ties were included in the final calculation of service life. Four ties had been removed from the track in 1910 for laboratory examination.

In the second trial reported, a total of 700 green cross-ties of the following species: jack pine, white spruce, white and yellow birch and aspen poplar were treated in a "chain dipping" operation in the railway's treating plant at Hawk Junction, Ontario. The treatment employed Osmosar, a proprietary preservative of fluor-chrome-arsenate-phenol made up as a slurry in water.

Seven hundred ties were installed in 1951, in an out-of-face installation on a tangent track where the original ballast was cinder, earth, slag and gravel mixture. By 1968, only two out of 100 spruce ties installed remained in service. The average life was calculated to be 13.3 years for No. 2 grade ties and 14.1 years for No. 1 grade ties. The jack pine ties were in better condition, with 39 ties remaining in test out of 99 installed. The average service life to the 1968 inspection was reported to be 16.1 and 16.3 for No. 1 and No. 2 grade ties, respectively. Neither the spruce nor the jack pine ties were prebored and antichecking S-irons were not used. It was also estimated that the average service of the jack pine ties will be approximately 18 years at conclusion of test.

Of particular interest is the degree of checking in the spruce and jack pine ties. Almost two-thirds of the spruce ties had the highest checking rating of 4 which indicated full length checks were present and both ends of the tie were split. The jack pine ties were checked less severely having predominantly ratings of 2 (both ends checked) and 3, a full length, medium size check.

Reference:

Krzyzewski, J. 1969. Durability data on treated and untreated railway ties. Dept. of Fisheries and Forestry. Forest Products Laboratory, Ottawa. Information Report No. OP-X-20. 77 pp.

MANITOBA

PERFORMANCE OF SPRUCE AND JACK PINE TIES TREATED WITH CREOSOTE BY THE RUEPING PROCESS

WOOD SPECIES	NO. OF TIES	RETENTION (kg/m^3)	AVGE LIFE (YRS)
JACK PINE	35	75	32.9
SPRUCE	57	61	

ONTARIO

PERFORMANCE OF TIES TREATED WITH "OSMOSAR" BY A DIFFUSION PROCESS AFTER 17 YEARS

	RETENTION (kg/m^3)	CHECKING (% OF TIES) NO. OF CHECKS PER TIE 0	1	2	3	4	AVG	TIES (%) IN TEST IN 1968	AVGE LIFE YRS
WHITE SPRUCE	4.6	-	-	-	33	67	3.7	0	14.1
	6.1	-	-	-	100	-	3.0	0	13.3
JACK PINE	4.6	-	5	43	52	-	2.5	43	16.1
	6.1	-	11	39	50	-	2.4	36	16.3

PRINCES RISBOROUGH LABORATORY

Princes Risborough, U.K.

Comparison of IPBC and TBTO treated spruce, pine and hemlock L-joints

Field trials have been reported, comparing the performance of IPBC (3-iodo 2-propynyl butyl carbamate) with that of TBTO (tri-n-butyltin oxide) which is widely used in Europe for the protection of window joinery and timber used out of contact with the ground, e.g., in roof spaces. The report presented data from a large scale field trial involving 1079 L-joint test samples. The parameters investigated in the trials included timber species (pine, spruce and hemlock), preservative application methods (3 minute dip and double vacuum treatment) and finishing systems.

Control of fungal colonization

The report concluded that untreated spruce was colonized by active decay fungi within the first eight months of exposure though not as extensively as pine sapwood. Double vacuum treatment with IPBC and TBTO generally prevented colonization for up to 36 months exposure. Similar results were obtained with western hemlock although colonization proceeded more slowly in the untreated samples.

Sistotrema brinkmannii colonized untreated spruce within eight months of exposure; both IPBC and TBTO completely prevented colonization up to and including 36 months.

The study concluded that the two chemicals were equally effective in preventing decay in spruce and hemlock.

Reference:

Bravery, A.F. and J.K. Carey. 1986. Building Research Advisory Service. Princes Risborough Laboratory. Report PRL15-86. 11 pp.

PER CENT OCCURENCE OF DECAY FUNGI IN SPRUCE, AND HEMLOCK L-JOINTS

TIMBER	EXPOSURE PERIOD -MONTHS	UNTREATED	DOUBLE VACUUM TREATED	
			IPBC*	TBTO**
SPRUCE	8	17	0	2
	24	17	0	0
	36	11	0	2
HEMLOCK	8	0	2	0
	24	28	0	2
	36	17	0	2

* 0.5% IPBC ** 1.0% TBTO

PER CENT OCCURENCE OF SISTOTREMA BRINKMANNII IN SPRUCE AND HEMLOCK L-JOINTS

TIMBER	EXPOSURE PERIOD -MONTHS	UNTREATED	DOUBLE VACUUM TREATED	
			IPBC*	TBTO**
SPRUCE	8	17	0	0
	24	0	0	0
	36	33	0	0
HEMLOCK	8	0	0	0
	24	0	2	9
	36	0	0	11

* 0.5% IPBC ** 1.0% TBTO

PRINCES RISBOROUGH LABORATORY

Princes Risborough, U.K.

Field trials with Norway spruce sapwood L-joints, treated by a ten-minute dip using solutions containing 0.5% TBTO and various levels of waxes were reported. It was clear that such treatments were inadequate to provide long term protection to spruce. A second trial was initiated in 1973 using spruce heartwood, and a 1% TBTO solution. In this second test, after four years the double vacuum treatment with TBTO has completely protected the spruce joinery, with or without painting. A ten-minute dip treatment with the same preservative was less successful with the joinery showing early signs of decay.

Of particular interest are the observations of moisture uptake by the spruce L-joints compared to those of the Scots pine. The results showed that spruce has natural water repellent properties which prevented the joinery from absorbing moisture as rapidly as Scots pine. This could be beneficial for out of ground contact applications such as decking, siding, etc. The influence of water repellents is also shown, since such treatment could be considered when investigating modifications to the treatment, e.g., a finishing stain which included a water repellent. It is therefore of interest to note the relatively poor response for the use of wax water repellents on unpainted spruce joinery. Although moisture contents did not exceed 20% after four years exposure, they did not correlate positively with the wax content. The authors also noted that there was little difference in the moisture uptake of L-joints which were given coatings of a "high build" stain and a paint. Presumably the known beneficial qualities of the CCA preservative in retarding the weathering of commodities such as decks, would also be beneficial in retarding the moisture uptake in spruce.

References:

Morgan, J.W.W. 1975. Whitewood - an external joinery timber. Building Research Establishment. Information Sheet IS 175. 2 pp.s

Purslow, D.F. and N.A. Williams. 1978. Field trials on preserved timber out of ground contact. Building Research Establishment. Princes Risborough Laboratory. Report No. CP78/78. 28 pp.

PRINCES RISBOROUGH

PERFORMANCE OF L-JOINTS TREATED WITH 1% TBTO BY A DOUBLE VACUUM PROCESS AFTER 4 YEARS EXPOSURE

RESIN (%)	WAX (%)	PAINTED	GROSS RETENTION (kg/m³)	DECAY RATING (%)
10	0	Y	143	0
10	0.5	Y	173	0
10	0.5	N	159	0

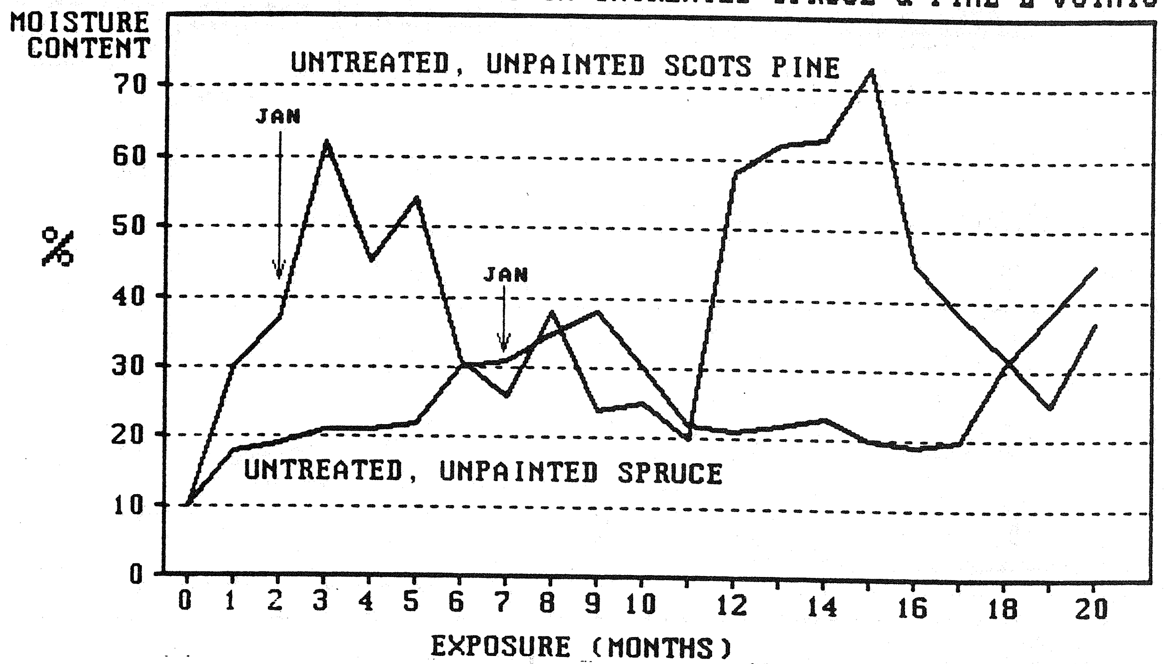
PRINCES RISBOROUGH

AMPLITUDE OF ANNUAL MOISTURE CONTENT (%) IN NORWAY SPRUCE

WAX CONTENT	UNPAINTED				PAINTED			
%	1971	1972	1973	1974	1971	1972	1973	1974
0	18	34	26	29	6	9	10	8
0.2	9	21	18	12	3	5	6	6
0.5	10	20	19	15	2	3	5	4
1.0	9	20	19	20	4	3	4	2

PRINCES RISBOROUGH

VARIATION IN MOISTURE CONTENT IN UNTREATED SPRUCE & PINE L-JOINTS



PRINCES RISBOROUGH

CONCLUSIONS 1. FOR SPRUCE, THE INITIAL MOISTURE CONTENT OF WOOD EXPOSED ABOVE GROUND IS NOT EFFECTED GREATLY BY

- WATER REPELLENT CONTENT
- METHOD OF TREATMENT
- SOLUTION UPTAKE

PRINCES RISBOROUGH

CONCLUSIONS 2. LONG TERM BENEFITS MAY BE OBTAINED FROM WATER REPELLENT TREATMENTS

PRINCES RISBOROUGH

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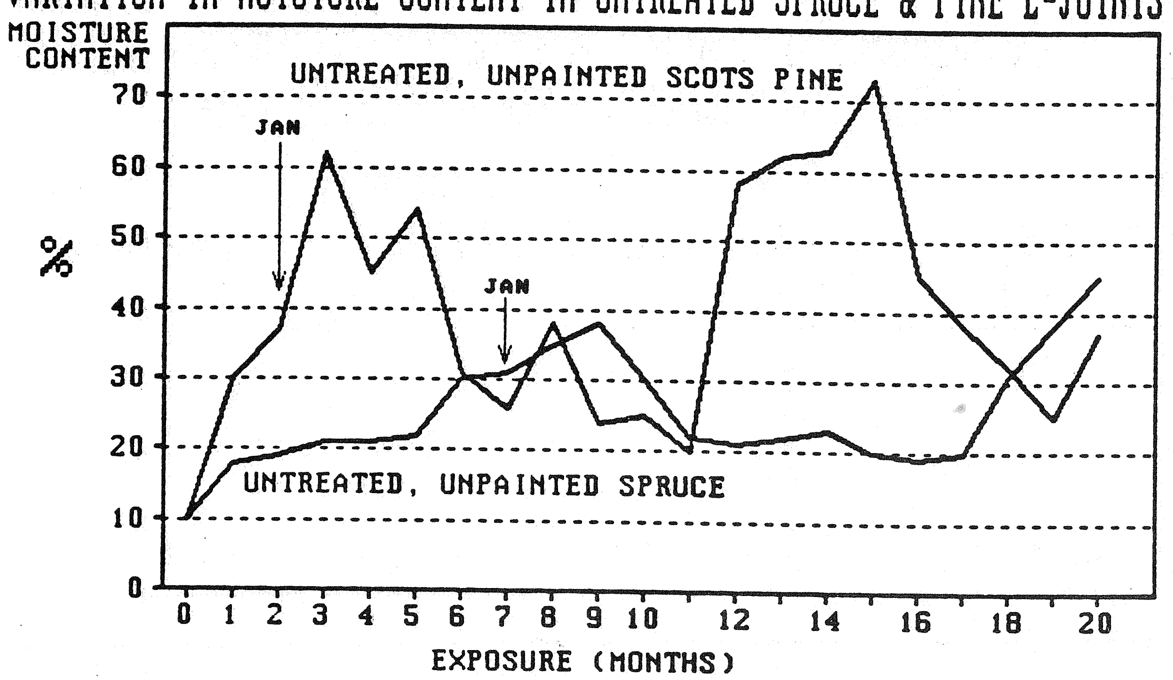
1.0	9	20	19	20	4	3	4	2

PRINCES RISBOROUGH

VARIATION IN MOISTURE CONTENT IN UNTREATED SPRUCE & PINE L-JOINTS



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PRINCES RISBOROUGH

CONCLUSIONS 2. LONG TERM BENEFITS MAY BE OBTAINED FROM WATER REPELLENT TREATMENTS

FORINTEK CANADA CORP.

Westham Island, Canada

To provide background information for the performance of wooden siding, Forintek is carrying out a limited field test of western red cedar, spruce and pine siding, treated with selected finishes. Eleven combinations of siding and finish have been installed during the previous six years at the Westham Island test site. Western red cedar siding is undergoing testing with six finishes: CCA and ACC pressure treatments; a brush-applied formulation based on PCP with waxes as water repellents (reported in the literature as either the EFPL Natural Finish or the Madison Formula) with and without a chromic acid pretreatment; and two commercial brush-applied, semi-transparent stains. Pine siding pressure treated with either CCA (two widths) or ACC, and spruce siding treated with CCA and CCA with pre-stain are also being assessed.

The siding being tested was made into panels 1.2 x 2.4 m (4 x 8 ft.) with pretreated boards being aplied horizontally to support panels. For each test rack, replicate panels were mounted with southern and northern exposures. To maximize weathering, particularly wetting, the panels were mounted at a slight angle (15°) from the vertical.

After four years in test, western red cedar continues to outperform the alternate species due to its higher dimensional stability and natural color. When used in a narrow width (<12.5 cm), lodgepole pine may give adequate performance, although some checking and cupping have been recorded. Neither the spruce siding nor the wider (20 cm) lodgepole pine siding are performing satisfactorily due to excessive checking and cupping. Color fade was also much more obvious in spruce than in pine or western redcedar.

<u>Reference</u>:

Ruddick, J.N.R., N.A. Ross and A. Byrne. 1985. Field Testing of Siding/ Natural Finishes. Forintek Canada Corp. Report prepared for the Canadian Forestry Service. 19 pp.

WESTHAM ISLAND

PERFORMANCE OF CCA-TREATED SIDING AT WESTHAM ISLAND

WOOD SPECIES	SIZE (mm)	TYPE	CHECKING S/N	CUPPING S/N	TOTAL SCORE
SPRUCE	2.5x20	T/G	3/1	4/0	19
SPRUCE	2.5x15	CHANNEL	4/1	3/1	28
LODGEPOLE PINE	2.5x20	CHANNEL	2/1	3/1	27

EXPOSURE PERIODS WERE 49 MONTHS FOR CHANNEL SIDING AND 53 MONTHS FOR TONGUE AND GROOVE (T/G) SIDING

S/N = SOUTH/NORTH EXPOSURE

FORINTEK CANADA CORP.

Ottawa, Canada

The performance of eastern white spruce (*Picea glauca*) pressure treated with an ammoniacal zinc salt-latex system was compared with that of eastern white pine (*Pinus strobus* L), red pine (*Pinus resinosa* Ait) and western red cedar (*Thuja plicata* Donn). After 240 days of exposure the spruce control boards were heavily stained with extractives compared to the pine. Fungal staining was apparent after one year, and becoming more severe each year during the three year test. In addition deep checks were recorded for the spruce boards. The treated spruce also exhibited heavy fungal and extractive staining after 240 days of exposure while the red pine gave a superior performance, showing only light discoloration. Surface checking remained a problem in the spruce.

Reference:

Dolenko, A.J. and R.L. Desai. 1977. Exterior durability of some eastern Canadian wood species treated with zinc salts. Journal of Coatings Technology. 49:79-87.

FORINTEK CANADA CORP.

Treatment of Dimensional Material

Research at Forintek Canada Corp. on the treatment of spruce lumber has shown that it must be incised with a close spaced staggered incising pattern to ensure a uniform penetration. Based upon the results of several experiments, a pattern with a longitudinal spacing of 18 mm and a lateral separation of incisions of 1 mm will be needed to consistently treat the more refractory material.

A second observation which will have a major impact upon the acceptability of pressure treated spruce is the cell collapse which often occurs. This may be reduced by lowering the pressure from 1000 KPa to ca 700 kPa.

Reference:

Ruddick, J.N.R. 1986. Unpublished observations

CONCLUSIONS

- Spruce is refractory to conventional pressure treatment with the standard preservatives (CCA, ACA, PCP and creosote).
- Lumber/timber must be incised with a close-spaced incising pattern.
- A typical pattern deduced from CCA treatment of white spruce from one location in B.C. would have a lateral incision spacing of 1 mm and a longitudinal separation of 18 mm.
- When adequately treated with an effective preservative, a fully acceptable performance can be anticipated, with respect to protection from decay.
- Distribution of the CCA preservative components may be different in spruce and pine. A much greater concentration gradient from the wood surface has been reported.
- Spruce is prone to collapse during conventional treatment conditions in Canada.
- Checking in spruce may be greater than in pine.
- Careful preconditioning of sawn wood will be more important in spruce than in pine, to prevent degrade due to splitting, cupping, etc.
- Spruce may not weather as well as pine, particularly when treated with a stain.
- Moisture uptake in spruce may be lower than in pine.
- Tests need to be established to determine the performance of other spruce commodities, e.g., decking.
- Research should be conducted on ways of reducing the checking in treated spruce.