

**NWPC FIELD TEST WITH WOOD
PRESERVATIVES.**

RESULTS FROM TRIALS 1968 TO 1989.

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Marie-Louise Edlund and Östen Bergman

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ABSTRACT

This report gives results from the NWPC field trials started in 1968, 1971, 1973, 1975, 1977, 1978, and 1980 to 1989. The tests have been performed in co-operation with the Danish Technological Institute, the Technical Research Centre of Finland, the Norwegian Institute of Wood Technology and the Department of Forest Products (since 1999 the Department of Wood Science) at the Swedish University of Agricultural Sciences. The field trials are carried out according to the NWPC Standard No. 1.4.2.1./71 "Testing of wood preservatives. Mycological tests. Field test - a field test with stakes" and from 1986 according to EN 252 "Field test method for determining the relative protective effectiveness of a wood preservative in ground contact". The test fields were Hillerød and Tåstrup in Denmark, Vaasa, Vihti and Viikki in Finland, Sørkedalen in Norway and Simlångsdalen old and new fields in Sweden (Figure 1). In 1974 all the stakes at Hillerød were moved to Tåstrup, and in 1986 all the stakes at Vaasa and Vihti were moved to Viikki. Between 1992 and 1996 all stakes at Simlångsdalen old field were moved to Simlångsdalen new field. The stakes used in the trials were made from sapwood of European redwood (*Pinus sylvestris* L.). This is the species on which testing for approval is performed. However, in some of the trials other species were used, such as European beech (*Fagus sylvatica* L.), European birch (*Betula* spp.) and alder (*Alnus incana* (L.) Moench).

The preservatives, their chemical formulations and their average index of decay are presented in Tables 1 - 43. Index of decay in relation to the retention of the preservatives is shown in Figures 2 - 23. In the Appendix (Figures 24 - 165), the rate of decay is presented for every preservative tested.

INTRODUCTION

Field tests with wood preservatives have been conducted for many years in each of the Nordic countries. In 1968 the first NWPC test was started. This report gives results from field trials started in 1968, 1971, 1973, 1975, 1977, 1978 and 1980 to 1989.

The tests were carried out by the NWPC in co-operation with the Danish Technological Institute, the Technical Research Centre of Finland, the Norwegian Institute of Wood Technology and the Department of Forest Products (since 1999 the Department of Wood Science) at the Swedish University of Agricultural Sciences.

The results of the 1968 field trial after 5 years were reported in 1974 by Henningsson (1974). Borsholt (1979) reported results after 10 years for European redwood in 1979 and Bergman and Jermer (1990) reported results after 20 years in 1990. Bergman and Jermer (1989) reported the results of the trials started in 1971, 1973, 1975 and 1977 and trials started 1968 to 1981 were reported by the same authors in 1993.

MATERIALS AND METHODS

The field trials are carried out according to the NWPC Standard No. 1.4.2.1./71 "Testing of wood preservatives. Mycological test. Field test - a field test with stakes" and from 1986 according to EN 252 "Field test method for determining the relative protective effectiveness of a wood preservative in ground contact". The stakes used in the trials were made from sapwood of European redwood (*Pinus sylvestris* L.). This is the species on which testing for approval is performed. In the 1968 trial European beech (*Fagus sylvatica* L.), European birch (*Betula* spp.) and alder (*Alnus incana* (L.) Moench) were also used. The trial 1980:2 was mainly carried out on European beech. For one preservative, European beech was also used in the 1981 trial. In 1983 a trial was started with untreated and treated heartwood and sapwood of European redwood (*Pinus sylvestris* L.), Larch (*Larix* sp), Douglas fir (*Pseudotsuga menziesii*), Lodgepole pine (*Pinus contorta*), Red silver fir (*Abies amabilis*) and Western hemlock (*Tsuga heterophylla*). The size of the stakes used in trials until 1985 was 20 x 50 x 500 mm and thereafter 25 x 50 x 500 mm.

The locations of the Nordic test fields are shown in Figure 1. The soil types of the test fields are:

Denmark	Hillerød:	Moraine sand
	Tåstrup:	Moraine clay
Finland	Vaasa:	Mull rich soil containing considerable organic material
	Vihti:	Clay containing some organic material
	Viikki:	Clay containing organic material
Norway	Sørkedalen:	Sandy soil containing some organic material
Sweden	Simlångsdalen	
	old and new field:	Sandy soil
	Ultuna:	Clay

In 1974 the remaining stakes at Hillerød were moved to Tåstrup, in 1986, the remaining stakes at Vaasa and Vihti were moved to Viikki and between 1992 and 1996 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

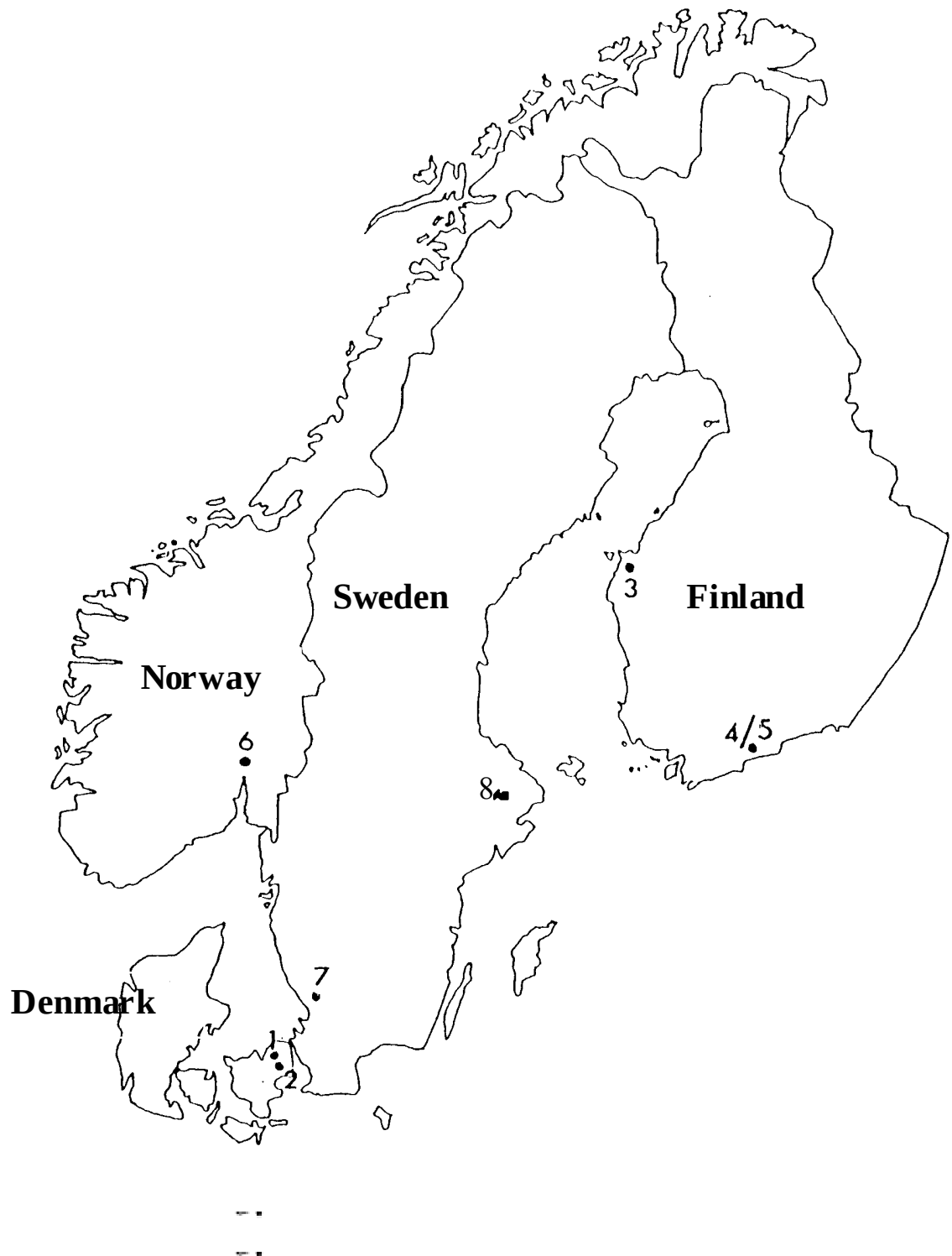


Figure 1. Location of the Nordic test fields.

1. Hillerød	5. Viikki, near Helsinki
2. Tåstrup	6. Sørkedalen
3. Vaasa	7. Simlångsdalen
4. Vihti, near Helsinki	8. Ultuna, near Uppsala

The extent of decay was graded according to the following scale:

Condition	Rating of decay	Index of decay
Sound - no decay	0	0
Slight decay	1	25
Moderate decay	2	50
Severe decay	3	75
Very severe decay (stake rejected, due to failure in bending apparatus).	4	100

By adding the index of decay for the stakes of each group and dividing the sum by the number of stakes, the average index of decay for each preservative and retention level is obtained. When all stakes in a group have failed (average index of decay = 100), the average life is calculated.

The retention of a preservative is based on the chemical composition presented in the tables.

RESULTS AND DISCUSSION

Field trial 1968

The preservatives of the 1968 trial and their chemical formulations are listed in Table 1.

The test fields used at the start of the 1968 trial were Simlångsdalen, Hillerød, Vaasa and Sørkedalen. Stakes of European redwood were set out at all of the four test fields. Each hardwood species was only set out at one of the test fields viz.: European beech at Simlångsdalen, European birch at Vaasa and alder at Sørkedalen.

20 stakes were set out at Simlångsdalen and 10 stakes at each of the other test fields for every retention level. In 1974 the remaining stakes at Hillerød were moved to Tåstrup, in 1986, the remaining stakes at Vaasa were moved to Viikki and in 1996 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

Five concentration levels for each preservative were chosen. The medial concentration was that recommended in 1968 for European redwood in ground contact.

Index of decay for stakes of European redwood after 5 and 31 years' testing and average life are shown in Table 2 for test fields Simlångsdalen and Hillerød/Tåstrup and Table 3 for Vaasa/Viikki and Sørkedalen. The results for European beech tested at Simlångsdalen, European birch at Vaasa/Viikki and alder at Sørkedalen are shown in Tables 4-6.

Index of decay in relation to the retention of the preservatives after 31 years is shown for stakes of European redwood in Figures 2 to 5.

Figures 24 - 63 in the Appendix give the rate of decay for stakes with various retention levels of the preservatives. Results for European redwood are shown in Figures 24 - 39 and for hardwoods in Figures 40 - 63.

European redwood

The life of untreated European redwood stakes was 1.0 year at Vaasa, 3.5 years at Simlångsdalen, 4.7 years at Sørkedalen and 5.1 years at Hillerød (Tables 2 and 3).

A comparison of the index of decay in relation to retention of the preservatives after 31 years shows that there is some variation at the different test fields (Figures 2 to 5).

Treated stakes at Hillerød/Tåstrup and Sørkedalen have the lowest index of decay (Table 2 - 3, Figure 2 - 3). In fact for several preservatives tested at Sørkedalen, there are after 31 years of exposure, stakes treated to the lowest concentration still remaining in the field (Table 3). A comparison of the preservatives at Sørkedalen using the medial concentration levels gives the following order in index of decay (in brackets): Tanalith C (38), Wolmanit CB (45), Boliden K33 (50), Celcure A (50), Basilit CFK (55), BP Hylosan (75), creosote (83) and KP Cuprinol (98) (Table 3).

At Simlångsdalen the lowest concentration levels for all preservatives tested have reached an index of decay of 100 (Table 2). The average life was in the range of 13 - 16 years at that concentration level for all preservatives except creosote (8.4 years). The order of the preservatives given by increasing index of decay for the medial retention levels used was: Tanalith C (93), Wolmanit CB (93), Boliden K33 (99), Basilit CFK (100), Celcure A (100), KP Cuprinol (100) BP Hylosan (100) and creosote (100) (Table 2).

At Hillerød/Tåstrup all stakes, except those treated with Tanalith C, have been rejected at the lowest concentration tested (Table 2). The index of decay for the medial retention levels gives the following order of the preservatives: Tanalith C (30), Boliden K33 (60), Basilit CFK (60), Wolmanit CB (64), Celcure A (75), KP Cuprinol (100), BP Hylosan (100) and creosote (100).

At Vaasa/Viikki, all stakes have been rejected at the lowest retention level (Table 3). The index of decay for the medial concentration levels gives the following order for the preservatives: Wolmanit CB (81), Tanalith C (83), Boliden K33 (94), Celcure A (97), BP Hylosan (100), Basilit CFK (100), creosote (100) and KP Cuprinol (100).

In general the CCA-preservatives have given the best protection closely followed by Wolmanit CB, Basilit CFK and BP Hylosan. The preservatives KP Cuprinol and creosote have been less successful. However, it is well known that stake tests do not give a fair result for creosote. If stakes and poles are treated to the same retention of either CCA or creosote, the CCA-treated stake will last longer than the creosote stake, while the creosote pole will last as long as or even longer than the CCA-treated pole. The protection of the creosote pole will increase during the service period due to accumulation of the creosote at the base of the pole.

Hardwoods

The treated hardwood stakes deteriorated more rapidly than treated European redwood stakes (Table 4-6).

At Simlångsdalen, all stakes of European beech have reached an index of decay of 100 except some stakes treated to the highest retention levels of Wolmanit CB (Table 4). At the lowest retention level tested, the life of the preservatives was in the range of 4.3 to 6.4 years. At medial retention levels Wolmanit CB had the longest life (14 years), followed by BP Hylosan (9.3 years), KP Cuprinol (9.1 years), Basilit CFK (8.5 years), Tanalith C (6.5 years), creosote (6.4 years), Boliden K33 (6.3 years) and Celcure A (5.3 years) (Table 4). It was earlier shown from Simlångsdalen that the life of European redwood stakes treated with the lowest concentration was in the range of 13-16 years for all the preservatives tested except creosote. Thus the lowest concentration in stakes of European redwood gave better protection than twice the concentration in stakes of European beech.

At Vaasa/Viikki all stakes of European birch, except those treated with the highest retention of Wolmanit CB, are rejected (Table 5). A comparison of the preservatives at the medial concentration level gives the following order of efficacy as indicated by life: Wolmanit CB (21 years), BP Hylosan (18 years), Basilit CFK (17 years), Creosote (16 years), Tanalith C (14 years), Boliden K33 (13 years), KP Cuprinol (10 years) and Celcure A (8.3 years).

For alder at Sørkedalen all stakes treated with the lowest concentration of preservatives are rejected as are all stakes treated with Basilit CFK, Celcure A and KP Cuprinol (Table 6). The life at the medial concentrations were Wolmanit CB 23 years, BP Hylosan 22 years, Tanalith C 17 years, creosote 17 years, Basilit CFK 16 years, Boliden K33 16 years, KP Cuprinol 11 years and Celcure A 9.1 years.

Table 1. NWPC Field trial 1968. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Basilit CFK	CuSiF ₆ · 4 H ₂ O	35.9	Cu	8.2	Farbenfabriken Bayer AG
	(NH ₄) ₂ Cr ₂ O ₇	63.1	F	14.7	
	(NH ₄) ₂ HPO ₄	1.0	Cr	26.0	
Boliden K33	CuO	14.8	Cu	11.8	Boliden AB
	CrO ₃	26.6	Cr	13.8	
	As ₂ O ₅	34.0	As	22.2	
	H ₂ O	24.6			
Celcure A	CuSO ₄ · 5 H ₂ O	23.2	Cu	8.2	Celcure Ltd.
	CuO	2.8	Cr	14.0	
	Na ₂ Cr ₂ O ₇ · 2 H ₂ O	40.0	As	14.8	
	As ₂ O ₅	22.7			
	H ₂ O	11.3			
KP Cuprinol	K-salt 91.3 %				Bönnelyche & Thurøe AB
	CuO	15	Cu	10.9	
	NH ₃	18	Na-PCP	6.1	
	CO ₂	44			
	H ₂ O	23			
	P-salt 8.7 %				
	C ₆ HCl ₄ ONa (Na-PCP)	70			
H ₂ O	30				
Tanalith C (Tancas C)	CuSO ₄ · 5 H ₂ O	35	Cu	8.9	Hickson and Welch Ltd.
	Na ₂ Cr ₂ O ₇ · 2 H ₂ O	45	Cr	15.7	
	As ₂ O ₅ · 2 H ₂ O	20	As	11.3	
Wolmanit CB	CuO	10.8	Cu	8.6	Dr. Wolman GmbH
	CrO ₃	26.4	Cr	13.3	
	H ₃ BO ₃	25.5	B	4.5	
	KHSO ₄	37.3			
BP Hylosan	PCP	5	PCP	5	Svenska BP AB
	Water repellents	< 4			
	Solvent	ad 100			
Creosote	Scandinavian specification				

* Manufacturer that originally ordered the test.

Table 2. NWPC Field trial 1968. Results after 5 and 31 years' testing.
Wood species: European redwood (sapwood).

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{X}$)					
			Simlångsdalen (Sweden)*			Hillerød/Tåstrup (Denmark)*		
			Year	Year	$\bar{X}$	Year	Year	$\bar{X}$
			5	31		5	31	
Basilit CFK	1.0	6.7	0	100	14	0	100	17
	1.5	10	3	100	15	3	88	
	2.0	14	0	100	19	0	60	
	3.0	20	0	90		0	60	
	4.0	27	0	61		0	23	
Boliden K33	1.0	6.6	3	100	15	0	100	19
	1.5	10	0	100	19	0	100	26
	2.0	13	0	99		0	60	
	3.0	20	0	83		0	25	
	4.0	27	0	60		0	22	
Celcure A	1.2	7.7	0	100	14	0	100	18
	1.8	12	0	100	16	0	95	
	2.4	16	0	100	18	0	75	
	3.6	23	0	88		0	9.4	
	4.8	32	0	74		0	13	
KP Cuprinol	1.4	9.0	5	100	14	0	100	16
	2.1	14	0	100	15	0	100	19
	2.7	18	0	100	17	0	100	22
	4.1	27	0	100	18	0	86	
	5.5	36	0	100	22	0	65	
Tanalith C (Tancas C)	1.2	8.1	0	100	16	0	93	
	1.8	12	0	100	19	0	58	
	2.4	16	0	93		0	30	
	3.6	24	0	86		0	13	
	4.8	33	0	45		0	5	
Wolmanit CB	1.5	10	0	100	14	0	100	21
	2.3	15	0	100	18	0	58	
	3.0	20	0	93		0	64	
	4.5	31	0	80		0	23	
	6.0	41	0	61		0	23	
BP Hylosan	17	70	33	100	13	10	100	17
	25	104	9	100	19	0	100	20
	33	126	10	100	21	5	100	23
	50	217	0	90		0	79	
	67	305	0	78		0	70	
Creosote	17	74	54	100	8.4	33	100	12
	25	108	54	100	11	18	100	16
	33	143	35	100	14	10	100	18
	50	194	10	98		5	100	23
	67	229	3	99		0	100	23
Untreated			100		3.5	82	100	5.1

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1996 and from Hillerød to Tåstrup in 1974.

Table 3. NWPC Field trial 1968. Results after 5 and 31 years' testing.
Wood species: European redwood (sapwood).

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Vaasa/Viikki (Finland)*			Sørkedalen (Norway)		
			Year		$\bar{x}$	Year		$\bar{x}$
			5	31		5	31	
Basilit CFK	1.0	6.7	98	100	3.2	33	95	
	1.5	10	68	100	11	15	90	
	2.0	14	50	100	22	5	55	
	3.0	20	40	92		10	38	
	4.0	27	28	83		0	28	
Boliden K33	1.0	6.6	33	100	17	5	98	
	1.5	10	18	100	23	10	70	
	2.0	13	0	94		5	50	
	3.0	20	0	85		0	25	
	4.0	27	0	75		0	25	
Celcure A	1.2	7.7	40	100	17	5	100	26
	1.8	12	25	100	23	5	73	
	2.4	16	18	97		3	50	
	3.6	23	10	90		0	28	
	4.8	32	0	78		3	35	
KP Cuprinol	1.4	9.0	98	100	4.5	18	100	15
	2.1	14	60	100	8.7	8	100	16
	2.7	18	50	100	11	0	98	
	4.1	27	10	100	17	5	95	
	5.5	36	8	100	17	3	83	
Tanalith C (Tancas C)	1.2	8.1	35	100	16	0	98	
	1.8	12	22	97		5	70	
	2.4	16	8	83		3	38	
	3.6	24	3	78		0	25	
	4.8	33	0	70		0	30	
Wolmanit CB	1.5	10	100		3.3	13	95	
	2.3	15	55	100	14	10	58	
	3.0	20	30	81		0	45	
	4.5	31	20	89		5	28	
	6.0	41	0	83		0	28	
BP Hylosan	17	70	5	100	22	25	100	23
	25	104	3	100	23	20	88	
	33	126	5	100	25	12	75	
	50	217	0	100	27	10	43	
	67	305	0	100	28	5	50	
Creosote	17	74	25	100	19	33	95	
	25	108	17	100	22	25	95	
	33	143	13	100	22	20	83	
	50	194	0	100	24	10	58	
	67	229	0	98		13	63	
Untreated			100		1.0	88	100	4.7

*The stakes were moved from Vaasa to Viikki in 1986.

Table 4. NWPC Field trial 1968. Results after 5 and 31 years' testing.
Wood species: European beech.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$) Simlångsdalen (Sweden)*		
			5	Year 31	$\bar{x}$
Basilit CFK	1.0	6.4	93	100	4.8
	1.5	9.5	83	100	6.4
	2.0	12	55	100	8.5
	3.0	19	34	100	13
	4.0	25	19	100	18
Boliden K33	1.0	6.3	96	100	4.7
	1.5	9.5	94	100	5.2
	2.0	13	74	100	6.3
	3.0	19	55	100	9.0
	4.0	25	46	100	11
Celcure A	1.2	7.7	99	100	4.3
	1.8	11	99	100	4.4
	2.4	15	91	100	5.3
	3.6	23	78	100	6.0
	4.8	31	78	100	5.9
KP Cuprinol	1.4	8.7	95	100	4.6
	2.1	13	74	100	6.3
	2.7	17	55	100	9.1
	4.1	26	33	100	12
	5.5	36	3	100	15
Tanalith C (Tancas C)	1.2	7.6	94	100	4.8
	1.8	12	90	100	5.5
	2.4	15	71	100	6.5
	3.6	23	48	100	9.4
	4.8	31	34	100	13
Wolmanit CB	1.5	9.6	74	100	6.4
	2.3	14	53	100	9.9
	3.0	19	31	100	14
	4.5	29	15	98	
	6.0	39	4	86	
BP Hylosan	17	59	81	100	5.8
	25	87	63	100	7.5
	33	121	53	100	9.3
	50	181	43	100	11
	67	245	29	100	13
Creosote	17	60	91	100	5.7
	25	90	88	100	5.8
	33	119	73	100	6.4
	50	199	49	100	11
	67	282	30	100	13
Untreated			100		2.0

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1996.

Table 5. NWPC Field trial 1968. Results after 5 and 31 years' testing.
Wood species: European birch.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$) Vaasa/Viikki (Finland)*		
			5	31	$\bar{x}$
Basilit CFK	1.0	5.9	88	100	5.6
	1.5	8.9	55	100	11
	2.0	12	50	100	17
	3.0	18	33	100	21
	4.0	24	28	100	22
Boliden K33	1.0	6.1	50	100	9.3
	1.5	9.1	53	100	13
	2.0	13	50	100	13
	3.0	18	45	100	16
	4.0	24	30	100	18
Celcure A	1.2	7.1	50	100	6.0
	1.8	10	50	100	7.3
	2.4	14	53	100	8.3
	3.6	21	28	100	13
	4.8	29	23	100	16
KP Cuprinol	1.4	8.2	78	100	5.9
	2.1	12	73	100	7.4
	2.7	16	58	100	10
	4.1	24	48	100	14
	5.5	33	40	100	14
Tanalith C (Tancas C)	1.2	7.3	53	100	8.1
	1.8	11	43	100	12
	2.4	14	40	100	14
	3.6	21	28	100	19
	4.8	30	10	100	23
Wolmanit CB	1.5	8.8	70	100	7.9
	2.3	13	28	100	18
	3.0	18	23	100	21
	4.5	27	20	100	23
	6.0	36	3	97	
BP Hylosan	17	66	40	100	12
	25	105	15	100	18
	33	137	5	100	18
	50	208	8	100	23
	67	275	0	100	23
Creosote	17	69	63	100	15
	25	109	50	100	15
	33	147	50	100	16
	50	221	38	100	24
	67	314	13	100	26
Untreated			100		1.5

*The stakes were moved from Vaasa to Viikki in 1986.

Table 6. NWPC Field trial 1968. Results after 5 and 31 years' testing.
Wood species: Alder.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$) Sørkedalen (Norway)		
			5	Year 31	$\bar{x}$
Basilit CFK	1.0	8.0	58	100	9.6
	1.5	12	45	100	13
	2.0	16	33	100	16
	3.0	24	20	100	23
	4.0	32	10	100	25
Boliden K33	1.0	7.8	53	100	7.9
	1.5	12	40	100	15
	2.0	16	33	100	16
	3.0	24	13	100	21
	4.0	32	8	95	
Celcure A	1.2	9.4	85	100	5.3
	1.8	14	60	100	6.6
	2.4	19	50	100	9.1
	3.6	28	28	100	15
	4.8	38	20	100	21
KP Cuprinol	1.4	11	75	100	5.7
	2.1	16	58	100	8.5
	2.7	22	40	100	11
	4.1	32	28	100	15
	5.5	44	18	100	19
Tanalith C (Tancas C)	1.2	9.5	55	100	9.0
	1.8	14	38	100	14
	2.4	19	30	100	17
	3.6	29	10	100	25
	4.8	39	8	90	
Wolmanit CB	1.5	12	53	100	12
	2.3	18	40	100	21
	3.0	24	25	100	23
	4.5	36	20	100	27
	6.0	48	10	90	
BP Hylosan	17	91	43	100	8.9
	25	140	33	100	19
	33	187	28	100	22
	50	281	15	95	
	67	377	15	98	
Creosote	17	94	65	100	7.2
	25	143	43	100	11
	33	198	38	100	17
	50	315	18	90	
	67	428	3	80	
Untreated			100		2.8

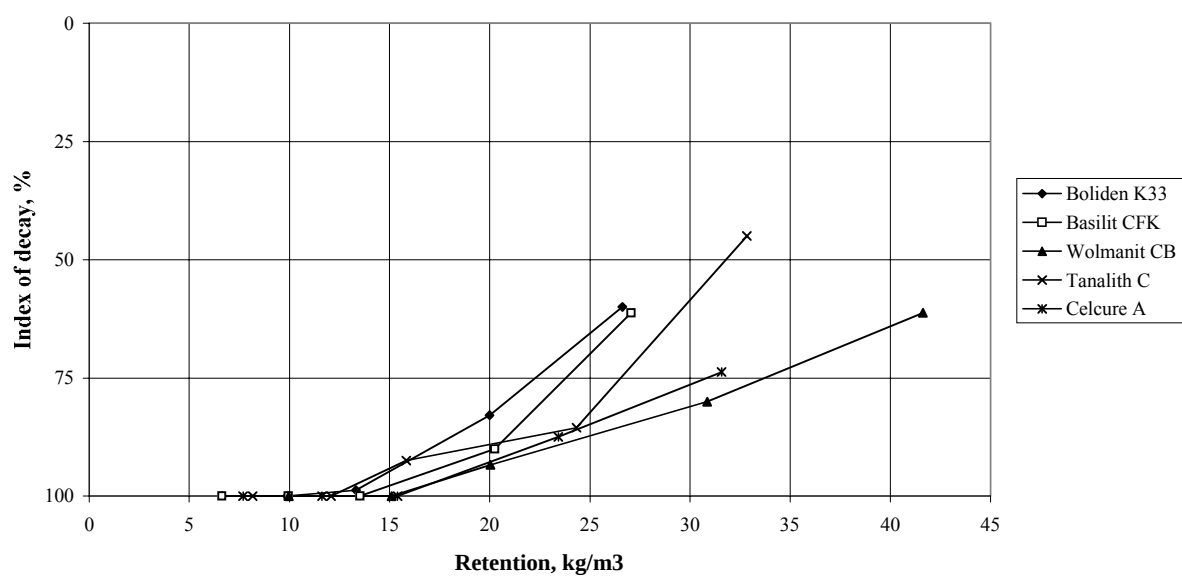
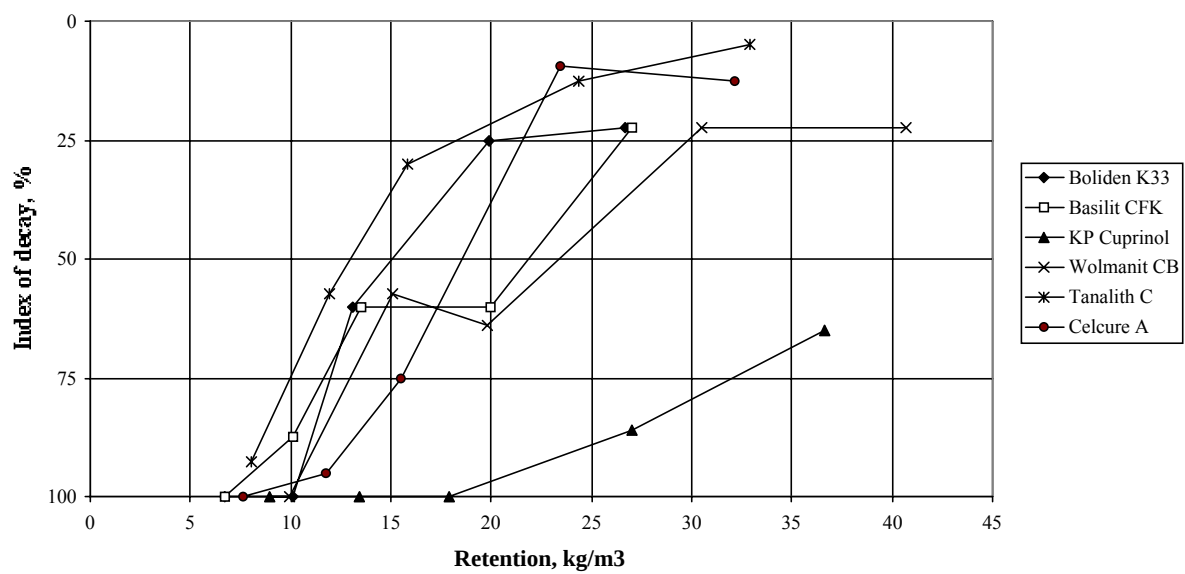
Simlångsdalen.**Hillerød/Tåstrup.**

Figure 2. Index of decay in relation to retention after 31 years. Wood species: European redwood (sapwood).

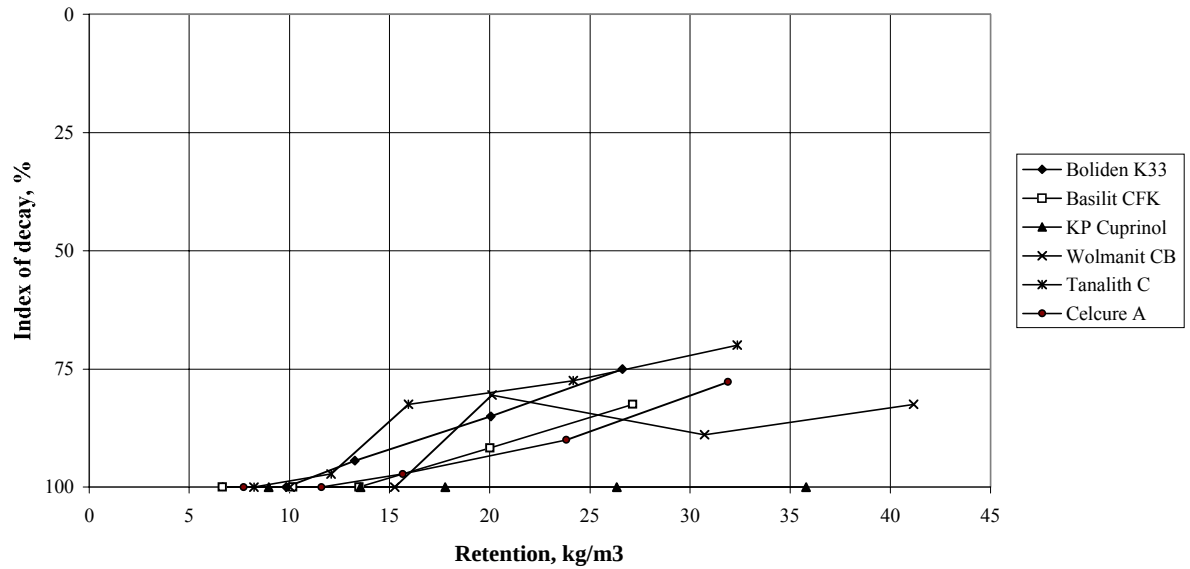
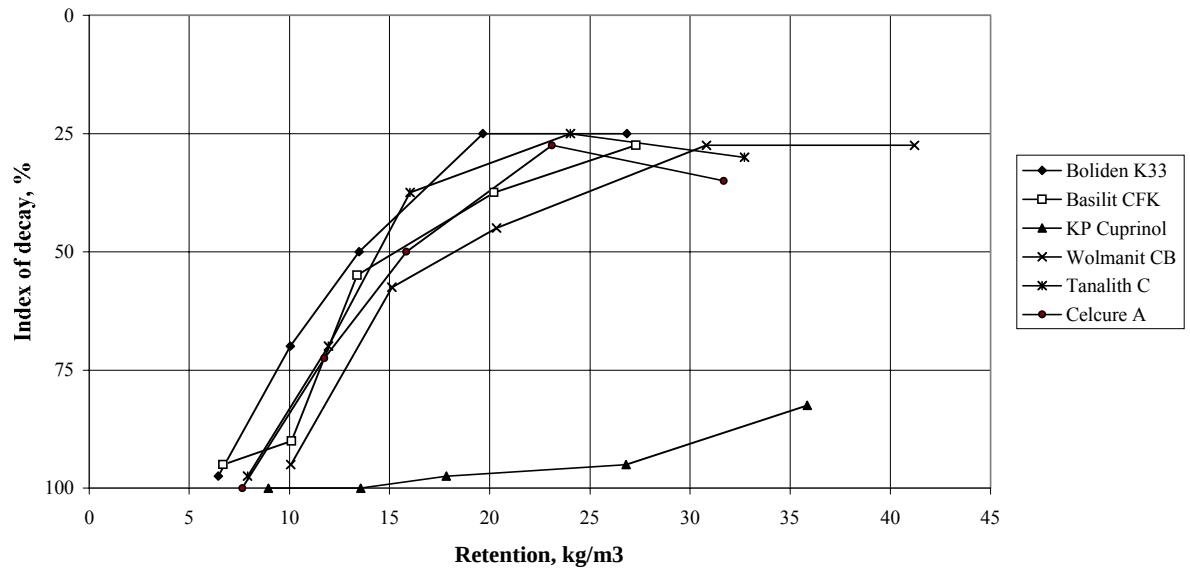
Vaasa/Viikki.**Sørkedalen.**

Figure 3. Index of decay in relation to retention after 31 years. Wood species: European redwood (sapwood).

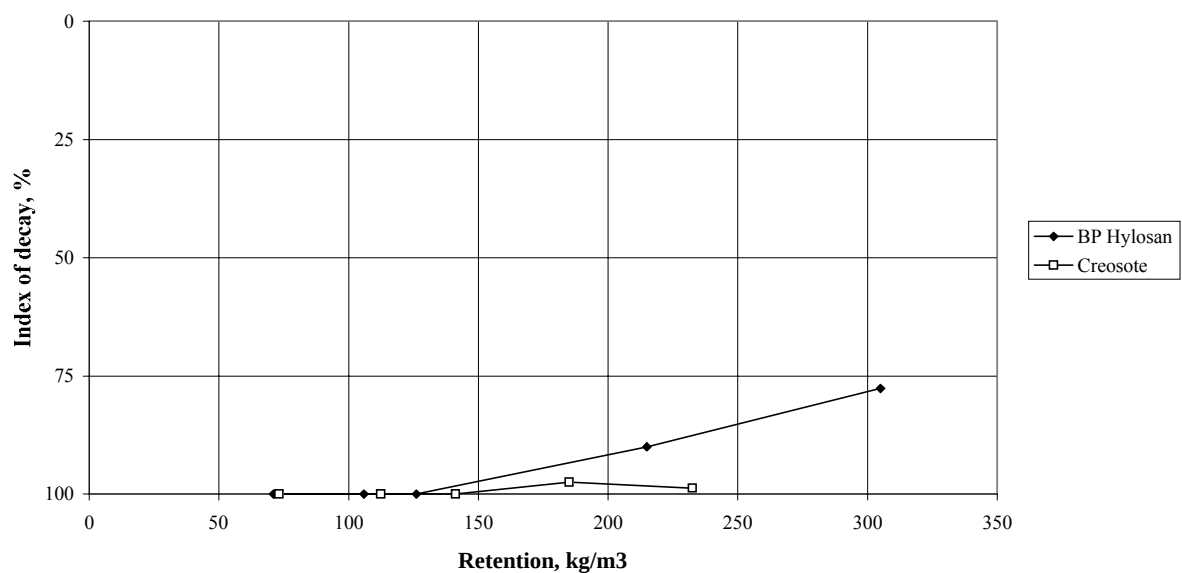
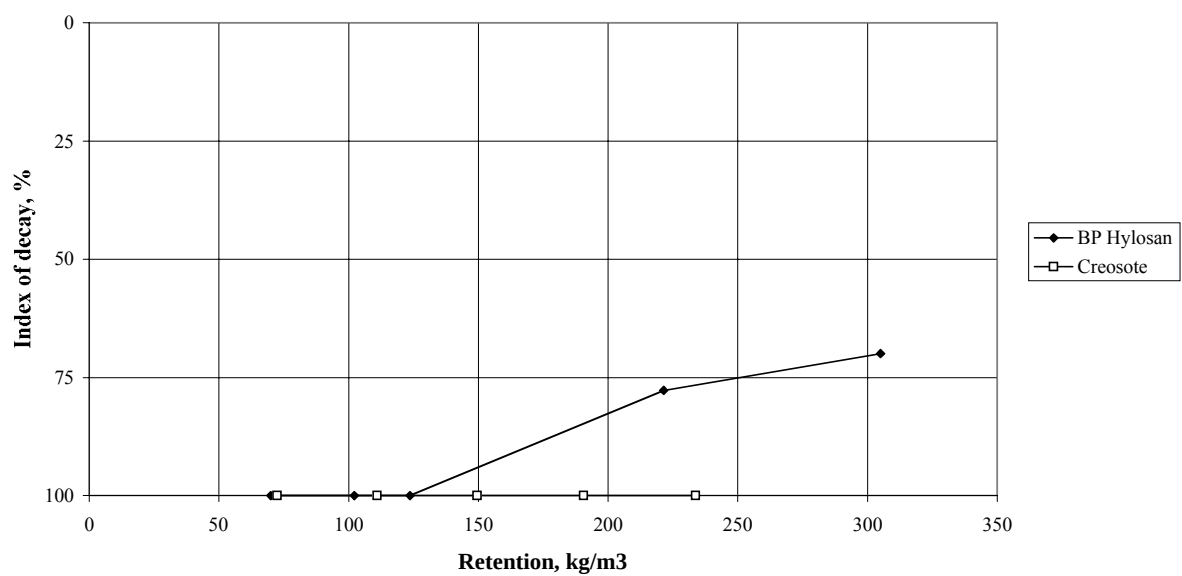
Simlångsdalen.**Hillerød/Tåstrup.**

Figure 4. Index of decay in relation to retention after 31 years. Wood species: European redwood (sapwood).

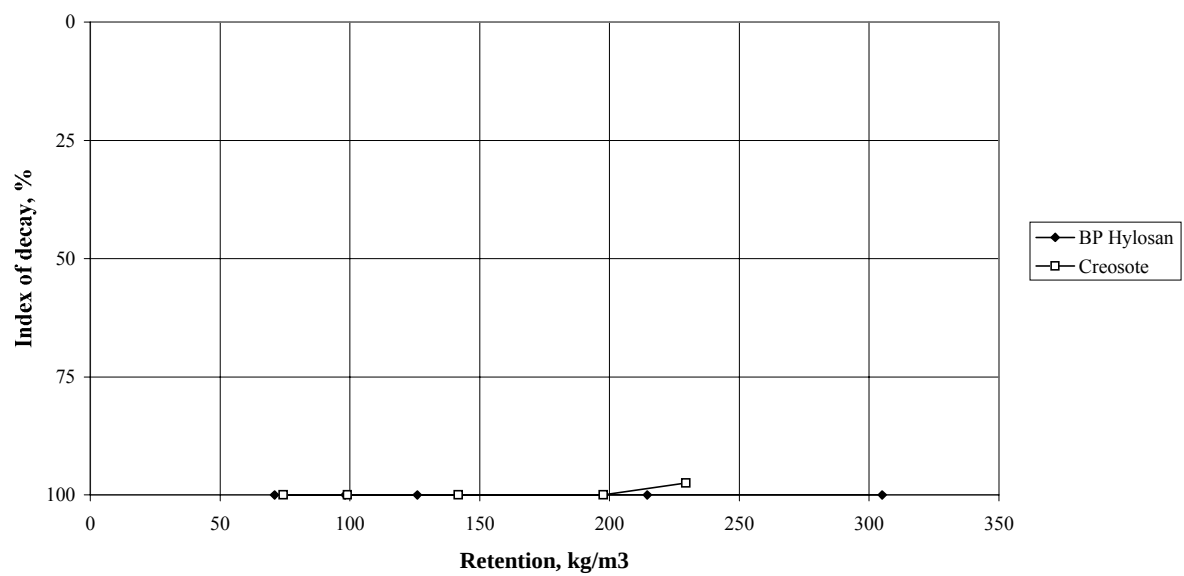
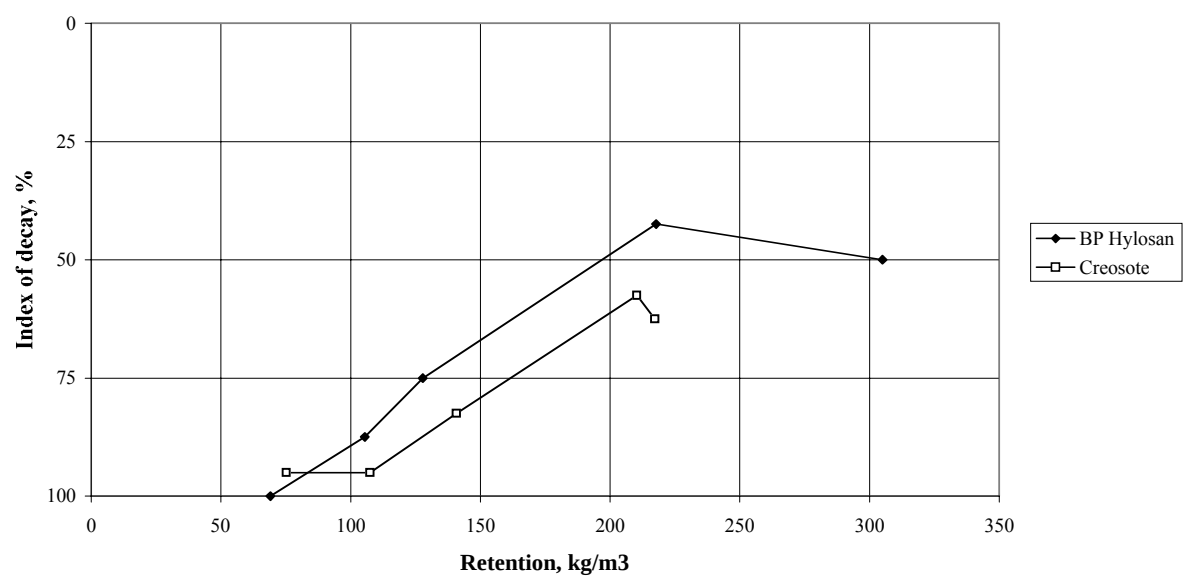
Vaasa/Viikki.**Sørkedalen.**

Figure 5. Index of decay in relation to retention after 31 years. Wood species: European redwood (sapwood).

Field trial 1971

The preservatives of the 1971 trial and their chemical formulations are listed in Table 7. The test fields used were Simlångsdalen, Vaasa and Sørkedalen. 10 stakes (sapwood of European redwood) were set out at each test field for every retention level. However the number of untreated stakes at each test field was 20. In 1986 the remaining stakes at Vaasa were moved to Viikki and in 1993 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The average index of decay after 5 and 28 years' testing is shown in Table 8 for the preservatives tested at Simlångsdalen and Vaasa/Viikki and in Table 9 for the preservatives tested at Simlångsdalen and Sørkedalen.

Index of decay in relation to retention of the preservatives is shown in Figure 6 for stakes at Simlångsdalen and Vaasa/Viikki and in Figure 7 for stakes at Simlångsdalen and Sørkedalen. Figures 64 - 75 in the Appendix give the rate of decay for stakes with various retention levels of the preservatives tested.

Both treated and untreated stakes decayed more rapidly at Vaasa than at Simlångsdalen and more rapidly at Simlångsdalen than at Sørkedalen. This is the case for all preservatives tested in the trial. The life of untreated stakes was 1.1 years at Vaasa, 3.6 years at Simlångsdalen and 4.1 years at Sørkedalen. The main reason for the variation between test fields is thought to be soil and climate. The soil at Vaasa is very rich in organic matter, while that at Sørkedalen is poor (Henningsson 1974, Borsholt 1979).

A comparison of the preservatives at Simlångsdalen and Vaasa/Viikki (Table 8) using the medial concentration levels gives the following order in index of decay (in brackets). At Simlångsdalen: Kemira C64 (60), Celcure M (70), Kemira K64 (90), NWPC Standard Preservative No. 1 (90), Tanalith NCA (100), Celcure SM (100) and KP Cuprinol (100). At Vaasa/Viikki: Kemira C64 (83), Celcure M (88), Tanalith NCA (93), Kemira K64 (95), Celcure SM (98), NWPC Standard Preservative No. 1 (100), and KP Cuprinol (100).

A similar comparison of the preservatives tested at Simlångsdalen and Sørkedalen gives the following order (Table 9). At Simlångsdalen: CCB A (78), Boliden APUS (83), NWPC Standard Preservative No. 1 (90), Boliden P50 (100), Cuprinol Tryck (100) and BP SUN/WP (100). At Sørkedalen: Boliden APUS (28), CCB A (35), NWPC Standard Preservative No. 1 (53), Boliden P50 (65), BP SUN/WP (100) and Cuprinol Tryck (100).

Table 7. NWPC Field trial 1971. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Boliden APUS	CuO	12.3	Cu	9.8	Boliden AB
	CrO ₃	32.4	Cr	16.8	
	As ₂ O ₅	27.4	As	17.9	
	Na ₂ O	3.4			
	H ₂ O	24.5			
Boliden P50	CuO	15.0	Cu	12.0	Boliden AB
	CrO ₃	21.0	Cr	10.9	
	P ₂ O ₅	17.6	P	7.7	
	H ₂ O	46.4			
Celcure M	CuSO ₄ · 5H ₂ O	36.0	Cu	9.2	Rentokil Ltd.
	Na ₂ Cr ₂ O ₇ · 2H ₂ O	40.0	Cr	14.8	
	Cr(CH ₃ COO) ₃ · H ₂ O	4.0	B	3.5	
	H ₃ BO ₃	20.0			
Celcure SM	CuSO ₄ · 5H ₂ O	53.0	Cu	13.5	Rentokil Ltd.
	Na ₂ Cr ₂ O ₇ · 2H ₂ O	29.4	Cr	10.8	
	Cr(CH ₃ COO) ₃ · H ₂ O	2.9	B	2.6	
	H ₃ BO ₃	14.7			
Cuprinol Tryck (KP-N)	CuO	12	Cu	9.5	Hager AB
	C ₇ H ₁₅ COOH	4.75	C ₇ H ₁₅ COOH	4.75	
	NH ₃	≈ 20			
	CO ₂	≈ 40			
	H ₂ O	≈ 25			
KP Cuprinol	<i>K-salt 91.3 %</i>		Cu	10.9	Bönnelyche & Thurøe AB
	CuO	15	Na-PCP	6.1	
	NH ₃	18			
	CO ₂	44			
	H ₂ O	23			
	<i>P-salt 8.7 %</i>				
	C ₆ HCl ₄ ONa (Na-PCP)	70			
	H ₂ O	30			
Kemira K64	CuO	22.9	Cu	18.3	Kemira Oy
	CrO ₃	33.6	Cr	17.5	
	As ₂ O ₅	18.3	As	11.9	
	P ₂ O ₅	10.4	P	4.5	
	SO ₃	3.6			
	H ₂ O	11.2			
Kemira C64	CuO	25.3	Cu	20.2	Kemira Oy
	CrO ₃	40.8	Cr	21.2	
	P ₂ O ₅	16.8	P	7.3	
	SO ₃	4.4			
	H ₂ O	12.7			
Tanalith NCA (Tancas NCA)	CuSO ₄	29.7	Cu	11.8	Hickson and Welch Ltd.
	Na ₂ Cr ₂ O ₇	31.7	Cr	12.6	
	As ₂ O ₅ · 2H ₂ O	26.3	As	20.0	
	Na ₄ As ₂ O ₇	12.3			
CCB A	CuO	10.8	Cu	8.6	-
	CrO ₃	26.4	Cr	13.7	
	H ₃ BO ₃	25.5	B	4.5	
	KHSO ₄	35.7			
	ZnO	1.6			
BP SUN/WP (CBY)	Mixture of saturated and unsaturated hydrocarbons				The British Petroleum Co Ltd.
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	-
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

* Manufacturer that originally ordered the test.

Table 8. NWPC Field trial 1971. Results after 5 and 28 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Vaasa/Viikki (Finland)*		
			Year			Year		
			5	28	$\bar{x}$	5	28	$\bar{x}$
Celcure M	1.4	9.9	0	100	18	53	100	8.8
	2.2	16	0	85		38	100	19
	3.0	20	0	70		28	88	
	4.5	33	0	55		0	73	
	6.0	42	0	35		5	68	
Celcure SM	1.0	7.3	0	100	14	53	100	7.2
	1.5	11	0	100	15	68	100	8.0
	2.0	15	0	100	16	45	98	
	3.0	21	0	73		30	90	
	4.0	29	0	58		8	85	
KP Cuprinol	1.5	11	0	100	13	40	100	7.1
	2.3	16	0	100	13	48	100	10
	3.3	25	0	100	14	28	100	14
	4.3	30	0	95		15	100	18
	5.7	41	0	98		15	100	20
Kemira K64	0.8	5.5	3	100	15	13	100	15
	1.2	8.1	0	100	21	25	100	19
	1.6	11	0	90		3	95	
	2.4	18	0	70		0	75	
	3.2	23	0	50		0	60	
Kemira C64	0.9	6.5	0	100	19	23	100	10
	1.4	10	0	93		15	100	19
	1.8	12	0	60		5	83	
	2.7	19	0	55		3	68	
	3.7	26	0	45		0	65	
Tanalith NCA	1.0	7.4	0	100	15	8	100	14
	1.5	11	0	100	17	10	100	17
	2.0	14	0	100	20	3	93	
	3.0	21	0	88		0	75	
	4.0	30	0	75		0	75	
NWPC Standard Preservative No. 1	1.3	9.4	0	90		8	100	18
Untreated			100		3.6	100		1.1

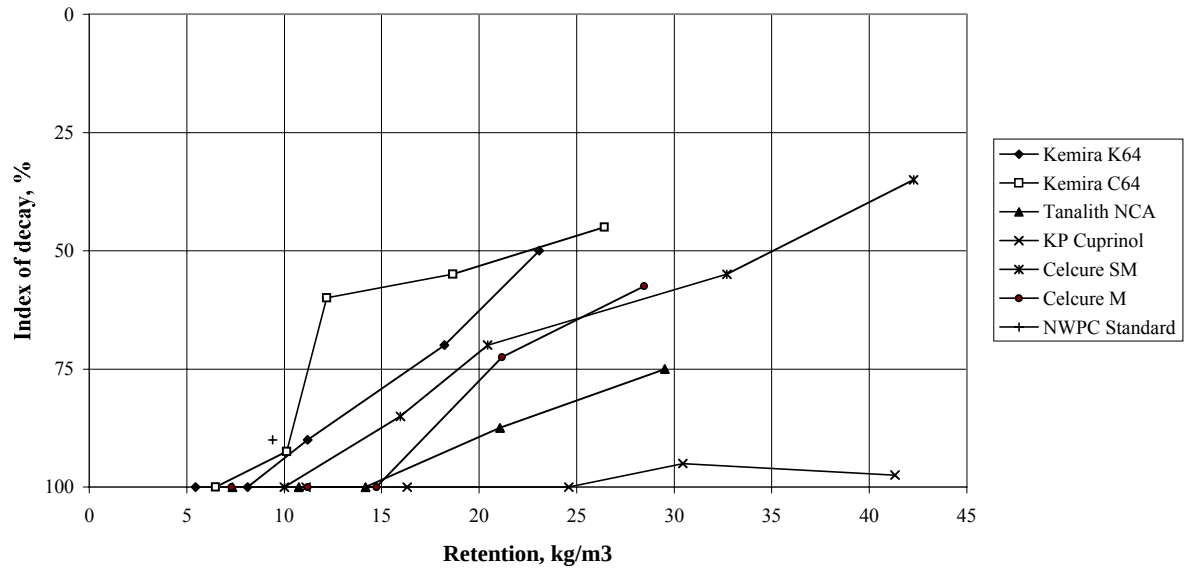
* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993 and from Vaasa to Viikki in 1986.

Table 9. NWPC Field trial 1971. Results after 5 and 28 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Sørkedalen (Norway)		
			Year		$\bar{x}$	Year		$\bar{x}$
			5	28		5	28	
Boliden APUS	1.0	7.2	0	100	16	0	95	
	1.5	11	0	95		0	50	
	2.0	14	0	83		0	28	
	3.0	21	0	53		0	25	
	4.0	29	0	53		0	28	
Boliden P50	1.0	7.2	0	100	14	3	100	20
	1.5	11	0	93		0	95	
	2.0	14	0	100	19	0	65	
	3.0	22	0	70		0	33	
	4.0	29	0	63		0	30	
Cuprinol Tryck (KP-N)	1.6	11	3	100	13	13	100	17
	2.4	17	0	100	15	3	100	23
	3.2	23	0	100	15	0	100	24
	4.8	34	0	95		0	88	
	6.4	45	0	88		0	85	
CCB A	1.3	8.7	0	100	19	0	95	
	1.9	14	0	93		0	50	
	2.5	18	0	78		0	35	
	3.8	27	0	63		0	30	
	5.0	37	0	38		0	28	
BP SUN/WP (CBY)		75	40	100	9.1	8	100	18
		112	25	100	11	3	100	20
		150	33	100	12	0	100	26
		225	18	100	16	0	65	
		300	13	98		0	48	
NWPC Standard Preservative No. 1	1.3	9.6	0	90		3	53	
Untreated			100		3.6	100		4.1

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993.

Simlångsdalen



Vaasa/Viikki.

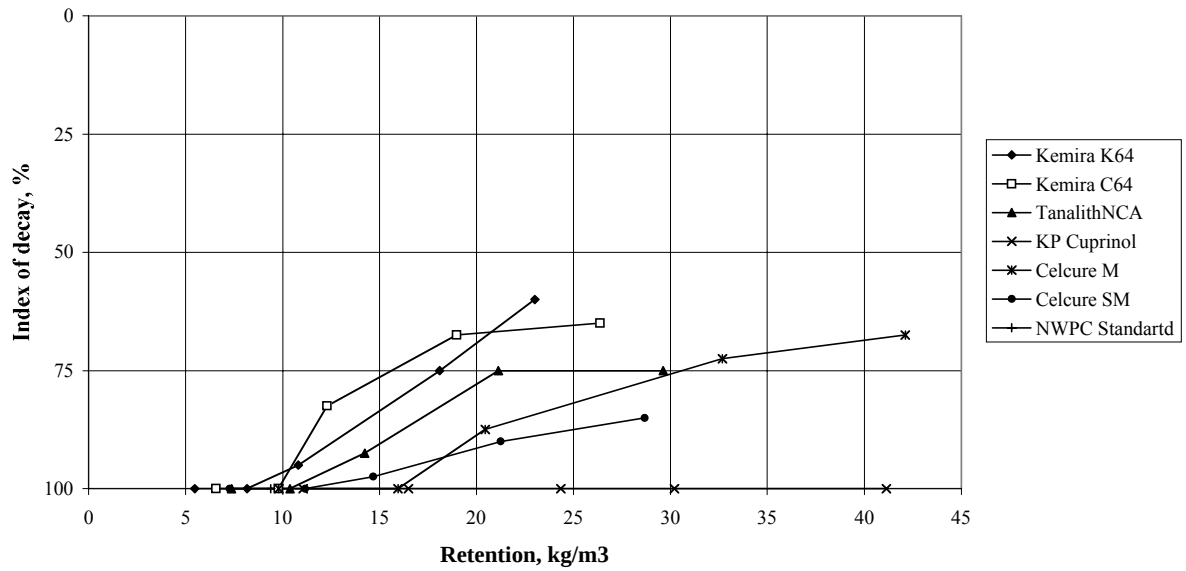
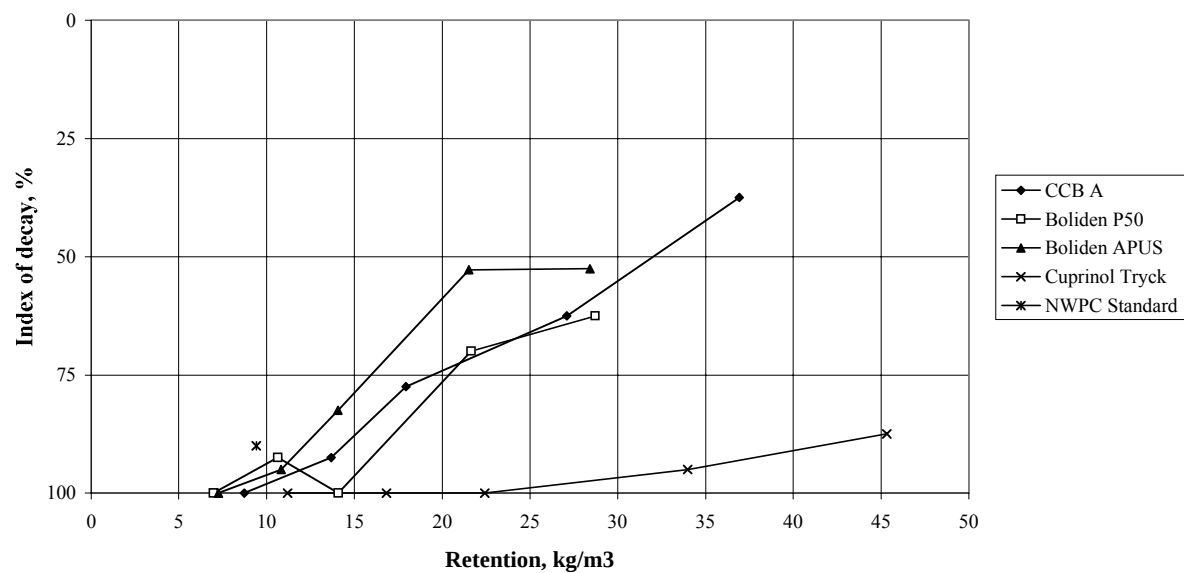


Figure 6. Index of decay in relation to retention after 28 years.

Simlångsdalen



Sørkedalen.

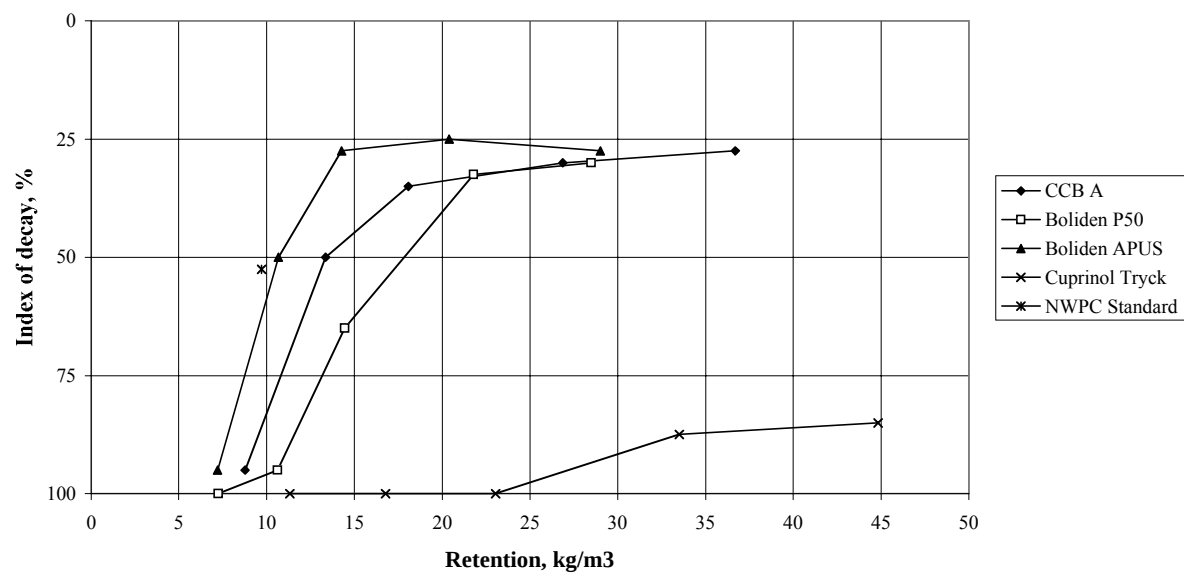


Figure 7. Index of decay in relation to retention after 28 years.

Field trial 1973

The preservatives of the 1973 trial and their chemical formulations are listed in Table 10. The trial in Tåstrup (Denmark) was started in 1974. The number of stakes for every retention level at the test fields were 10 at Vaasa, Tåstrup and Sørkedalen and 20 at Simlångsdalen.

In 1986 the remaining stakes at Vaasa were moved to Viikki and in 1993 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 25 - 26 years' testing is shown in Table 11 for Simlångsdalen and Tåstrup, in Table 12 for Simlångsdalen and Vaasa/Viikki, and in Table 13 for Simlångsdalen and Sørkedalen.

Stakes treated with NWPC Standard Preservative No. 1 were set out at every test field. However, it was found that an erroneous concentration had been used in the treatment. Thus no results from stakes treated with NWPC Standard Preservative No. 1 are presented. The results of NWPC Standard Preservative No. 1 in the field trials of 1971 or 1975 may be used for comparison instead.

Index of decay in relation to the retention of the preservatives is shown in Figure 8 for stakes at Simlångsdalen and Tåstrup, in Figure 9 for stakes at Simlångsdalen and Vaasa/Viikki, and in Figure 10 for stakes at Simlångsdalen and Sørkedalen. Figures 76 - 83 of the Appendix give the rate of decay for stakes with various retention levels of preservatives tested.

The life of untreated stakes was shortest at Vaasa (1.0 year), followed by Tåstrup (3.8 years), Simlångsdalen (4.4 years) and Sørkedalen (4.8 years).

A comparison of the preservatives used in test fields Simlångsdalen and Tåstrup (Figure 8), Simlångsdalen and Vaasa/Viikki (Figure 9) and Simlångsdalen and Sørkedalen (Figure 10) reveals almost the same order of efficacy.

Table 10. NWPC Field trial 1973. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Amline	CuO	7.4	Cu	5.9	Hager AB
	CrO ₃	4.0	Cr	2.1	
	As ₂ O ₅	4.0	As	2.6	
	NH ₃	19.0			
	CO ₂	39.0			
	H ₂ O	26.4			
Boliden P50B	CuO	11.2	Cu	8.9	Boliden AB
	CrO ₃	15.8	Cr	8.2	
	P ₂ O ₅	13.2	P	5.8	
	B ₂ O ₃	14.1	B	4.4	
	H ₂ O	45.7			
Celcure AP5	CuO	13.1	Cu	10.5	Boliden AB
	CrO ₃	34.4	Cr	17.9	
	As ₂ O ₅	27.5	As	17.9	
	H ₂ O	25.0			
Kemira KC-73	CuO	25.5	Cu	23.5	Kemira Oy
	CuSO ₄	8.3	Cr	34.4	
	CrO ₃	66.2			
Kemira KCA-73	CuO	21.6	Cu	19.3	Kemira Oy
	CuSO ₄	5.4	Cr	28.0	
	CrO ₃	53.8	As	12.5	
	As ₂ O ₅	19.2			
Kemira KFN-73	Cu(NH ₄) ₄ CO ₃	13.5	Cu	4.3	Kemira Oy
	NH ₄ HCO ₃	9.9	Cr	7.5	
	BON-NH ₄ **	4.8	F	7.9	
	NH ₄ OH	2.6	BON-NH ₄	3.9	
	NH ₄ F	15.3			
	(NH ₄) ₂ CrO ₄	22.1			
	NaOH	0.9			
	H ₂ O	≈ 31			
Hylosan PT (Permapruf T)	TBTO	10	TBTO	10	Penarth Research Centre
	Benzalkyl trimethyl ammoniumchloride (BAC)	40	BAC	40	
	Additives	≈ 6			
	H ₂ O	≈ 44			

* Manufacturer that originally ordered the test.

** BON = Beta-oxy naphthoic acid.

Table 11. NWPC Field trial 1973. Results after 5 and 25 - 26 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Tåstrup (Denmark)		
			Year			Year		
			5	26	$\bar{x}$	5	25	$\bar{x}$
Boliden P50 B	1.3	8.4	33	100	12	18	88	
	1.8	12	16	99		13	50	
	2.5	17	0	98		3	31	
	3.5	24	0	75		3	25	
	5.0	34	3	65		3	6	
Kemira KCA-73	0.5	3.7	1	100	16	5	60	
	0.8	5.2	1	95		5	48	
	1.1	7.4	0	90		3	23	
	1.5	10	0	51		0	15	
	2.1	15	0	56		8	13	
Untreated			93	100	4.4	95	100	3.8

*The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993

Table 12. NWPC Field trial 1973. Results after 5 and 26 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Vaasa/Viikki (Finland)*		
			Year			Year		
			5	26	$\bar{x}$	5	26	$\bar{x}$
Amline	2.1	14	16	100	10	43	100	12
	3.0	20	4	100	13	25	100	17
	4.3	29	4	100	17	10	100	16
	6.0	41	0	79		15	100	20
	8.5	59	0	65		20	90	
Celcure AP5	1.0	6.2	0	100	16	25	100	17
	1.4	9.0	0	98		10	100	18
	2.0	13	0	75		3	88	
	2.8	19	0	39		3	63	
	4.0	28	0	29		0	55	
Hylosan PT (Permapruf T)	1.0	6.8	18	100	10	25	100	14
	1.5	10	8	100	13	18	100	17
	2.0	14	10	99		5	100	18
	3.0	16	8	97		5	100	19
	4.0	23	4	91		0	98	
Untreated			93	100	4.4	100		1.0

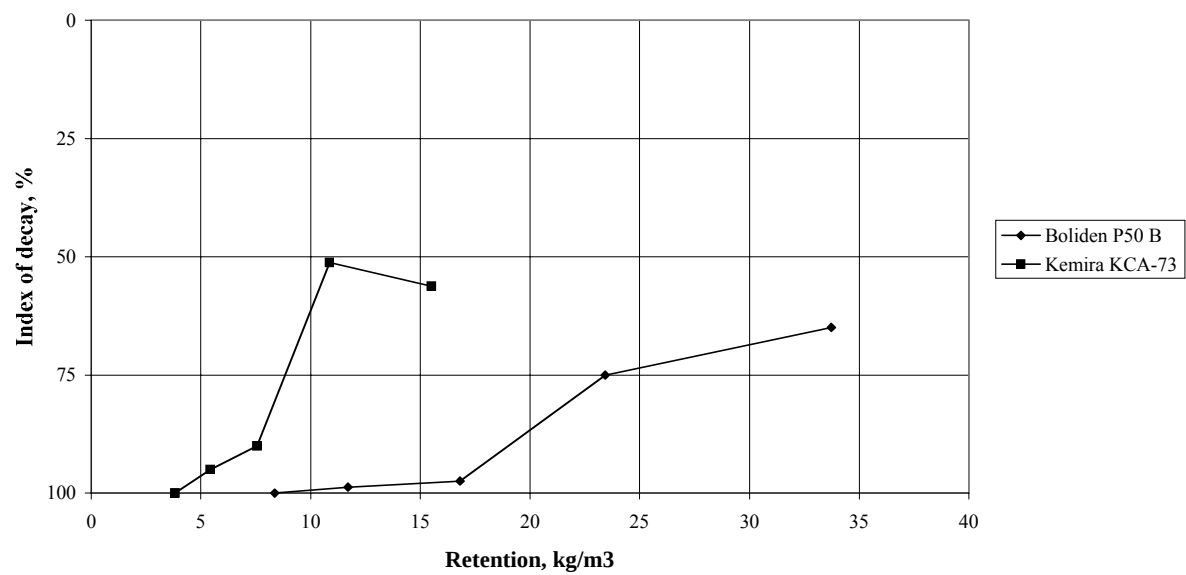
* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993 and from Vaasa to Viikki in 1986.

Table 13. NWPC Field trial 1973. Results after 5 and 26 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{X}$)					
			Simlångsdalen (Sweden)*			Sørkedalen (Norway)		
			Year		$\bar{X}$	Year		$\bar{X}$
			5	26		5	26	
Kemira KC-73	0.5	3.6	20	100	13	8	85	
	0.8	5.2	15	93		0	53	
	1.1	7.4	3	73		0	33	
	1.5	10	0	48		0	25	
	2.1	15	0	58		0	25	
Kemira KFN-73	1.9	12	0	100	11	20	100	17
	2.6	18	0	100	14	10	98	
	3.7	25	0	100	16	18	90	
	5.2	29	24	100	12	18	93	
	7.4	42	16	98		10	60	
Untreated			93	100	4.4	93	100	4.8

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993

Simlångsdalen



Tåstrup

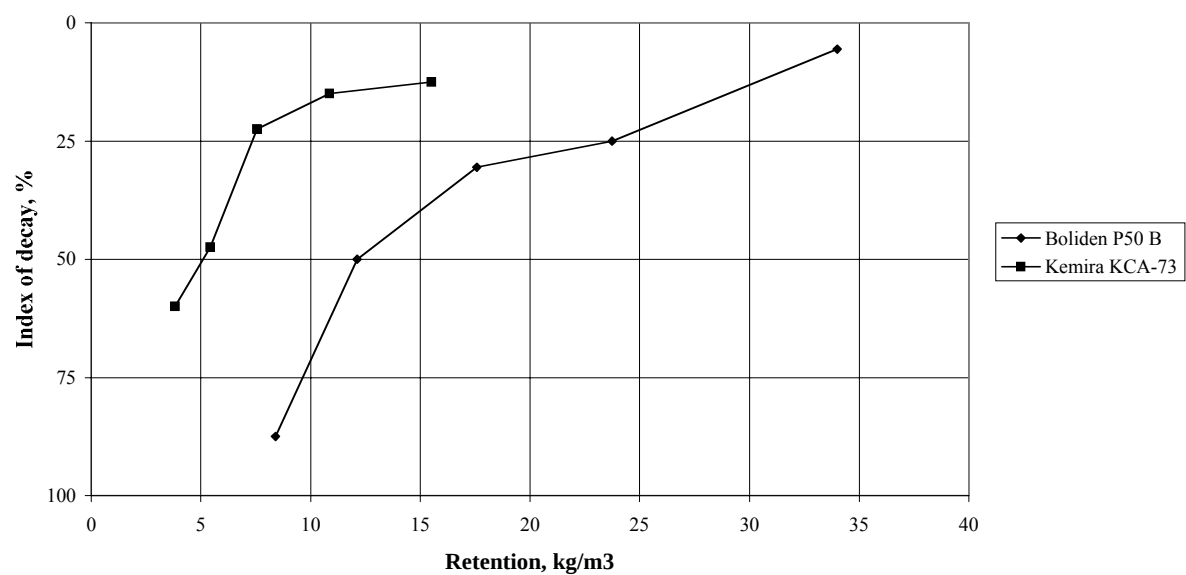
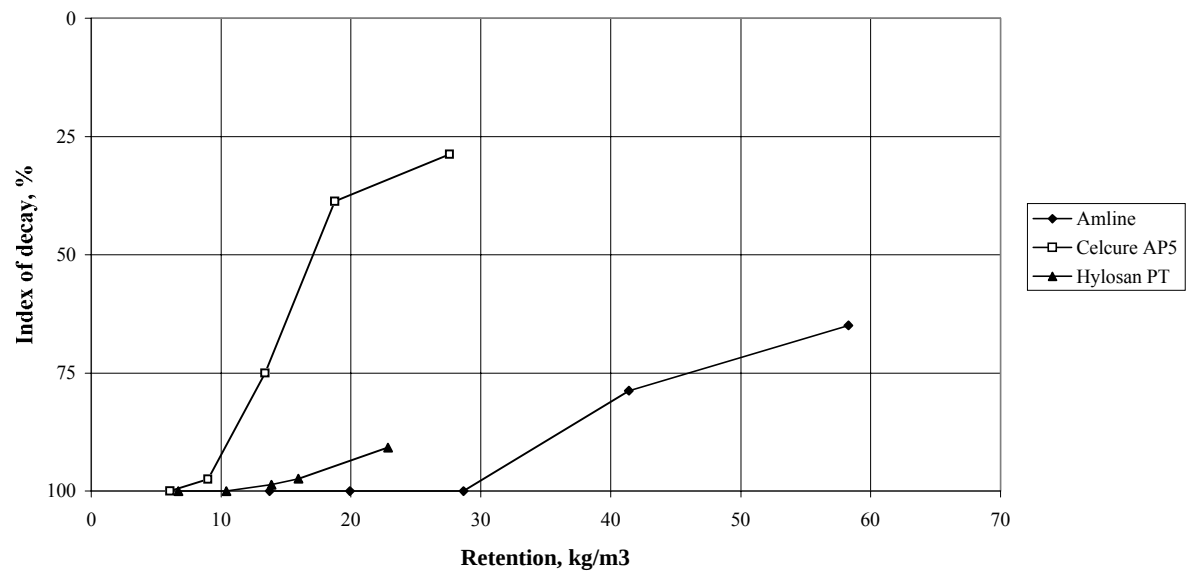


Figure 8. Index of decay in relation to retention after 25-26 years.

Simlångsdalen



Vaasa/Viikki

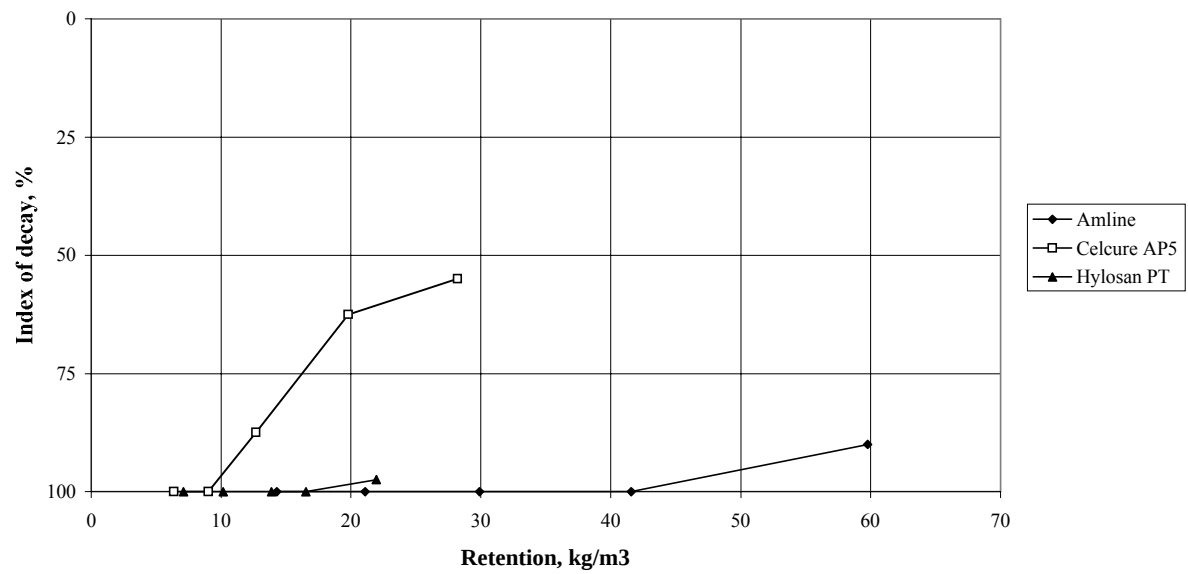


Figure 9. Index of decay in relation to retention after 26 years.

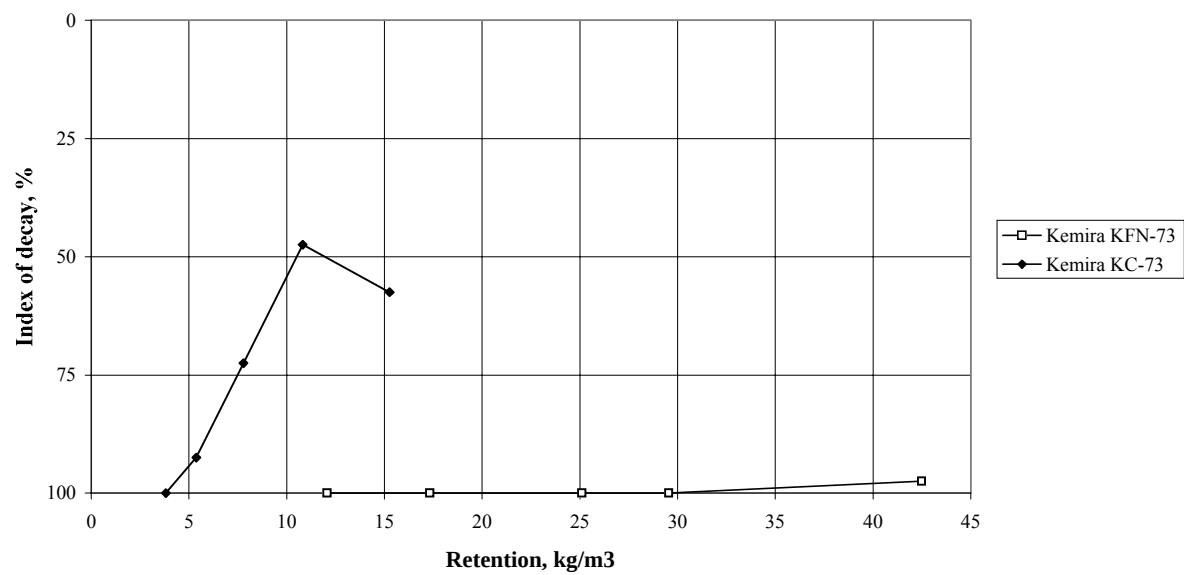
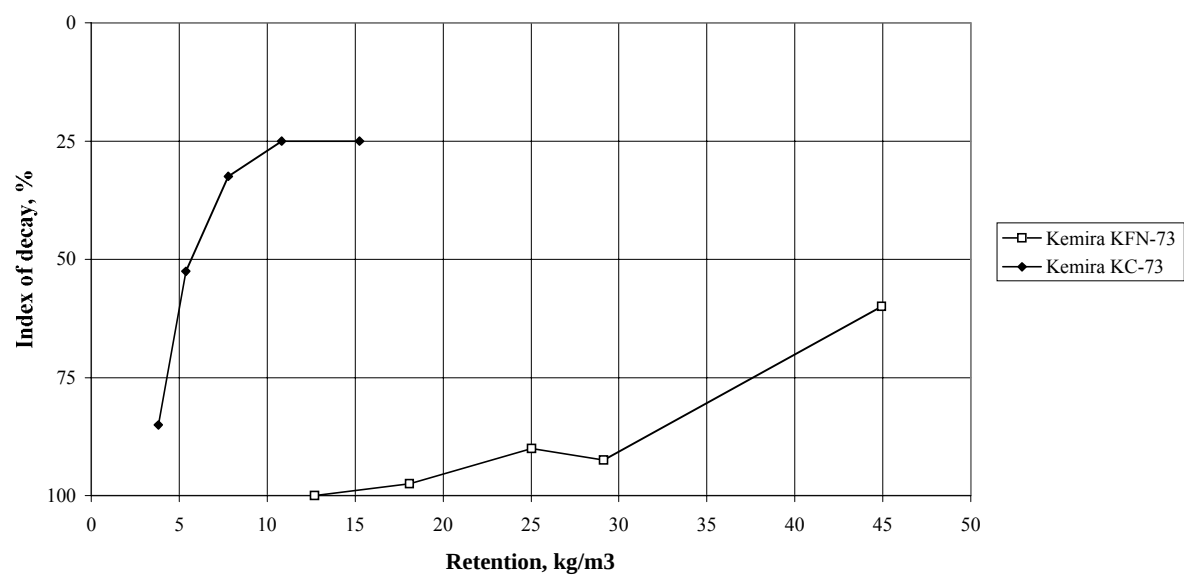
Simlångsdalen**Sørkedalen**

Figure 10. Index of decay in relation to retention after 26 years.

Field trial 1975

The preservatives of the 1975 trial and their chemical formulations are listed in Table 14. For every retention level of preservatives tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Tåstrup. In 1994 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 24 years' testing is shown in Table 15. Figure 11 presents index of decay in relation to the retention of preservatives tested. The rate of decay for stakes with various retentions of preservatives is shown in Figures 84 - 88 of the Appendix.

The life of untreated stakes was 3.8 years at Simlångsdalen and 3.6 years at Tåstrup.

A comparison of the preservatives using the medial concentration levels gives the following order for index of decay (in brackets). At Simlångsdalen: Basilit KM (70), NWPC Standard Preservative No. 1 (84), Kemira K-75 (93), Kemira KB-75 (99) and Gufa 521 (100). At Tåstrup: Basilit KM (11), NWPC Standard preservative No. 1 (30), Kemira K-75 (40), Kemira KB-75 (78) and Gufa 521 (81).

Table 14. NWPC Field trial 1975. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Basilit KM	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	49.5	Cu	12.6	Desowag-Bayer Holzschutz GmbH
	CrO_3	1.7	Cr	17.8	
	$\text{K}_2\text{Cr}_2\text{O}_7$	47.8			
	Anticorrosive	1.0			
Gufa 521	CuO	13.8	Cu	11.1	Gullviks Fabriks AB
	H_3BO_3	4.0	B	0.7	
	$\text{C}_2\text{H}_5\text{COOH}$	5.1			
	$\text{NH}_3, \text{CO}_2, \text{H}_2\text{O}$	rest**			
Kemira K-75	Copper thallate (9.5 % Cu)	43.1	Cu	5.7	Kemira Oy
	Copper naphthenate (9.5 % Cu)	16.9			
	CH_2Cl_2	40.0			
Kemira KB-75	$\text{Cu}(\text{NH}_4)_4\text{CO}_3$	30.2	Cu	9.8	Kemira Oy
	$\text{CH}_3\text{COONH}_4$	5.0	B	4.8	
	$(\text{NH}_4)_2\text{B}_4\text{O}_7$	24.0			
	NH_4HCO_3	40.0			
NWPC Standard Preservative	CuO	19.0	Cu	15.2	-
	CrO_3	36.0	Cr	18.7	
No. 1	As_2O_5	45.0	As	29.3	

* Manufacturer that originally ordered the test.

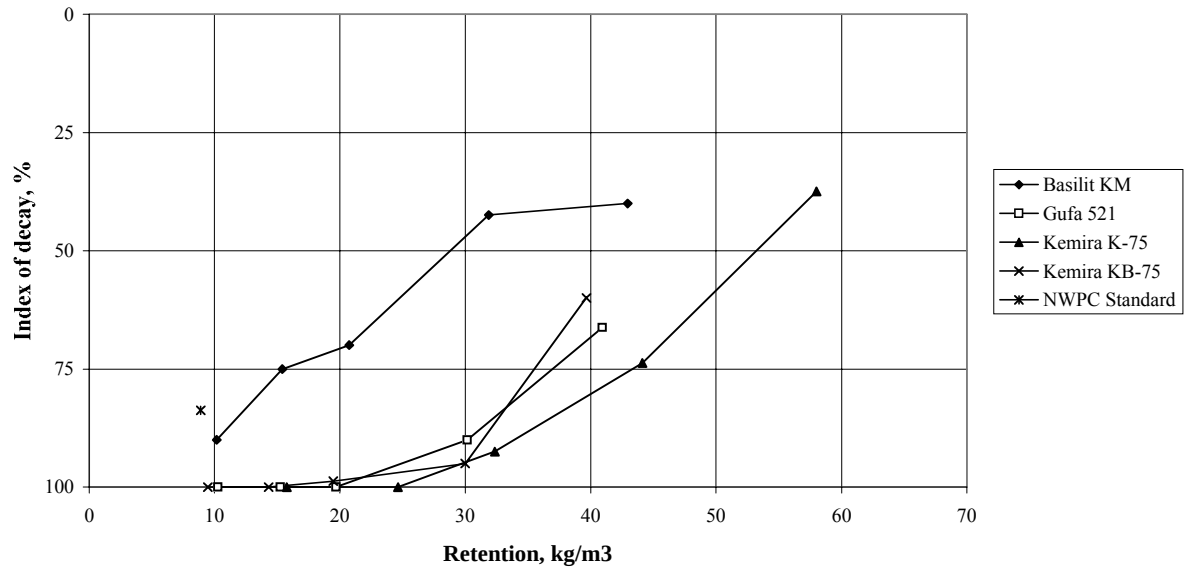
** Not specified in detail.

Table 15. NWPC Field trial 1975. Results after 5 and 24 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Tåstrup (Denmark)		
			Year	5	$\bar{x}$	Year	5	$\bar{x}$
Basilit KM	1.5	10	1	90		13	43	
	2.3	16	0	75		10	20	
	3.0	21	0	70		5	11	
	4.5	32	0	43		0	3	
	6.0	42	0	40		0	3	
Gufa 521	1.5	10	0	100	11	18	100	17
	2.3	15	0	100	12	25	92	
	3.0	20	0	100	13	5	81	
	4.5	30	1	90		5	30	
	6.0	41	0	66		10	35	
Kemira K-75		16	0	100	11	10	90	
		25	0	100	17	0	75	
		32	0	93		5	40	
		45	0	74		0	25	
		58	0	38		0	28	
Kemira KB-75	1.5	9.5	0	100	11	40	100	14
	2.3	14	0	100	12	8	83	
	3.0	19	0	99		13	78	
	4.5	30	0	95		5	38	
	6.0	40	0	60		3	25	
NWPC Standard Preservative No. 1	1.3	8.9	0	84		0	30	
Untreated			100		3.8	100		3.6

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1994.

Simlångsdalen



Tåstrup

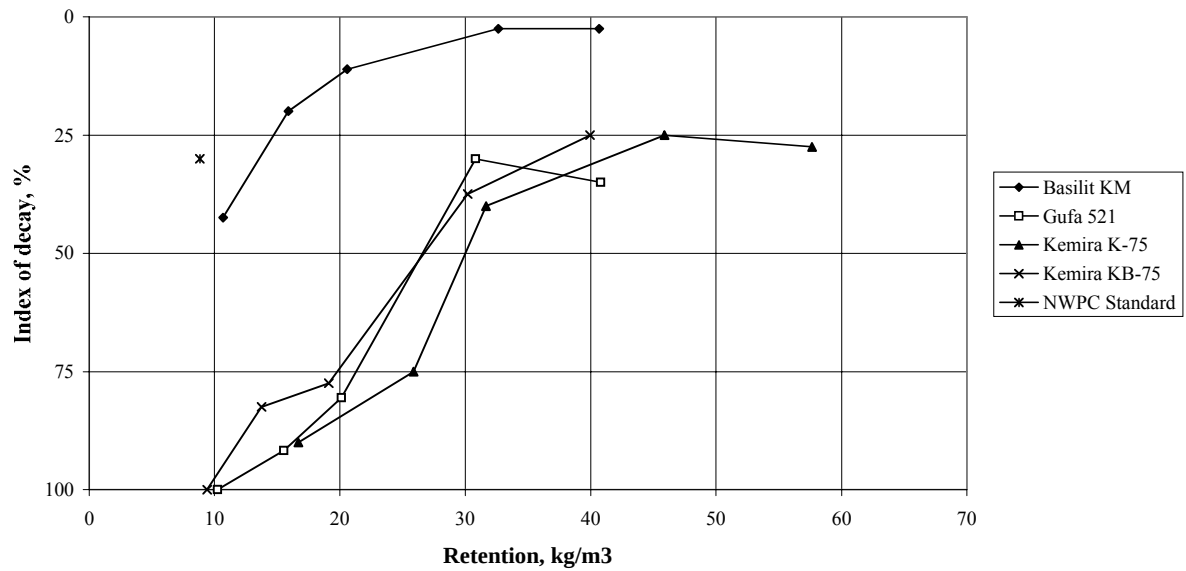


Figure 11. Index of decay in relation to retention after 24 years.

Field trial 1977

The preservatives of the 1977 trial and their chemical formulations are listed in Table 16. For every retention level of tested preservatives, 10 stakes were set out at test fields Simlångsdalen, Vaasa and Vihti. The stakes in Vihti were set out in 1978. In 1986 the stakes at Vaasa and Vihti were moved to Viikki and 1993 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 21 - 22 years' testing is presented in Table 17. In this trial, four retention levels were prepared for NWPC Standard Preservative No. 1. Figures 12 and 13 shows index of decay in relation to retention of the preservatives tested. The rate of decay of stakes with various retentions of preservatives is shown in Figures 89 - 92 of the Appendix.

The life of untreated stakes was 3.8 years at Simlångsdalen, 2.3 years at Vaasa and 2.0 years at Vihti.

Table 16. NWPC Field trial 1977. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Basilit CCB	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	34	Cu	8.7	Desowag-Bayer Holzschutz GmbH
	$\text{K}_2\text{Cr}_2\text{O}_7$	39	Cr	14.3	
	CrO_3	1	B	4.5	
	H_3BO_3	26			
Boliden P50**	CuO	15.0	Cu	12.0	Rentokil Ltd
	CrO_3	21.0	Cr	10.9	
	P_2O_5	17.6	P	7.7	
	H_2O	46.4			
Cuprinol Tryck** (KP-N)	CuO	12	Cu	9.5	Hager AB
	$\text{C}_7\text{H}_{15}\text{COOH}$	4.75	$\text{C}_7\text{H}_{15}\text{COOH}$	4.75	
	NH_3	≈ 20			
	CO_2	≈ 40			
	H_2O	≈ 25			
NWPC Standard Preservative	CuO	19.0	Cu	15.2	-
	CrO_3	36.0	Cr	18.7	
No. 1	As_2O_5	45.0	As	29.3	

* Manufacturer that originally ordered the test or at the time when the test was started produced the preservative.

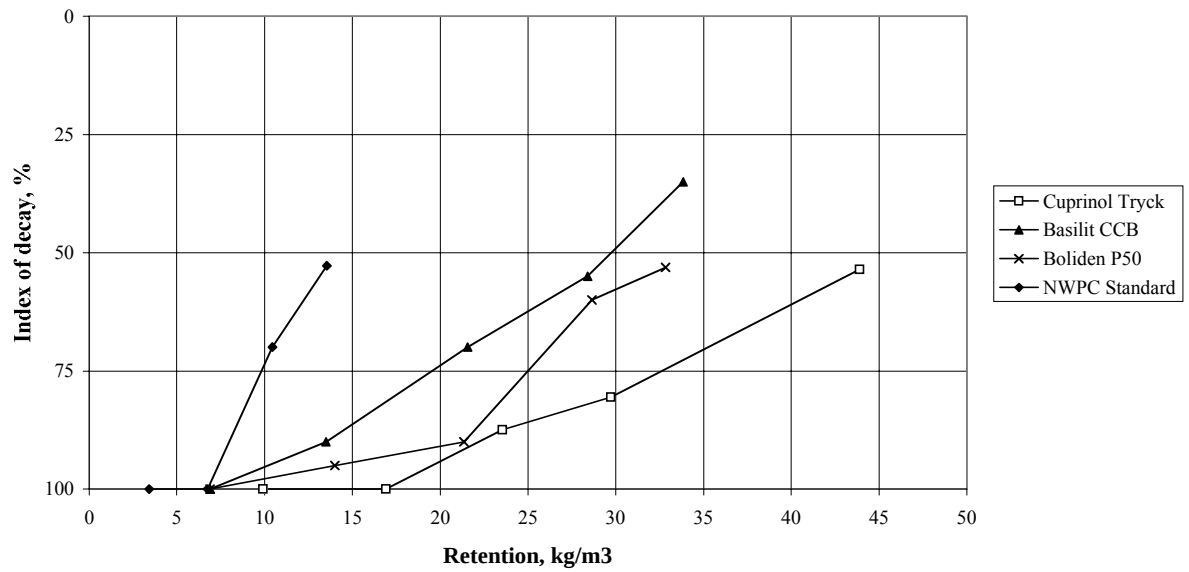
** Preservative introduced by the NWPC in the test.

Table 17. NWPC Field trial 1977. Results after 5 and 21-22 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)								
			Simlångsdalen (Sweden)*			Vaasa/Viikki (Finland)*			Vihti/Viikki (Finland)*		
			Year			Year			Year		
			5	22	$\bar{x}$	5	22	$\bar{x}$	5	21	$\bar{x}$
Basilit CCB	1.0	7.0	55	100	6.5	75	100	8.9	43	100	12
	2.0	14	35	90		43	97		25	73	
	3.0	21	18	70		20	60		33	75	
	4.0	28	15	55		5	60		10	66	
	5.0	34	13	35		5	58		5	47	
Boliden P50	1.0	6.9	63	100	6.6	28	100	12	45	100	10
	2.0	14	30	95		33	92		35	97	
	3.0	21	15	90		30	88		25	88	
	4.0	28	15	60		5	75		10	59	
	5.0	34	15	53		5	63		23	79	
Cuprinol Tryck (KP-N)	1.5	9.8	53	100	6.0	90	100	5.8	50	100	10
	2.5	17	40	100	10	35	100	14	28	100	13
	3.5	23	5	88		33	98		45	100	12
	4.5	30	15	81		53	97		18	83	
	6.5	44	10	54		40	88		20	84	
NWPC Standard Preservative No. 1	0.4	2.6	50	100	6.9	58	100	12	25	100	12
	0.8	5.1	18	100	14	35	100	17	20	100	14
	1.1	7.8	13	70		25	81		5	94	
	1.5	10	8	53		20	83		13	75	
Untreated			95	100	3.8	100		2.3	100		2.0

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993 and from Vaasa and Vihti to Viikki in 1986.

Simlångsdalen



Vaasa/Viikki

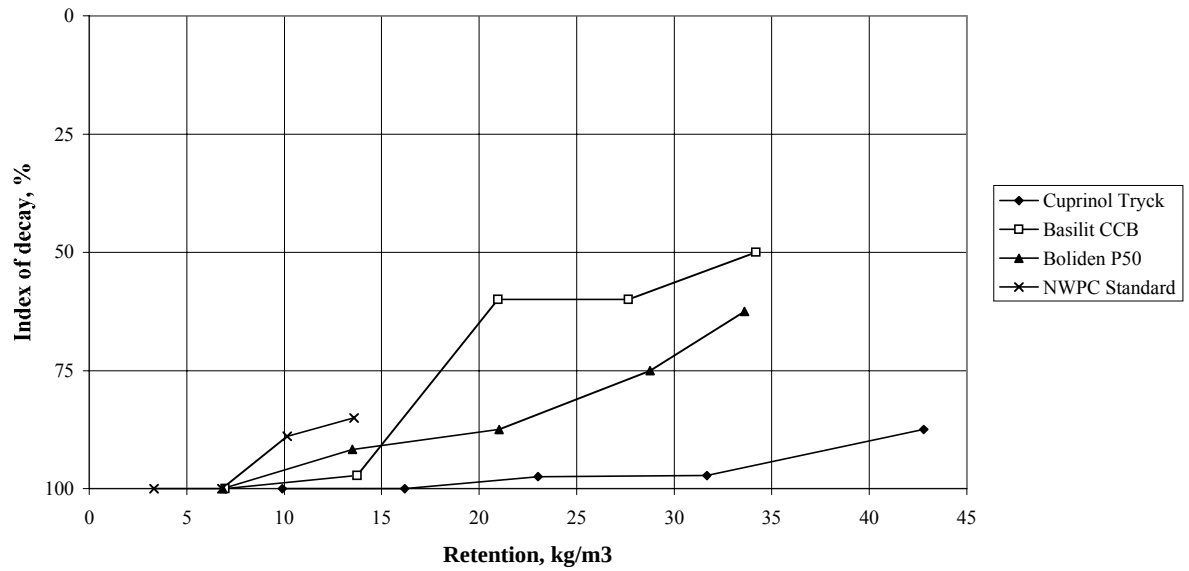


Figure 12. Index of decay in relation to retention after 22 years.

Vihti/Viikki

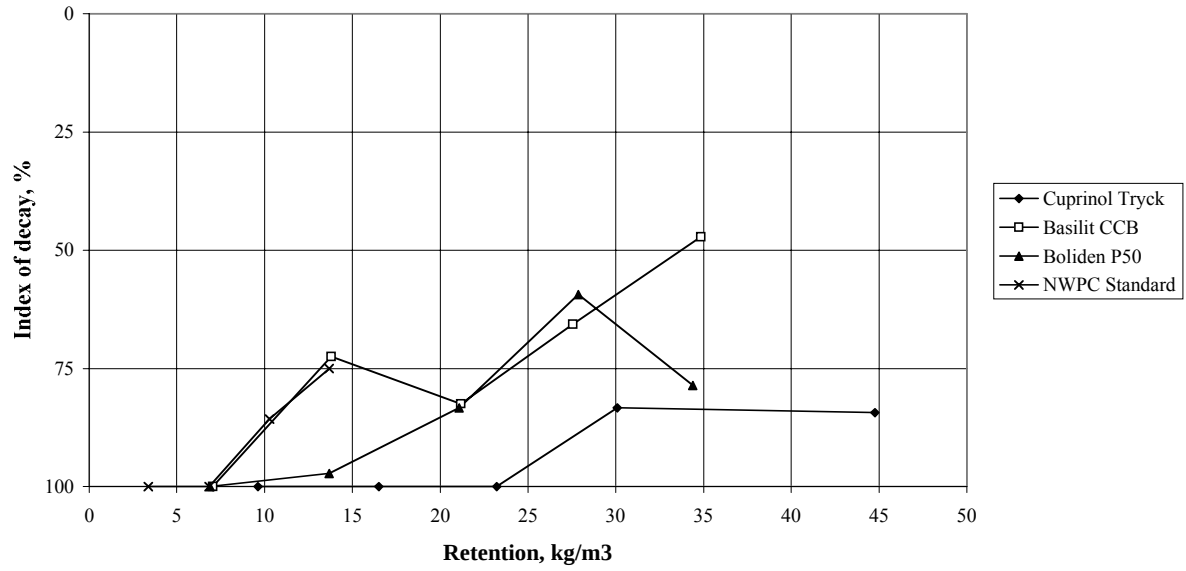


Figure 13. Index of decay in relation to retention after 21 years.

Field trial 1978

The preservatives of the 1978 trial and their chemical formulations are listed in Table 18. For every retention level of preservatives tested, 15 stakes were set out at Simlångsdalen and 10 stakes at Sørkedalen. In 1992 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 21 years' testing is shown in Table 19. Figure 14 presents index of decay in relation to retention of the preservatives tested. The rate of decay for stakes with various retentions of preservatives is shown in Figures 93 - 101 of the Appendix.

The life of untreated stakes was 2.6 years at Simlångsdalen and 7.2 years at Sørkedalen.

A comparison of the preservatives using the medial concentration levels gives the following order in index of decay (in brackets). At Simlångsdalen: NWPC Standard Preservative No. 1 (63), Hylosan PT (98), Cuprinol Tryck (100), Test product A (100), Test product C (100), Test product B (100), creosote (100), Celcure Q (100) and Celcure T (100). At Sørkedalen: NWPC Standard Preservative No. 1 (33), Test product B (73), Cuprinol Tryck (80), Test product A (81), Test product C (85), creosote (88), Hylosan PT (90), Celcure Q (100) and Celcure T (100).

Table 18. NWPC Field trial 1978. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Hylosan PT** (Permapruf T)	TBTO	10	TBTO	10	Penarth Research Centre
	Benzalkyl trimethyl ammoniumchloride (BAC)	40	BAC	40	
	Additives	≈ 6			
	H ₂ O	≈ 44			
Cuprinol Tryck**	CuO	12	Cu	9.5	Hager AB
	C ₇ H ₁₅ COOH	4.75	C ₇ H ₁₅ COOH	4.75	
	NH ₃	≈ 20			
	CO ₂	≈ 40			
	H ₂ O	≈ 25			
Test product A	PCP (technical grade)	6.2	PCP	6.2	-
	Dichlofluanid	0.5	Dichlofluanid	0.5	
	Resin	9.0			
	Paraffin wax	2.0			
	Petroleum oil (distillation range 180-215°C)	82.3			
Test product B	Cu ₂ O	10.78	Cu	9.5	-
	NH ₄ HCO ₃	50.00			
	Acid 810***	4.98			
	NH ₃	34.24			
Test product C	Cu ₂ O	7.16	Cu	6.3	-
	NH ₄ HCO ₃	33.21			
	Acid 810***	26.57			
	NH ₃	33.06			
Celcure Q	Dialkyl dimethyl quaternary ammonium compound (DDQA) (general formula R ₂ Me ₂ NCl, where R is an alkyl radical of C ₈ or C ₁₀ chain lengths)				Rentokil Ltd
		50	DDQA	50	
	H ₂ O	50			
Celcure T	Alkyl dimethyl tertiary amine hydrochloride (ADTA) (general formula RMe ₂ NHCl where R is a mixed alkyl radical of C ₁₂ , C ₁₄ and C ₁₆ chain lengths)				Rentokil Ltd
		50	ADTA	50	
	H ₂ O	50			
Creosote**	Scandinavian specification				
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	-
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

* Manufacturer that originally ordered the test or at the time when the test was started produced the preservative

** Preservative introduced by the NWPC in the test.

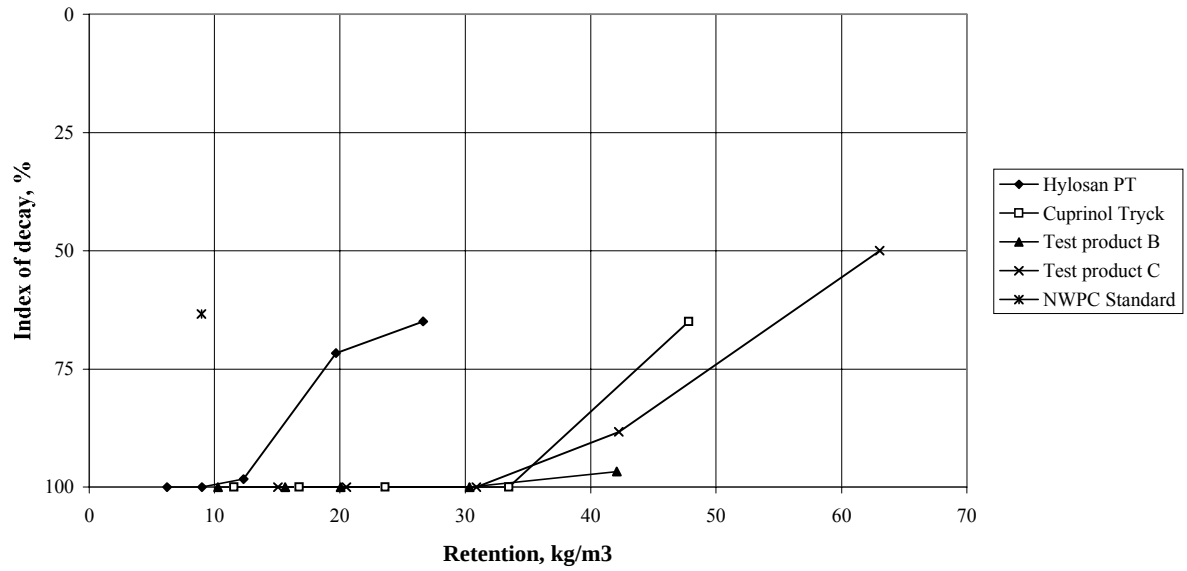
*** A mixture of isomers of C₈, C₉ and C₁₀ saturated aliphatic monocarboxylic acids.

Table 19. NWPC Field trial 1978. Results after 5 and 21 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Sørkedalen (Norway)		
			Year		$\bar{x}$	Year		$\bar{x}$
			5	21		5	21	
Hylosan PT (Permapruf T)	1.0	6.2	38	100	7.8	30	100	15
	1.5	9.1	32	100	9.8	20	100	17
	2.0	12	22	98		15	90	
	3.0	20	13	72		5	60	
	4.0	27	13	65		3	50	
Cuprinol Tryck	1.8	12	42	100	7.5	10	93	
	2.5	17	32	100	10	5	80	
	3.5	23	8	100	15	3	80	
	5.0	34	23	100	13	8	60	
	7.0	48	10	65		0	43	
Test product A	3.1	3.4	45	100	7.3	20	90	
	4.4	4.7	27	100	11	3	81	
	6.2	6.7	17	100	14	10	78	
Test product B	1.6	10	74	100	5.1	8	95	
	2.4	15	40	100	7.7	5	75	
	3.2	20	25	100	11	5	73	
	4.8	30	33	100	13	5	50	
	6.4	41	20	97		3	40	
Test product C	2.4	15	42	100	7.2	13	100	17
	3.2	21	25	100	11	8	80	
	4.8	31	23	100	10	3	85	
	6.4	42	13	88		5	53	
	9.6	64	8	50		3	40	
Celcure Q	0.7	4.4	97	100	3.1	53	100	10
	1.0	6.2	100		3.5	48	100	10
	1.4	8.9	100		3.9	45	100	13
	2.0	13	53	100	7.8	43	100	15
	2.8	18	43	100	9.3	30	100	17
Celcure T	0.7	4.3	97	100	2.8	60	100	8.0
	1.0	6.1	100		2.9	58	100	9.3
	1.4	8.8	100		3.0	48	100	13
	2.0	12	92	100	4.5	45	100	13
	2.8	18	89	100	4.9	45	100	17
Creosote		125	50	100	7.1	5	88	
NWPC Standard Preservative No. 1	1.3	9.0	5	63		0	33	
Untreated			100		2.6	68	100	7.2

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1992.

Simlångsdalen



Sørkedalen

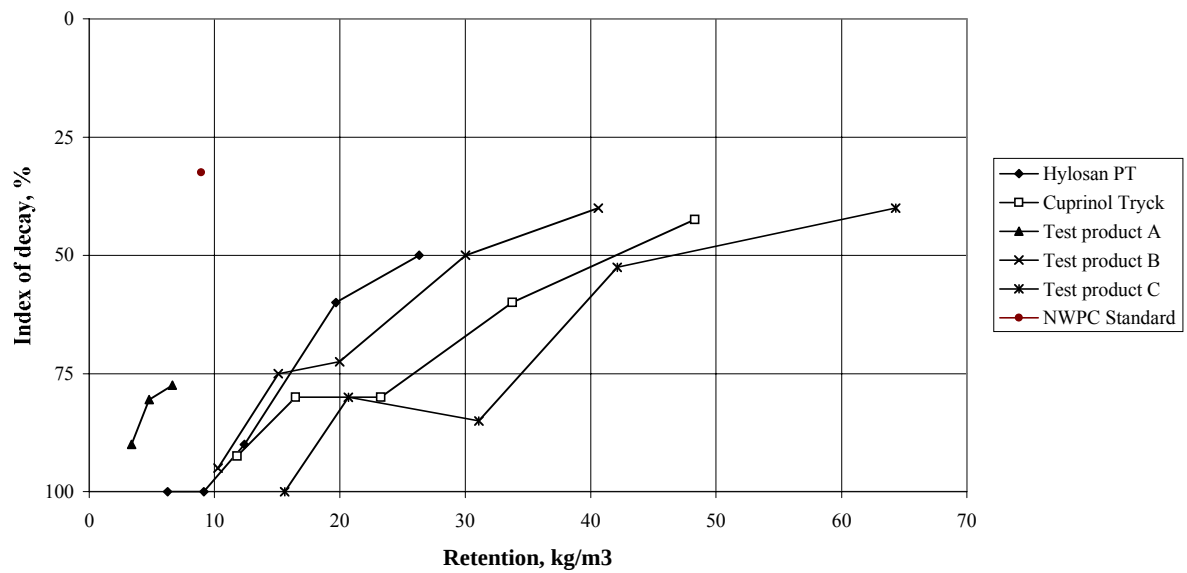


Figure 14. Index of decay in relation to retention after 21 years.

Field trial 1980

The preservatives of the 1980 trial and their chemical formulations are listed in Table 20. The trial was carried out as three experiments viz. 1980:1, 1980:2 and 1980:3.

Field trial 1980:1

For every retention level of preservatives tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Tåstrup. In 1995 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 19 years' testing is shown in Table 21. The rate of decay for stakes with various retentions of preservatives is shown in Figures 102 - 107 of the Appendix.

The life of untreated stakes was 1.4 years at Simlångsdalen and 2.5 years at Tåstrup.

Three of the preservatives tested, viz. Synprolam 35 DMA in water, Synprolam 35 DMA in white spirit and Synprolam 35 DMBQC in water failed rather early. At both Tåstrup and Simlångsdalen all stakes are rejected. Test product D shows a slightly better performance than test product E at Simlångsdalen but a similar performance at Tåstrup (Figure 15).

Field trial 1980:2

In this trial, European beech (*Fagus sylvatica* L.) was the main species used, with European redwood (*Pinus sylvestris* L.) included for comparison (Table 22). Three retention levels of Amline special (Table 20) were applied for European beech and one level for European redwood. For every retention level of European beech the treated stakes were stored in plastic bags for 0, 2, 4 and 8 weeks. Stakes of European redwood were stored in plastic bags 0 and 8 weeks. The aim of storing the stakes in plastic bags immediately after treatment was to find out if this could affect distribution and fixation of the preservative and thus increase the efficacy. European beech and redwood were also treated with NWPC Standard Preservative No. 1. For every combination 10 stakes were set out at Simlångsdalen and 10 at Sørkedalen. In 1993 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 19 years' testing is shown in Table 22. The rate of decay for every sample is shown in Figures 108 - 114 of the Appendix.

The index of decay was not affected by storing stakes in plastic bags after treatment. No storage in plastic bags gave almost the same life at Simlångsdalen and almost the same index of decay at Sørkedalen as storage in plastic bags for 2, 4 and 8 weeks for every retention.

European beech treated with Amline special or NWPC Standard Preservative No. 1 showed much worse performance than European redwood treated with the same preservatives. The highest retention of Amline special gave for European beech almost the same life (Simlångsdalen) or index of decay (Sørkedalen) as the NWPC Standard Preservative.

Field trial 1980:3

Celcure Q and Celcure T tested in the 1978 trial, were also used in 1980 at higher concentrations. For every retention level 15 stakes were set out at Simlångsdalen and 10 stakes at Sørkedalen. Index of decay after 5 and 19 years' testing is presented in Table 23. The rate of decay with various retentions is shown in Figures 115 - 116 of the Appendix. All stakes at Simlångsdalen are rejected while the stakes at Sørkedalen are rejected or severely decayed.

Table 20. NWPC Field trial 1980. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m	Active components % m/m	Manufacturer*
Test product D	Cu (NH ₃) ₄ ²⁺ 16.6 Benzalkoniumchloride (QKKBCI) 20.6 NH ₃ 9.3 (NH ₄) ₂ CO ₃ 3.7 Anti foam agent 0.2 H ₂ O rest	Cu 8.0 QKKBCI 20.6	-
Test product E	Cu 6.6 Propionate 42.0 NH ₃ 12.9 Ca 0.9 H ₂ O rest	Cu 6.6	-
Synprolam 35 DMA	Acetate salt of dimethyl tertiary fatty amine (Synprolam 35DM) (combination of C ₁₃ and C ₁₅ species is approx ratio 70:30; overall ratio of linear:branched chains is approx 50:50) 100	35DMA 100	ICI Ltd.
Synprolam 35DMBQC	Benzylchloride quaternary salt of dimethyl tertiary fatty amine (Synprolam 35DM) (combination of C ₁₃ and C ₁₅ species is approx ratio 70:30; overall ratio of linear:branched chains is approx 50:50) 50	35DMBQC50	ICI Ltd.
	H ₂ O 50		
Amline special	CuO 4.2 As ₂ O ₅ 2.25 CrO ₃ 2.25 NH ₃ 20.1 CO ₂ 45.5 H ₂ O 25.7	Cu 3.4 As 1.5 Cr 1.2	Hager AB
Celcure Q	Dialkyl dimethyl quaternary ammonium compound (DDQA) (general formula R ₂ Me ₂ NCl, where R is an alkyl radical of C ₈ or C ₁₀ chain lengths) 50	DDQA 50	Rentokil Ltd.
	H ₂ O 50		
Celcure T	Alkyl dimethyl tertiary amine hydrochloride (ADTA) (general formula RMe ₂ NHCl where R is a mixed alkyl radical of C ₁₂ , C ₁₄ and C ₁₆ chain lengths) 50	ADTA 50	Rentokil Ltd.
	H ₂ O 50		
NWPC Standard Preservative No. 1	CuO 19.0 CrO ₃ 36.0 As ₂ O ₅ 45.0	Cu 15.2 Cr 18.7 As 29.3	-

* Manufacturer that originally ordered the test or at the time when the test was started produced the preservative.

Table 21. NWPC Field trial 1980:1. Results after 5 and 19 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Tåstrup (Denmark)		
			Year	Year	$\bar{x}$	Year	Year	$\bar{x}$
			5	19		5	19	
Test product D	0.94	6.2	85	100	4.3	50	100	8.3
	1.9	12	60	100	9.9	8	90	
	3.8	25	15	69		3	55	
	5.6	37	5	61		0	50	
	7.5	49	18	42		0	30	
Test product E	2.0	13	78	100	5	20	93	
	2.7	18	54	98		0	95	
	3.8	26	38	95		0	63	
	5.3	36	28	96		5	48	
	7.4	50	30	73		0	33	
Synprolam 35 DMA in water	0.16	1.0	100		1.0	100		2.2
	0.31	2.0	100		1.5	100		2.4
	0.62	4.1	100		1.7	100		2.7
	1.25	8.2	100		2.8	95	100	3.4
	2.50	16	81	100	5.7	95	100	3.9
Synprolam 35 DMA in white spirit	0.20	0.8	100		2.3	100		3.1
	0.40	1.6	100		2.4	100		3.7
	0.80	3.1	100		2.7	98	100	3.7
	1.60	6.1	88	100	4.2	92	100	4.7
	3.20	13	74	100	5.8	93	100	4.9
Synprolam 35 DMBQC in water	0.16	1.0	100		1.5	100		2.1
	0.31	2.1	100		2.0	100		2.5
	0.62	4.0	100		2.0	100		2.6
	1.25	7.9	78	100	5.4	95	100	3.5
	2.50	16	36	100	13	80	100	6.1
NWPC Standard Preservative No. 1	1.3	8.8	4	45		0	8.3	
Untreated			100		1.4	100		2.5

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1995.

Table 22. NWPC Field trial 1980:2. Results after 5 and 19 years' testing.

Wood preservative	Concentration of Cu % m/m		Retention of Cu kg/m ³	Index of decay and average life ($\bar{x}$)					
				Simlångsdalen (Sweden)*			Sørkedalen (Norway)		
				Year	$\bar{x}$		Year	$\bar{x}$	
				5	19	$\bar{x}$	5	19	$\bar{x}$
Amline special - European beech									
Weeks in plastic bag	0	0.2	1.2	100		3.8	29	100	11
	2	0.2	1.2	100		3.5	31	100	10
	4	0.2	1.2	100		3.3	33	100	11
	8	0.2	1.2	100		3.7	33	100	10
Weeks in plastic bag	0	0.4	2.5	94	100	4.6	29	98	
	2	0.4	2.5	96	100	4.5	27	100	12
	4	0.4	2.5	87	100	4.9	31	100	13
	8	0.4	2.6	85	100	4.7	27	100	11
Weeks in plastic bag	0	0.8	5.2	65	100	6.0	17	94	
	2	0.8	5.0	75	100	6.1	15	83	
	4	0.8	5.1	83	100	5.8	17	96	
	8	0.8	5.0	79	100	5.5	21	98	
Amline special - European redwood									
Weeks in plastic bag	0	0.4	2.8	8	54		0	50	
	8	0.4	2.8	4	33		0	50	
NWPC Standard Preservative No. 1									
European beech		1.3 ¹⁾	8.1 ²⁾	77	100	5.6	23	100	14
European redwood		1.3 ¹⁾	9.1 ²⁾	10	58		2	40	

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993

1) Concentration of all components of the preservative.

2) Retention of all components of the preservative.

Table 23. NWPC Field trial 1980:3. Results after 5 and 19 years' testing.

Wood preservative	Concentration % m/m		Retention kg/m ³	Index of decay and average life ($\bar{x}$)				
				Simlångsdalen (Sweden)		Sørkedalen (Norway)		
				Year	$\bar{x}$	Year	$\bar{x}$	
				5	19	5	19	$\bar{x}$
Celcure Q	2.6	16	67	100	5.7	28	100	13
	3.6	22	38	100	6.7	18	98	
	4.6	28	38	100	8.1	8	93	
Celcure T	2.6	17	100		3.4	43	100	12
	3.6	22	97	100	4.3	38	100	13
	4.6	28	84	100	4.9	25	100	14

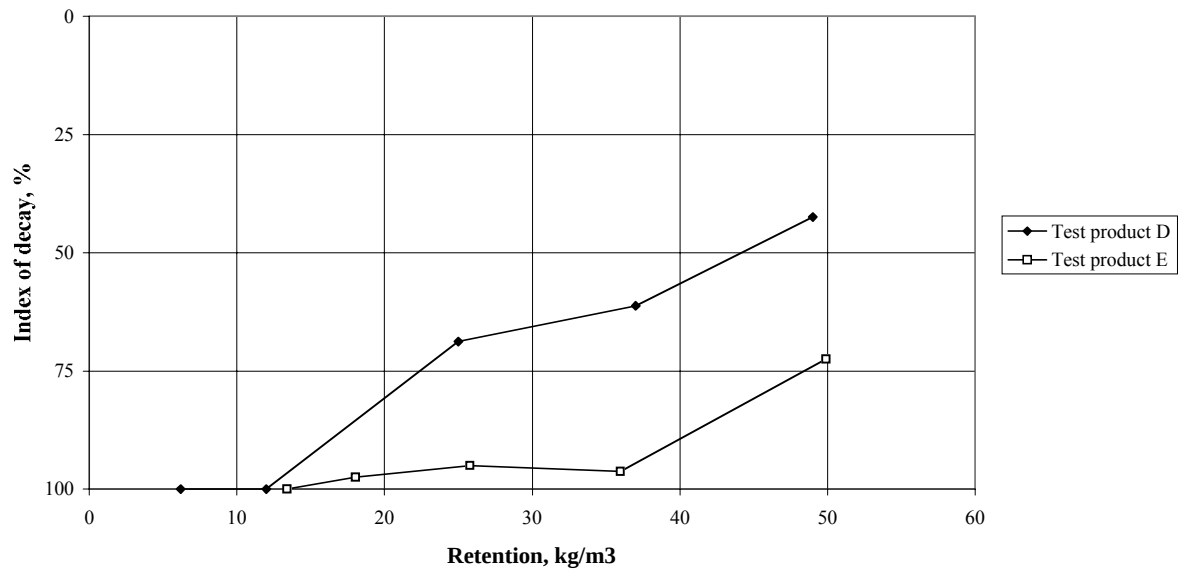
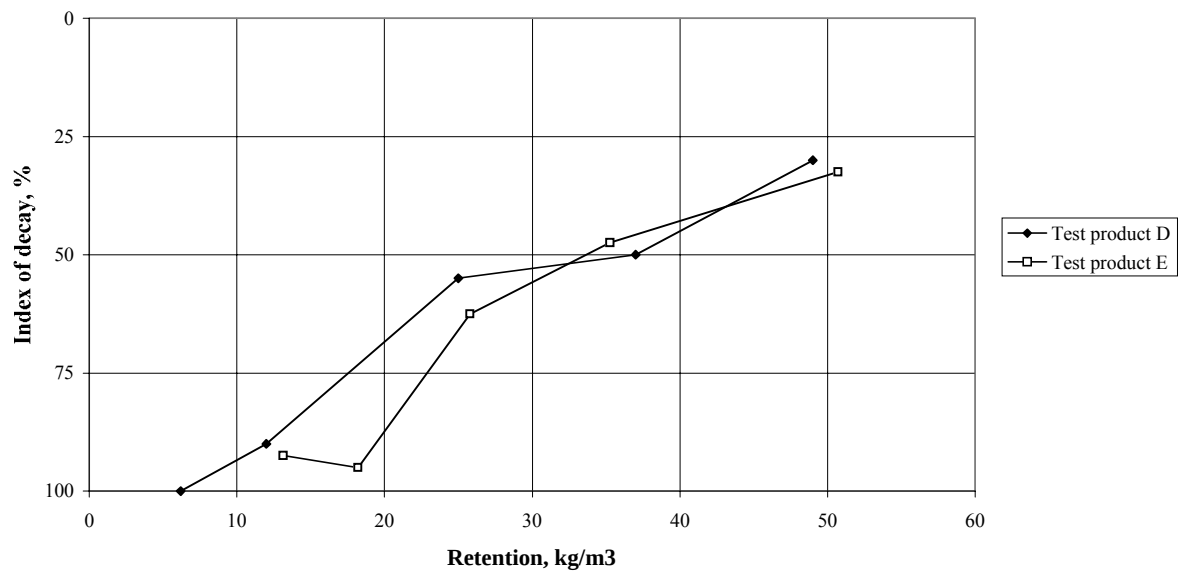
Simlångsdalen**Tåstrup**

Figure 15. Index of decay in relation to retention after 19 years.

Field trial 1981

The preservatives of the 1981 trial and their chemical formulations are listed in Table 24. For every retention level of preservatives tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Tåstrup. In 1992 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

European beech (*Fagus sylvatica* L.) was used for the preservative HW81. Stakes treated with this preservative to retentions of 6.2, 12, 19 and 25 kg/m³ were stored in plastic bags for 6 weeks immediately after the treatment. Extra stakes treated to a retention of 12 kg/m³ were dried directly after the treatment. For all other preservatives in the trial, European redwood (*Pinus sylvestris* L.) was used.

The index of decay after 5 and 18 years' testing is shown in Table 25. The rate of decay for stakes with various retentions of preservatives is shown in Figures 117 - 125 of the Appendix.

The life for untreated European redwood was 1.0 year at Simlångsdalen and 2.9 years at Tåstrup. For untreated European beech, the life was 1.4 years at Simlångsdalen and 1.1 years at Tåstrup.

All the stakes treated with HZ 81, Arquad AC and Arquad IC are now rejected. Hager Aceta shows the best results in this trial.

Table 24. NWPC Field trial 1981. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
HW 81	$\text{Cu}(\text{CH}_3\text{COO})_2 \cdot \text{H}_2\text{O}$	70.3	Cu	22.38	Hager AB
	$\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$	23.4	Zn	6.98	
	H_3BO_3	6.3	B	1.10	
Hager Aceta (HCZ 81)	$\text{Cu}(\text{CH}_3\text{COO})_2 \cdot \text{H}_2\text{O}$	73.0	Cu	23.2	Hager AB
	$\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$	22.9	Zn	6.8	
	H_3BO_3	4.1	B	0.7	
HZ 81	$\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$	85.1	Zn	27.9	Hager AB
	$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	11.1			
	H_3BO_3	3.8	B	0.66	
Hylosan PT 1/81	Benzalkyl trimethyl ammoniumchloride** (BAC)	40	BAC	40	KenoGard AB
	TBTO	10	TBTO	10	
	Amine D810	2			
	NH_3	2.25			
	Anti foam agent	2			
	H_2O	rest			
ES 240	A mixture of monoalkyl trimethyl ammonium chloride (MTAC) and dialkyl dimethyl ammonium chloride (DDAC)	50	MTAC/ DDAC	50	Akzo Chemicals International bv
	H_2O	30			
	Isopropanol	20			
Arquad AC	Monoalkyl trimethyl ammonium chloride (MTAC)	19.2	MATC	19.2	Akzo Chemicals International bv and Gori
	H_2O	80.8			
Arquad IC	Monoalkyl trimethyl ammonium chloride (MTAC)	17.3	MTAC	17.3	Gori
	Imazalil sulphate (IS)	1.9	IS	1.9	
	H_2O	80.8			
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	-
	CrO_3	36.0	Cr	18.7	
	As_2O_5	45.0	As	29.3	

* Manufacturer that originally ordered the test or at the time when the test was started produced the preservative.

** Gloquat C

Table 25. NWPC Field trial 1981. Results after 5 and 18 years' testing.

Wood preservative	Concentration % m/m		Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
				Simlångsdalen (Sweden)*			Tåstrup (Denmark)		
				Year			Year		
				5	18	$\bar{x}$	5	18	$\bar{x}$
<i>European beech</i>									
HW 81									
Weeks in plastic bag	6	1.0	6.2	45	100	7.1	53	100	8.1
	6	2.0	12	21	100	12	28	78	
	6	3.0	19	15	99		8	70	
	6	4.0	25	3	98		3	58	
Weeks in plastic bag	0	2.0	12	28	100	11	18	93	
<i>European redwood</i>									
Hager Aceta (HCZ 81)	0.7	4.6	39	100	9		8	95	
	0.9	5.8	34	100	11		5	60	
	1.3	8.5	13	63			0	45	
	1.8	12	3	33			0	41	
	2.6	18	0	21			0	23	
HZ 81	1.1	7.3	89	100	4.6		90	100	4.4
	1.6	11	79	100	5.4		95	100	4.4
	2.2	14	78	100	5.5		73	100	5.1
	3.1	21	36	100	6.4		53	100	6.5
	4.4	30	19	100	7.8		45	100	6.6
Hylosan PT 1/81	1.0	6.4	11	100	11		40	100	7.2
	1.5	9.5	1	100	15		28	100	8.8
	2.0	13	6	86			25	100	12
	3.0	20	3	56			25	95	
	4.0	26	1	48			23	68	
ES 240	1.0	6.3	100		3.6		95	100	3.9
	1.4	8.9	75	100	6.3		78	100	5.1
	1.9	12	39	100	9.3		80	100	5.1
	2.7	18	28	100	14		55	100	6.6
	3.8	25	25	98			50	100	7.7
Arquad AC	2.5	15	95	100	3.2		95	100	4.2
	3.5	22	100		3.8		95	100	4.5
	5.0	31	96	100	4.8		75	100	5.9
	7.0	46	69	100	6.6		68	100	6.2
	9.9	65	43	100	10		58	100	7.0
Arquad IC	2.5	16	98	100	3.5		95	100	4.2
	3.5	23	90	100	4.8		98	100	4.6
	5.0	33	74	100	6.1		83	100	5.5
	7.0	45	48	100	9.7		60	100	6.5
	9.9	64	25	100	13		58	100	7.2
NWPC Standard Preservative No. 1	1.3	8.7	6	28			5	20	
Untreated European redwood				100		1.0	100		2.9
European beech				100		1.4	100		1.1

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1992.

Field trial 1982

Only one preservative was tested in the 1982 trial and the chemical formulation is presented in Table 26. For every retention level of the preservative tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Viikki. In 1992 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 17 years' testing is shown in Table 27. Figure 16 presents index of decay in relation to retention of the preservative tested. The rate of decay for stakes with various retentions of preservative is shown in Figures 126 - 127 of the Appendix.

Table 26. NWPC Field trial 1982. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
H 82 - alfa	CuAc ₂ · aq	27.0	Cu	8.6	Hager AB
	ZnAc ₂ · aq	59.4	Zn	17.7	
	CrO ₃	13.5	Cr	7.0	
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

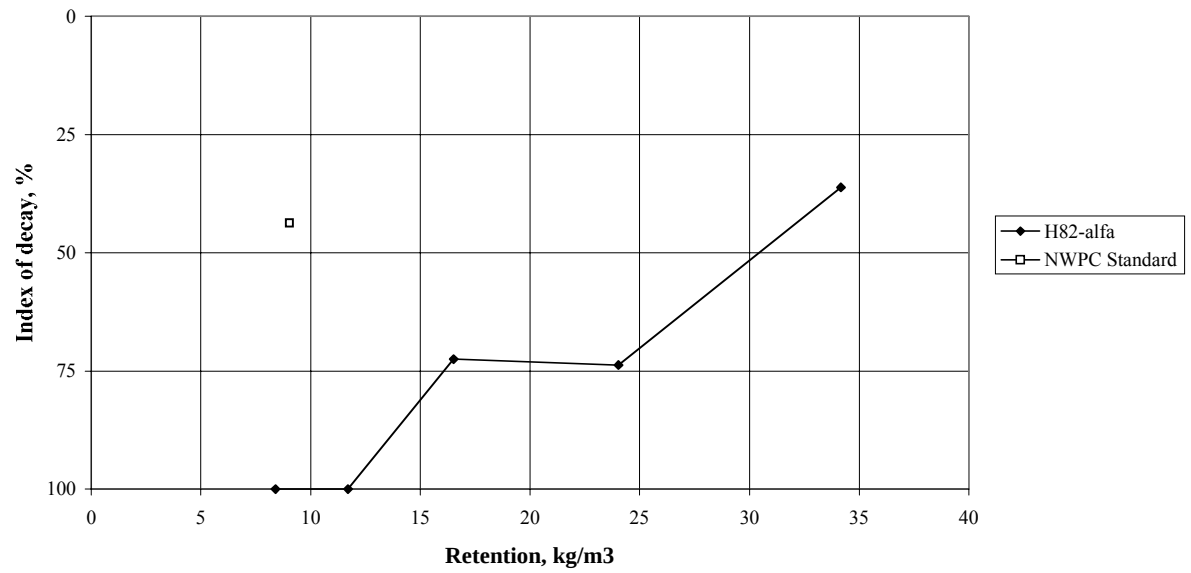
* Manufacturer that originally ordered the test.

Table 27. NWPC Field trial 1982. results after 5 and 17 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life($\bar{x}$)					
			Simlångsdalen (Sweden)*			Viikki (Finland)		
			Year	Year	$\bar{x}$	Year	Year	$\bar{x}$
H82 - alfa	1.2	9.9	23	100	9.9	12	100	12
	1.7	16	31	100	13	20	98	
	2.4	20	18	73		3	78	
	3.4	33	15	74		0	63	
	4.8	42	11	36		0	63	
NWPC Standard Preservative No. 1	1.3	9.0	20	44		0	60	

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1992

Simlångsdalen



Viikki

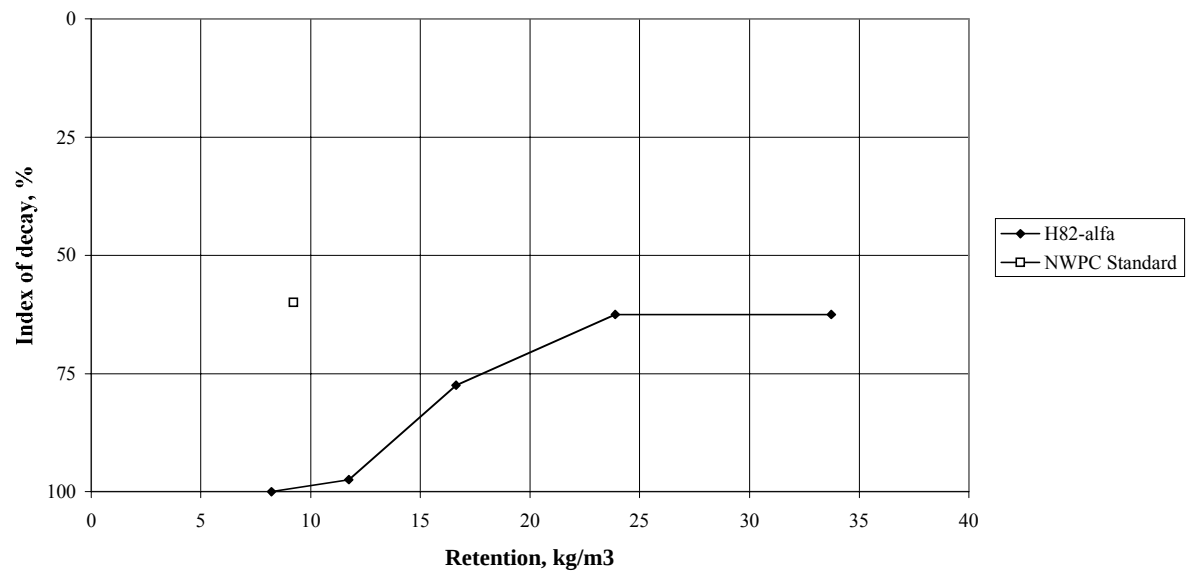


Figure 16. Index of decay in relation to retention after 17 years.

Field trial 1983

Field trial 1983:1

The preservatives of the 1983:1 trial and their chemical formulations are listed in Table 28. For every retention level of preservatives tested, 10 stakes were set out at Ultuna near Uppsala and 10 stakes at Tåstrup. The stakes were not free from knots and the quality not as high as in the other trials.

Heartwood and sapwood of European redwood (*Pinus sylvestris* L.), Larch (*Larix* sp), Douglas fir (*Pseudotsuga menziesii*), Lodgepole pine (*Pinus contorta*), Red silver fir (*Abies amabilis*) and Western hemlock (*Tsuga heterophylla*) were included in the trial. Untreated Red silver fir, Western hemlock, Lodgepole pine heartwood, Douglas fir heartwood, European redwood heartwood and Larch heartwood were not exposed in Tåstrup.

The index of decay after 5 and 16 – 17 years' testing is shown in Table 29. The rate of decay for stakes with various retentions of preservatives is shown in Figures 128 - 139 of the Appendix.

All untreated sapwood and heartwood stakes had comparable life, between 1.8 and 4.2 years, in the two fields.

At Ultuna all CCA treated stakes are rejected after 16 years' exposure and all stakes with the lowest retention of Cuprinol Tryck. At Tåstrup the stakes have performed somewhat better, but even here all stakes with the lowest retention of the two preservatives are rejected.

Field trial 1983:2

Only one preservative was tested in the 1983:2 trial and the chemical formulation is presented in Table 30. For every retention level of the preservative tested, 20 stakes were set out at Simlångsdalen. In 1992 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 16 years' testing is shown in Table 31 and index of decay in relation to retention after 16 years in Figure 17. The rate of decay for stakes with various retentions of preservative is shown in Figures 140 of the Appendix.

Table 28. NWPC Field trial 1983:1. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m	
Rentokil K33	CuO	14.8	Cu	11.8
	CrO ₃	26.6	Cr	13.8
	As ₂ O ₅	34.0	As	22.2
	H ₂ O	24.6		
Cuprinol Tryck	CuO	12.0	Cu	9.5
	C ₇ H ₁₅ COOH	4.75	C ₇ H ₁₅ COOH	4.75
	NH ₃	20		
	CO ₂	40		
	H ₂ O	25		

Tabell 29. NWPC Field trial 1982 - 83. Results after 5 and 16 - 17 years testing

Wood preservative	Retention kg/m ³	Index of decay and average life($\bar{x}$)					
		Ultuna (Sweden)			Tåstrup (Denmark)		
		5	16	$\bar{x}$	5	16-17	$\bar{x}$
CUPRINOL TRYCK							
Red silver fir, sapwood	6.3	50	100	7.0	35	95	
	23	5	100	12	0	25	
	35	0	83		0	20	
Red silver fir, heartwood	23	0	100	14	0	33	
Lodgepole pine, sapwood	7.4	93	100	4.9	20	100	7.2
	23	18	100	12	0	68	
	38	3	90		0	28	
Lodgepole pine, heartwood	16	13	100	9.5	3	42	
Douglas fir sapwood	6.5	85	100	5.3	5	97	
	20	3	95		0	25	
	32	0	65		0	10	
Douglas fir, heartwood	11	100	100	3.3	3	86	
Larch, sapwood	6.9	43	100	7.8	2.5	94	
	22	8	80		0	28	
	36	3	50		0	10	
Larch, heartwood	5.5	95	100	3.2	0	100	13
European redwoode, sapwood	6.8	60	100	6.4	20	100	8.8
	22	10	100	12	0	35	
	36	10	73		0	13	
European redwoode, heartwood	15	35	100	7.4	2.5	53	
Western hemlock, sapwood	6.1	68	100	5.8	30	100	9.1
	21	15	100	12	0	35	
	33	3	98		0	30	
Western hemlock, heartwood	21	3	100	13	0	35	

Tabell 29 (continuing)

Wood preservative	Retention kg/m ³	Index of decay and average life($\bar{X}$)					
		Ultuna (Sweden)			Tåstrup (Denmark)		
		5	16	$\bar{X}$	5	16	$\bar{X}$
RENTOKIL K33							
Red silver fir, sapwood	3.6	40	100	6.3	30	95	
	12	40	100	7.3	3	25	
	22	8	100	10	0	2.5	
Red silver fir, heartwood	12	38	100	7.5	3	18	
Lodgepole pine, sapwood	4.0	100		4.1	20	100	8.1
	13	50	100	6.4	0	19	
	21	5	100	9.3	0	0	
Lodgepole pine, heartwood	9.1	68	100	6.1	31	38	
Douglas fir sapwood	3.5	93	100	4.9	23	95	
	12	55	100	8.0	0	30	
	19	13	100	11	0	0	
Douglas fir, heartwood	9.4	73	100	4.4	0	5	
Larch, sapwood	3.8	78	100	5.4	25	100	11
	13	33	100	8.3	0	25	
	21	25	100	8.4	0	0	
Larch, heartwood	3.2	95	100	3	0	85	
European redwood, sapwood	3.6	60	100	6	13	100	10
	13	8	100	8.7	0	18	
	20	3	100	8.6	0	0	
European redwood, heartwood	11	43	100	7.8	0	23	
Western hemlock, sapwood	3.5	58	100	5.8	20	95	
	12	40	100	7.3	0	8	
	21	13	100	8.9	0	0	
Western hemlock, heartwood	11	18	100	12	5	13	
UNTREATED							
Red silver fir, sapwood		100		2.4	—	—	
heartwood		100		2.6	—	—	
Lodgepole pine, sapwood		100		1.9	100		1
Lodgepole pine, heartwood		100		1.8	—	—	
Douglas fir, sapwood		100		2.6	100		2.6
Douglas fir, heartwood		100		2.1	—	—	
European redwood, sapwood		100		2.4	100		2.9
European redwood, heartwood		90	100	3.2	—	—	
Larch, sapwood		100		2.0	100		1.8
Larch, heartwood		100		2.4	—	—	
Western hemlock, sapwood		100		2.9	—	—	
Western hemlock, heartwood		100		3.9	—	—	

Table 30. NWPC Field trial 1983:2. Preservative tested and the chemical formulation

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Testproduct E	Cu	6,6	Cu	6.6	—
	Propionate	42.0			
	NH ₃	12.9			
	Ca	0.9			
	H ₂ O	rest			
NWPC Standard	CuO	19.0	Cu	15.2	
Preservative No. 1	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

* Manufacturer that originally ordered the test.

Table 31. NWPC Field trial 1983:2. Results after 5 and 16 years' testing.

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life($\bar{x}$) Simlångsdalen (Sweden)*		
			Year		$\bar{x}$
			5	16	
Testproduct E	2	14	61	95	
	2.7	18	39	71	
	3.8	26	20	61	
	5.3	36	6	26	
	7.4	51	0	10	
NWPC Standard	1.3	8.7	3	44	
Preservative No. 1					

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1992

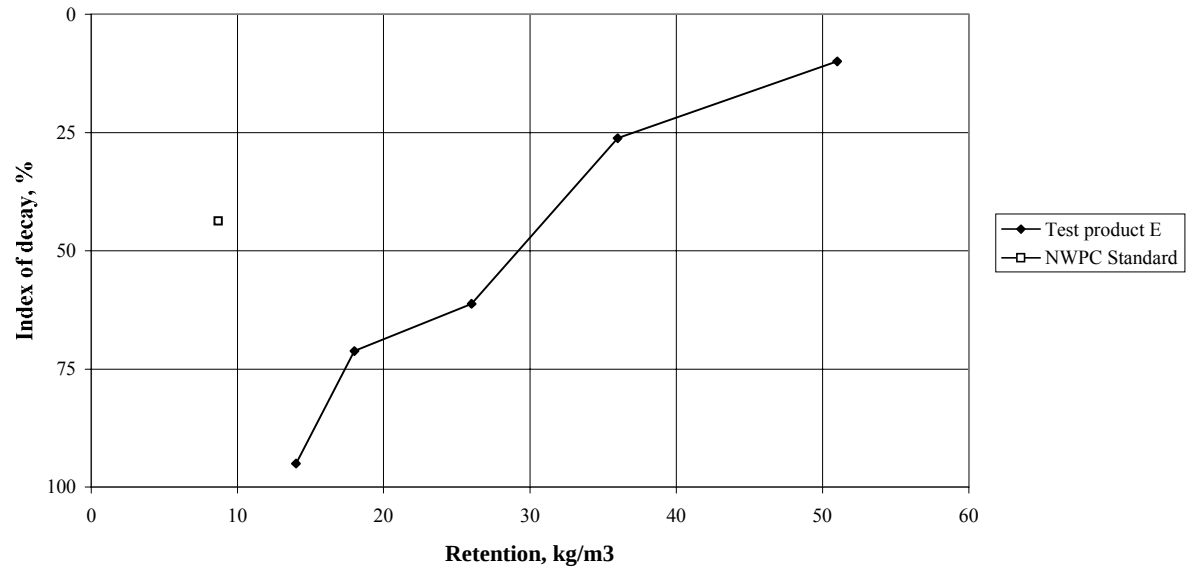
Simlångsdalen

Figure 17. Index of decay in relation to retention after 16 years.

Field trial 1984

The preservatives of the 1984 trial and their chemical formulations are listed in Table 32. For every retention level of preservatives tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Sørkedalen. In 1992 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 15 years' testing is shown in Table 33. Figure 18 presents index of decay in relation to retention of the preservatives tested. The rate of decay for stakes with various retentions of preservatives is shown in Figures 141 - 150 of the Appendix.

The life of untreated stakes was 1 year at Simlångsdalen and 5.9 years at Sørkedalen.

A comparison of the preservatives using the medial concentration levels gives the following order in index of decay (in brackets). At Simlångsdalen: Celcure A/oxide (48), NWPC Standard Preservative No. 1 (49), Kempol 110 (93), Mitrol CeQure 1125 (93), Kempol 101 (94), KS-impreg (94), Mitrol CeQure 3125 (95), Mitrol CeQure (96), Kempol 100 (100) and Kempol 200 (100).

At Sørkedalen: Celcure A/oxide (18), NWPC Standard Preservative No. 1 (30), Mitrol CeQure 1125 (43), KS-impreg (45), Mitrol CeQure 3125 (48), Kempol 100 (53), Mitrol CeQure (53), Kempol 110 (60), Kempol 101 (63) and Kempol 200 (100).

Table 32. NWPC Field trial 1984. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m	Active components % m/m		Manufacturer*
Kempol 100	Cu as polyacrylate NH ₃ H ₂ O	3.7 6.0	Cu 3.7	Kemira Oy
Kempol 101	Cu as polyacrylate -methylmetacrylate NH ₃ H ₂ O	2.4 3.8	Cu 2.4	Kemira Oy
Kempol 110	Cu as polyacrylate Didecyldimethylammonium chloride NH ₃ Nonylphenylpolyglycoether Isopropanol H ₂ O	2.8 4.3 4.5 12.8 1.7	Cu 2.8 4.3	Kemira Oy
Kempol 200	Zn as polyacrylate NH ₃ H ₂ O	3.8 5.9	3.8	Kemira Oy
KS-impregnering	Cu NH ₃ HCO ₃ NH ₃	9.4 30.9 10.6	9.4	Kemira Oy
Celcure A/oxide	CuO CrO ₃ As ₂ O ₅ H ₂ O	10 27 23 40	Cu 8 Cr 14 As 15	Rentokil Svenska AB
Mitrol CeQure	CuO Octyldecyldimethyl- ammonium chloride NH ₄ HCO ₃ NH ₃ H ₂ O	12.5 25.0 24.9 11.8 25.3	Cu 10.0 AAC 25.0	Keno Gard VT

* Manufacturer that originally ordered the test.

Table 32. (Continuing.)

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Mitrol CeQure 1125	CuO	10.0	Cu	8.0	Keno Gard VT
	Octyldecyldimethyl-ammonium chloride	20.0	AAC	20.0	
	ZnO	10.2	Zn	8.2	
	NH ₄ HCO ₃	20.0			
	NH ₃	18.8			
	H ₂ O	20.5			
Mitrol CeQure 3125	CuO	12.5	Cu	10.0	Keno Gard VT
	Octyldecyldimethyl-ammonium chloride	12.5	AAC	12.5	
	N-alkyldimethylbenzyl-ammonium chloride	12.5	AAC	12.5	
	NH ₄ HCO ₃	24.9			
	NH ₃	11.8			
	H ₂ O	25.3			
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

* Manufacturer that originally ordered the test.

Table 33 NWPC Field trial 1984. Results after 5 and 15 years testing

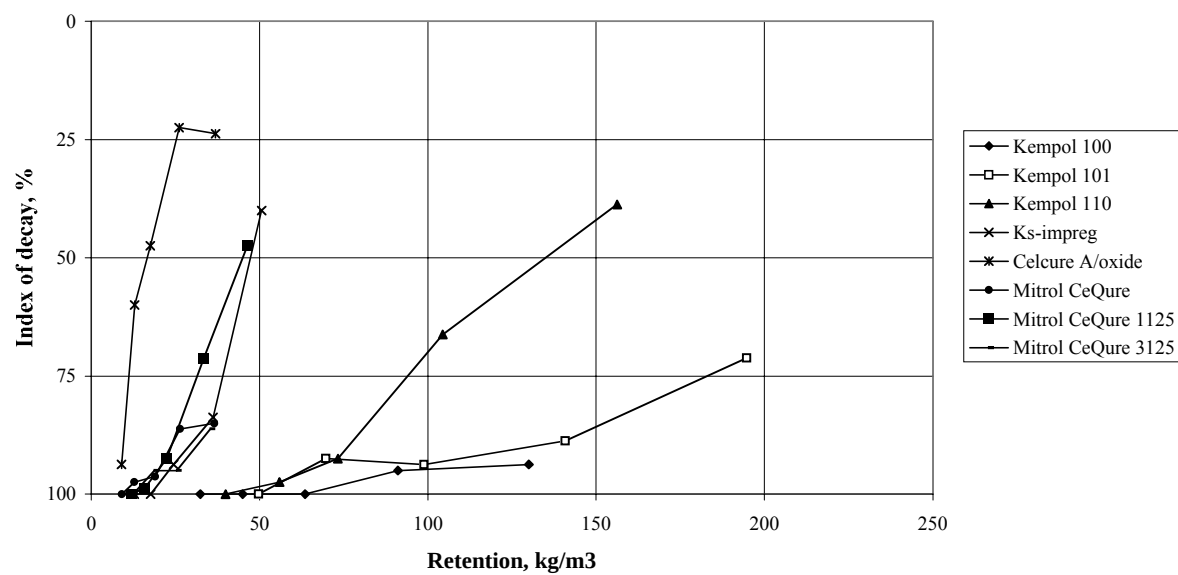
Wood preservative	Concentration %m/m	Retention kg/m ³	Index of decay and average life($\bar{X}$)					
			Simlångsdalen (Sweden)*			Sørkedalen (Norge)		
			Year	Year	$\bar{X}$	Year	Year	$\bar{X}$
			5	15		5	15	
Kempol 100	4.5	32	100		1	3	98	
	6.3	45	96	100	1.5	0	80	
	8.9	64	83	100	4.1	0	53	
	13	91	48	95		0	48	
	18	130	13	94		0	35	
Kempol 101	7.1	50	88	100	4.2	0	88	
	10	70	69	93		0	75	
	14	99	49	94		0	63	
	20	142	25	89		0	40	
	28	194	11	71		0	40	
Kempol 110	5.9	40	58	100	7.5	0	93	
	8.3	55	24	98		0	68	
	12	72	11	93		0	60	
	17	104	1	66		0	33	
	24	153	0	39		0	30	
Kempol 200	6.6	47	100	100	1.5	28	100	8.1
	9.3	66	100	100	1.9	30	100	7.3
	13	96	100	100	2.3	33	100	8.0
	19	136	100	100	2.4	20	100	8.0
	26	191	100	100	2.9	13	100	8.2
KS-impreg	1.8	13	83	100	4.4	0	65	
	2.5	18	76	100	6.6	0	60	
	3.5	25	70	94		0	45	
	5.0	36	35	84		0	28	
	7.1	51	5	40		0	33	
Celcure A/oxide	1.3	9.0	41	94		0	55	
	1.8	13	26	60		0	33	
	2.5	18	10	48		0	18	
	3.5	26	3	23		0	25	
	5	37	1	24		0	13	
Mitrol CeQure	1.3	9.1	81	100	5.4	0	65	
	1.8	13	45	98		0	50	
	2.7	19	35	96		0	53	
	3.7	26	8	86		0	43	
	5.2	37	1	85		0	35	

Table 33 (continuing)

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Sørkedalen (Norge)		
			Year	Year	$\bar{x}$	Year	Year	$\bar{x}$
			5	15		5	15	
Mitrol CeQure 1125	1.7	12	44	100	8.1	0	78	
	2.3	16	20	99		0	68	
	3.3	23	1	93		0	43	
	4.7	34	1	71		0	30	
	6.5	47	0	48		0	30	
Mitrol CeQure 3125	1.3	9.1	91	100	5	0	80	
	1.8	13	46	100	8.6	0	65	
	2.7	19	26	95		0	48	
	3.7	25	13	95		0	40	
	5.2	35	0	86		0	35	
NWPC Standard Preservative No. 1	1.3	9.3	5	49		0	30	
Untreated		100		1		45	100	5.9

The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1992.

Simlångsdalen



Sørkedalen

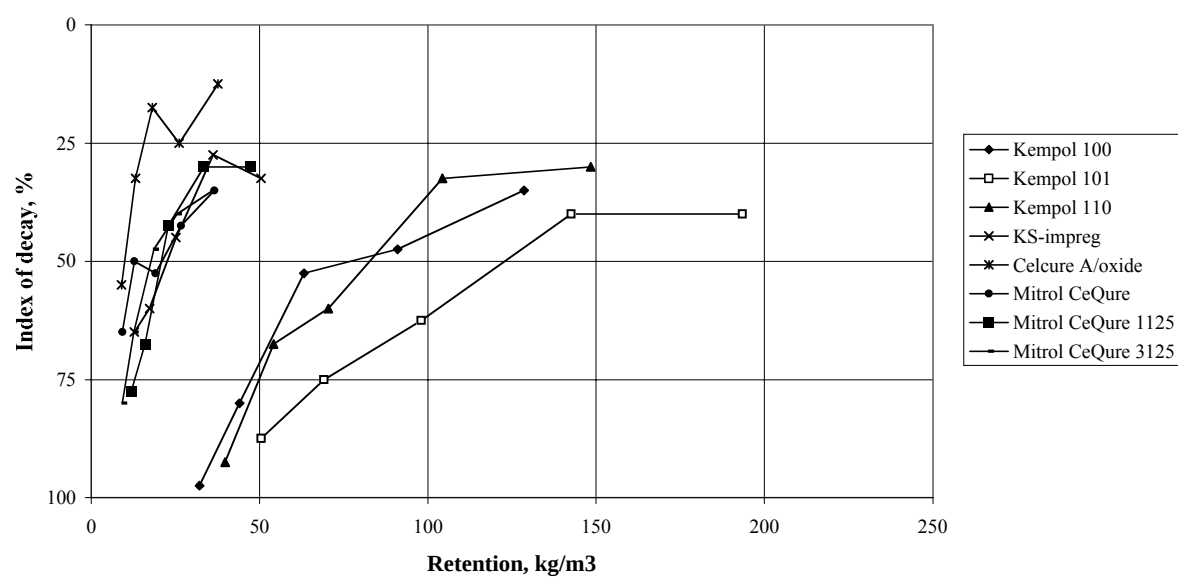


Figure 18. Index of decay in relation to retention after 15 years.

Field trial 1985

The preservative of the 1985 trial and its chemical formulation is presented in Table 34. For every retention level of preservative tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Tåstrup. In 1992 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 14 years' testing is shown in Table 35 and index of decay in relation to retention after 14 years in Figure 19. The rate of decay for stakes with various retentions of preservative is shown in Figures 151 of the Appendix.

Table 34. NWPC Field trial 1985. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Kemira KCP	CuO	14.8	Cu	11.8	Kemira Oy
	CrO ₃	26.6	Cr	13.8	
	P ₂ O ₅	21.0	P	9.2	
	H ₂ O	37.6			
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

* Manufacturer that originally ordered the test.

Table 35 NWPC Field trial 1985. Results after 5 and 14 years testing

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Tåstrup (Denmark)		
			5	14	$\bar{x}$	5	14	$\bar{x}$
Kemira KCP	1	7.1	21	98		15	73	
	1.4	10	9	73		5	53	
	2	14	6	48		0	28	
	2.8	20	1	11		0	0	
	4	29	0	5		0	0	
NWPC Standard Preservative No. 1	1.3	9.4	0	34		3	19	

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1992.

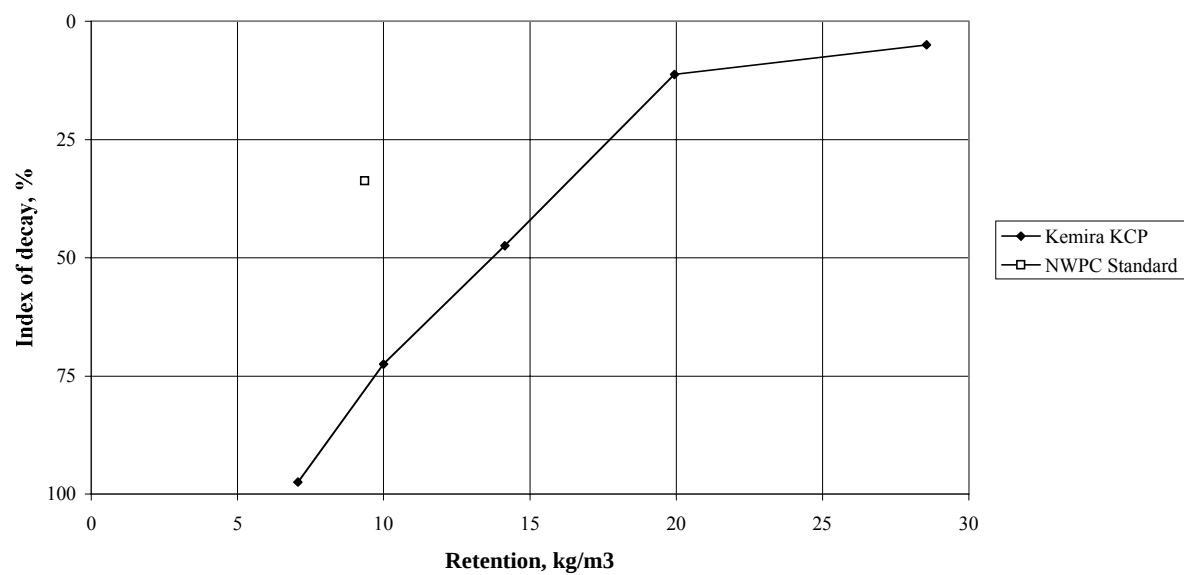
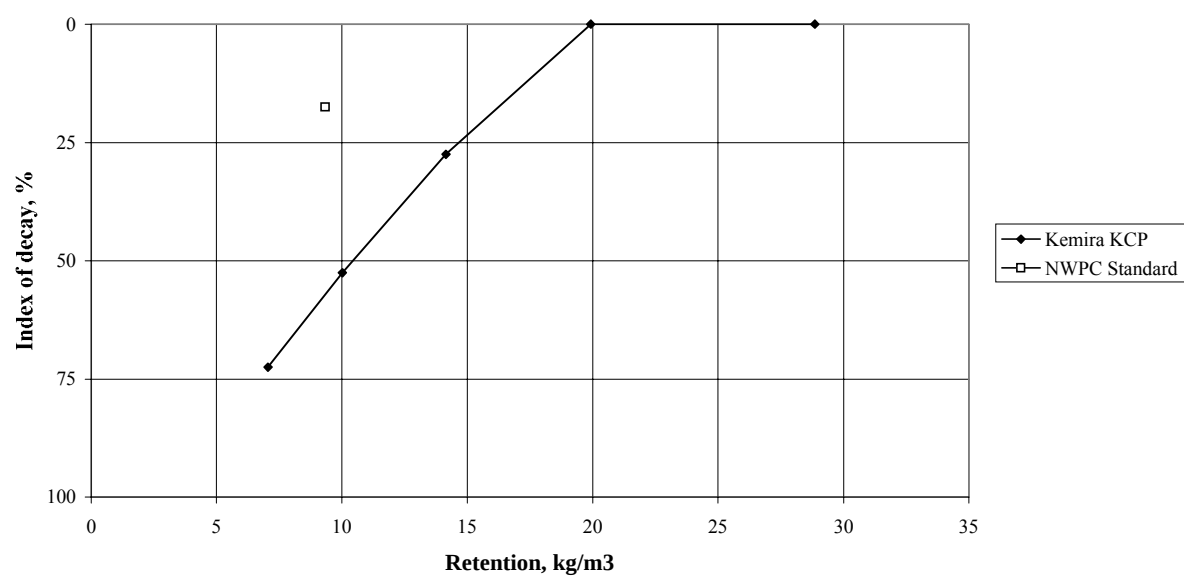
Simlångsdalen**Tåstrup**

Figure 19. Index of decay in relation to retention after 14 years.

Field trial 1986

The preservative of the 1986 trial and its chemical formulation is presented in Table 36. For every retention level of preservative tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Sørkedalen. In this trial the new stake size, 25 x 50 x 500 mm was introduced as well as two concentrations of referens preservative. In 1992 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The treatment of the stakes was carried out by a Norwegian company according to a special process for treating spruce. Treated European redwood was used as reference material.

The index of decay after 5 and 13 years' testing is shown in Table 37. The rate of decay for stakes with various retentions of preservative is shown in Figures 152 - 155 of the Appendix.

Table 36. NWPC Field trial 1986. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Tanalith CCA oxide B	CuO	14.8	Cu	11.8	—
	CrO ₃	26.6	Cr	13.8	
	As ₂ O ₅	34.0	As	22.2	
	H ₂ O	24.6			
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

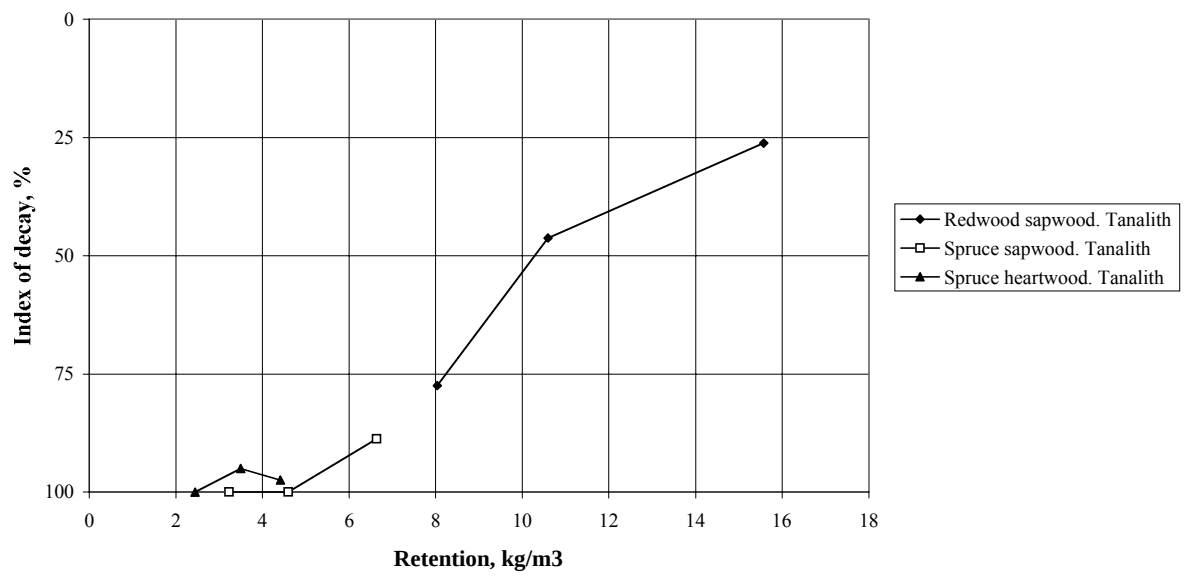
* Manufacturer that originally ordered the test.

Table 37. NWPC Field trial 1986. Results after 5 and 13 years testing

Wood preservative	Concentration %m/m	Retention kg/m ³	Index of decay and average life($\bar{x}$)					
			Simlångsdalen (Sweden)*			Sørkedalen (Norway)		
			Year	Year	Year	Year	Year	Year
			5	13	$\bar{x}$	5	13	$\bar{x}$
EUROPEAN REDWOOD								
SAPWOOD								
Tanalith CCA oxide B	1.4	8.1	23	78		5	40	
	2	11	6	46		3	30	
	2.8	16	3	26		0	25	
NWPC Standard Preservative No. 1	1.3	8.3	5	19		0	25	
	0.3	2.0	65	100	5.4	8	58	
Untreated			100		1.5	80	100	5.7
SPRUCE SAPWOOD								
Tanalith CCA oxide B	1.4	3.1	28	100	7.8	10	93	
	2	4.9	16	100	9	3	80	
	2.8	6.8	8	89		3	60	
Untreated			100		1.7	38	100	8.1
SPRUCE HEARTWOOD								
Tanalith CCA oxide B	1.4	2.7	33	100	7.5	13	93	
	2	3.4	14	95		0	75	
	2.8	4.7	9	98		0	75	
Untreated			100		2.8	38	98	

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1992.

Simlångsdalen



Sørkedalen

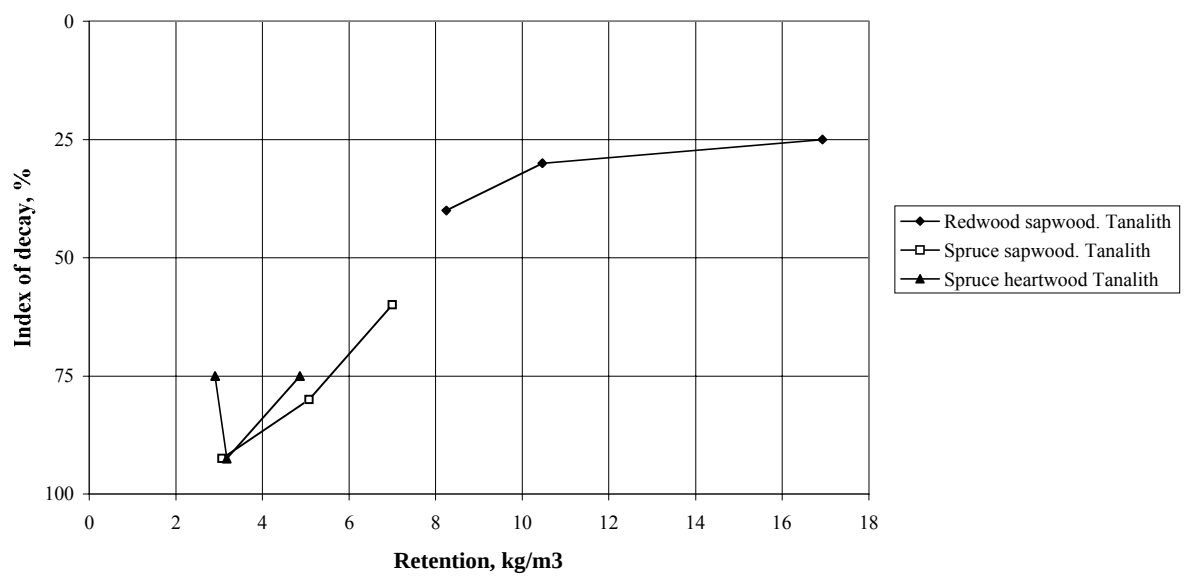


Figure 20. Index of decay in relation to retention after 13 years

Field trial 1987

In the 1987 trial treatment with combinations of copper and modified lignin are tested at the fields in Simlångsdalen and Viikki. The formulations are listed in Table 38.

The Lignin-Cu treatment was carried out according to a two step process, where the stakes were treated with lignin solution, dried and then with a copper solution, while the KLS-Cu treatment was carried out in a one step process.

For every combination of copper and lignin, 20 stakes were set out at Simlångsdalen and 10 stakes at Viikki. In 1993 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 12 years' testing is shown in Table 37 and index of decay in relation to retention after 12 years in Figure 21. The rate of decay for stakes with various retentions of preservative is shown in Figures 156 - 158 of the Appendix.

Table 38. NWPC Field trial 1987. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Lignin - Cu SO ₄ **	Modified lignin	10	Lignin	10	Holmens Bruk AB
	CuSO ₄	25	Cu	10	
KLS -1.5M Cu***	Modified lignin + CuSO ₄	6.0			Holmens Bruk AB
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	

* Manufacturer that originally ordered the test.

** Two step process

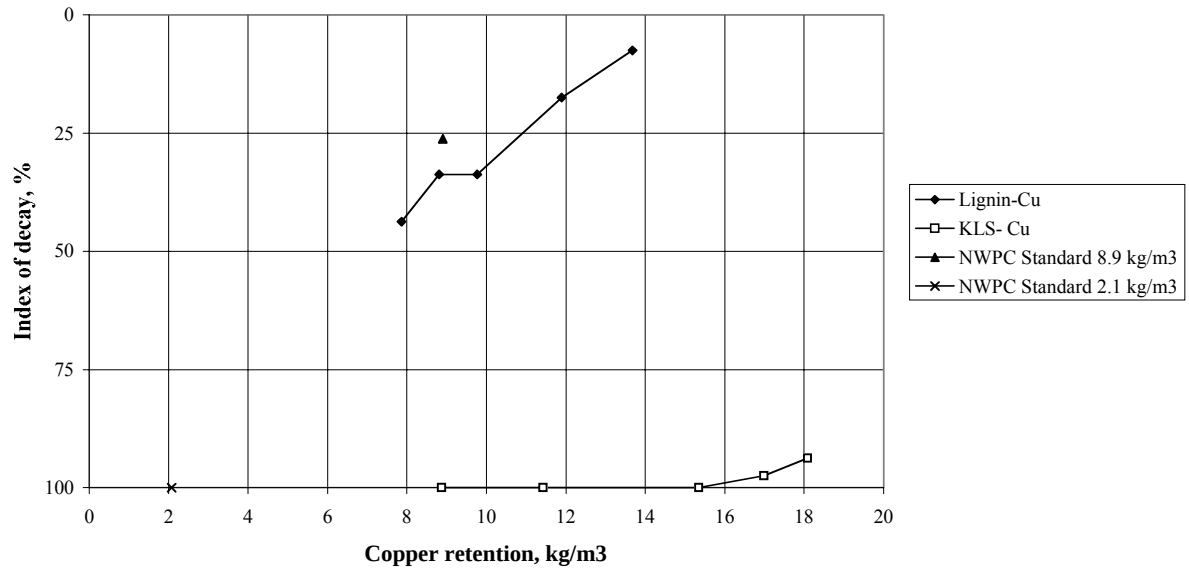
*** One step process

Table 39. NWPC Field trial 1987. Results after 5 and 12 years testing

Wood preservative	Concentration % m/m	Retention kg/m ³	Index of decay and average life($\bar{X}$)					
			Simlångsdalen (Sweden)*			Viikki (Finland)		
			Year			Year		
			5	12	$\bar{X}$	5	12	$\bar{X}$
Lignin - CuSO ₄	1.4 + 1.15	10 + 7.9	14	44		35	80	
	2.1 + 1.3	15 + 8.8	9	34		33	83	
	3.0 + 1.5	19 + 10	8	34		35	78	
	4.2 + 1.8	28 + 12	1	18		35	78	
	6.0 + 2.2	36 + 14	3	7.5		20	73	
KLS + 1.5M Cu	1.3	8.9	69	100	5.6	85	100	5.9
	1.8	11	61	100	6.8	65	95	
	2.5	15	43	100	8.7	63	98	
	3.6	17	36	98		48	93	
	5.0	18	40	94		40	95	
NWPC Standard Preservative No. 1	1.3	8.9	8	26		3	38	
	0.3	2.1	61	100	6	50	98	
Untreated			98	100	2.9	98	100	2.8

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1993

Simlångsdalen



Viikki

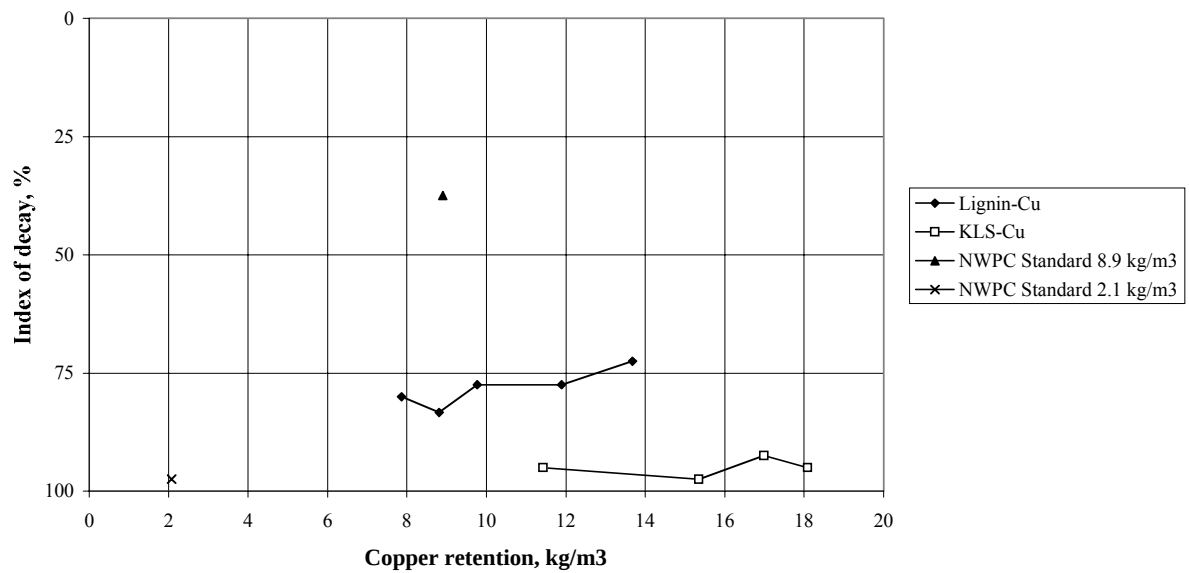


Figure 21. Index of decay in relation to retention after 12 years.

Field trial 1988

Two preservatives were tested in the 1988 trial and their chemical formulations are listed in Table 40. For every retention level of preservative tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Viikki. In 1994 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 11 years' testing is shown in Table 41 and index of decay in relation to retention after 11 years in Figure 22. The rate of decay for stakes with various retentions of preservative is shown in Figures 159 - 161 of the Appendix.

A comparison of the preservatives using the medial concentration show that Cuprinol Tryck 86 give a better protection both at Simlångsdalen and at Viikki than Test product F.

Table 40. NWPC Field trial 1988. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Cuprinol Tryck 86	coppertetraamindi-hydrogencarbonate	38.0-44.0	Cu	9.5	Keno Gard VT
	Bensalkoniumchloride	4.8	BAC	4.8	
	H ₂ O	51.2-57.2			
Test product F	Di-(N-cyclohexyl-diazenium-dioxy) copper (Cu-HDO)	12.5	(Cu-HDO)	12.5	–
	H ₃ BO ₃	6.25	H ₃ BO ₃	6.25	
	H ₂ O				
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	
EN Ref., CCA	CuSO ₄ ·5H ₂ O	35	Cu	9	
	K ₂ Cr ₂ O ₇	45	Cr	16	
	As ₂ O ₅ ·2H ₂ O	20	As	11	

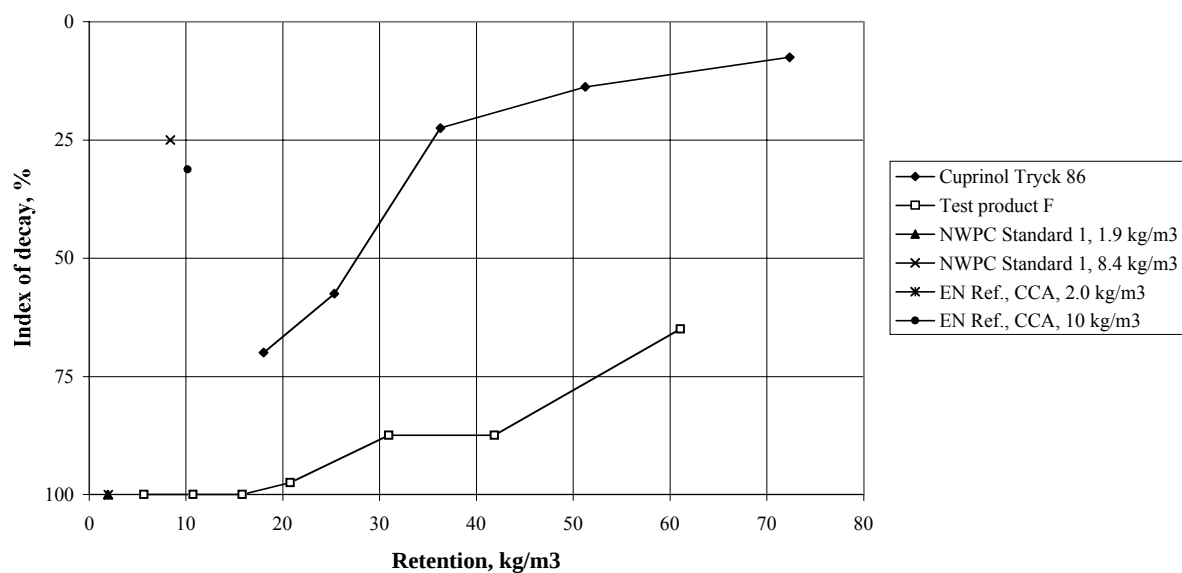
* Manufacturer that originally ordered the test.

Table 41 NWPC Field trial 1988. Results after 5 and 11 years testing

Wood preservative	Concentration %m/m	Retention kg/m ³	Index of decay and average life($\bar{X}$)					
			Simlångsdalen (Sweden)*			Viikki (Finland)		
			Year	Year	$\bar{X}$	Year	Year	$\bar{X}$
			5	11		5	11	
Cuprinol tryck 86	2.5	18	61	70		10	60	
	3.5	25	44	58		25	58	
	5.0	36	11	23		10	23	
	7.0	51	5	14		13	23	
	10	72	3	7.5		8	13	
Test product F	0.8	5.7	100	100	4.1	74	100	6.7
	1.5	11	71	100	6.4	58	100	8.3
	2.3	16	66	100	7.1	54	96	
	3.1	21	53	98		50	85	
	4.6	31	49	88		53	79	
	6.2	42	51	88		51	76	
	9.2	61	38	65		46	69	
NWPC Standard Preservative No. 1	0.3	1.9	93	100	4.7	63	92	
	1.3	8.6	14	25		23	48	
EN Ref., CCA	0.3	2.0	94	100	3.9	65	98	
	1.5	10	15	31		20	25	
Untreated			100		2.1	100	100	4.1

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1994.

Simlångsdalen



Viikki

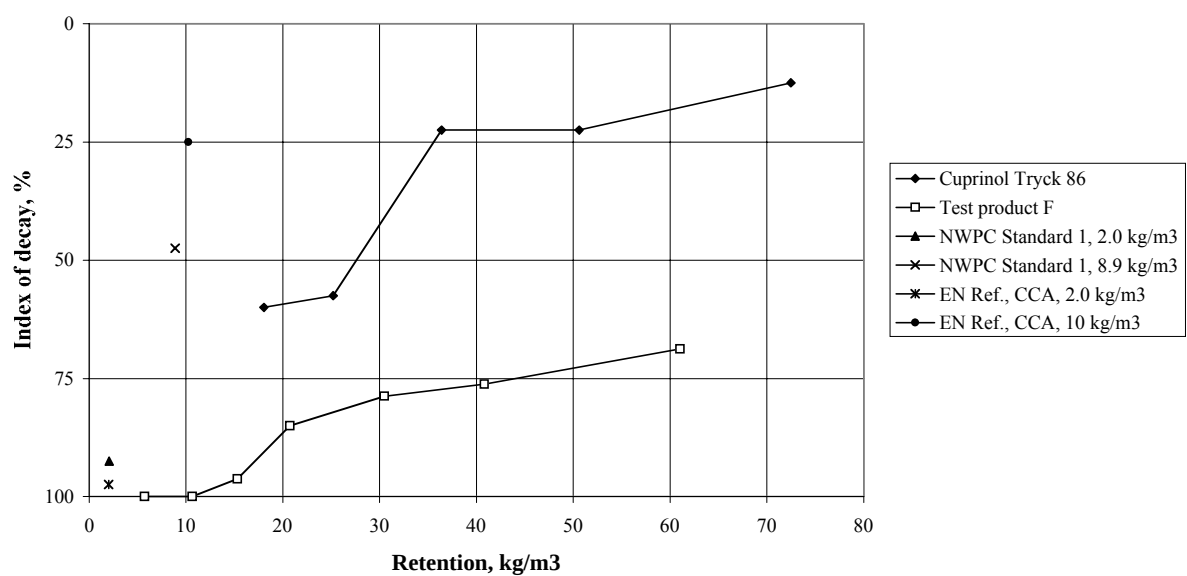


Figure 22. Index of decay in relation to retention after 11 years.

Field trial 1989

The preservatives of the 1989 trial and their chemical formulations are listed in Table 42 and index of decay in relation to retention after 10 years in figure 23. For every retention level of preservative tested, 20 stakes were set out at Simlångsdalen and 10 stakes at Tåstrup. In 1995 remaining stakes at Simlångsdalen old field were moved to Simlångsdalen new field.

The index of decay after 5 and 10 years' testing is shown in Table 43. The rate of decay for stakes with various retentions of preservative is shown in Figures 162 - 165 of the Appendix.

Table 42. NWPC Field trial 1989. Preservatives tested and their chemical formulation.

Wood preservative	Chemical formulation % m/m		Active components % m/m		Manufacturer*
Test product G (Creosote, WEI type B)					–
Creosote, WEI type B					–
Test product H	(NH ₄) ₂ Cr ₂ O ₇	63.0	Cr	26.0	–
	CuSiF ₆	17.3	Cu	4.0	
	ZnSiF ₆	19.7	Zn	4.1	
			F	14.2	
Tanalith 3418	Cu ₃ (BO ₃) ₂	13.8	Cu	8.5	Hickson Timber Products Ltd.
	NH ₃	8.57	B	2.9	
	H ₂ O	77.63			
NWPC Standard Preservative No. 1	CuO	19.0	Cu	15.2	
	CrO ₃	36.0	Cr	18.7	
	As ₂ O ₅	45.0	As	29.3	
EN Ref., CCA	CuSO ₄ ·5H ₂ O	35	Cu	9	
	K ₂ Cr ₂ O ₇	45	Cr	16	
	As ₂ O ₅ ·2H ₂ O	20	As	11	

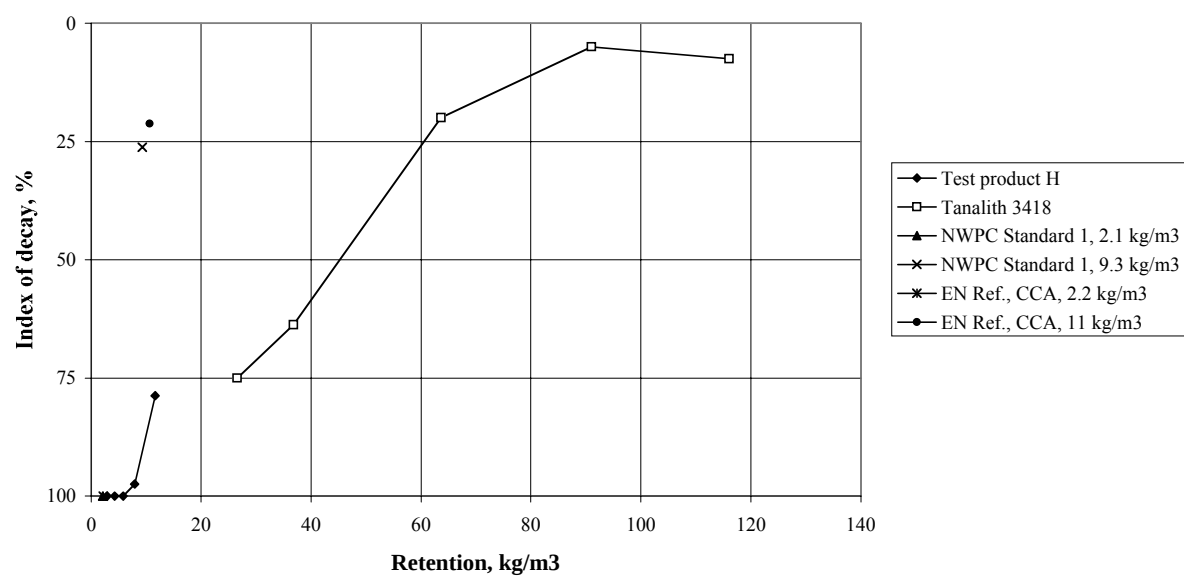
* Manufacturer that originally ordered the test.

Table 43. NWPC Field trial 1989. Results after 5 and 10 years testing

Wood preservative	Concentration %m/m	Retention kg/m ³	Index of decay and average life ($\bar{x}$)					
			Simlångsdalen (Sweden)*			Tåstrup (Denmark)		
			Year	Year	$\bar{x}$	Year	Year	$\bar{x}$
			5	10		5	10	
Test product G		142	8	49		18	53	
Creosote WEI type B		134	0	33		10	50	
Test product H	0.4	2.9	100		1.9	100		4.2
	0.6	4.3	100		2.5	68	100	6.7
	0.8	5.8	95		3.8	43	93	
	1.1	7.9	76	98		18	50	
	1.6	12	45	79		0	25	
Tanalith 3418	3.7	27	41	75		5	45	
	5.1	37	34	64		20	43	
	8.8	64	9	20		0	15	
	12	91	0	5		13	28	
	16	116	3	8		0	0	
NWPC Standard Preservative No. 1	0.3	2.1	74	100	5.4	40	95	
	1.3	9.3	23	26		3	8	
EN Ref., CCA	0.3	2.2	99	100	3.2	80	100	5.9
	1.5	11	16	21		5	10	
Untreated			100		1.4			

* The stakes were moved from Simlångsdalen old field to Simlångsdalen new field in 1995.

Simlångsdalen



Tåstrup

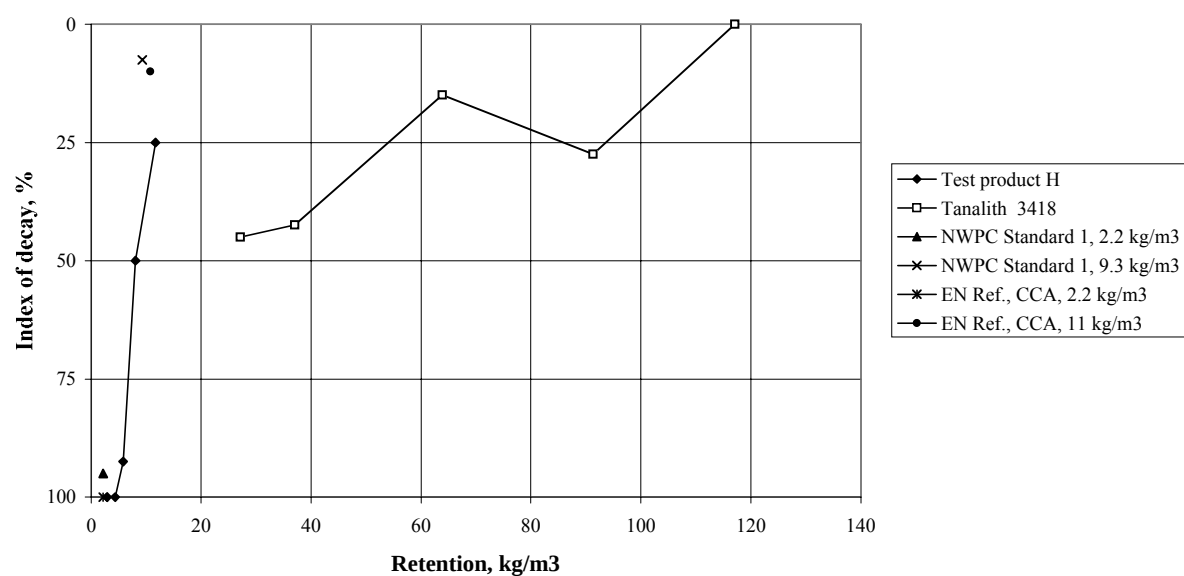


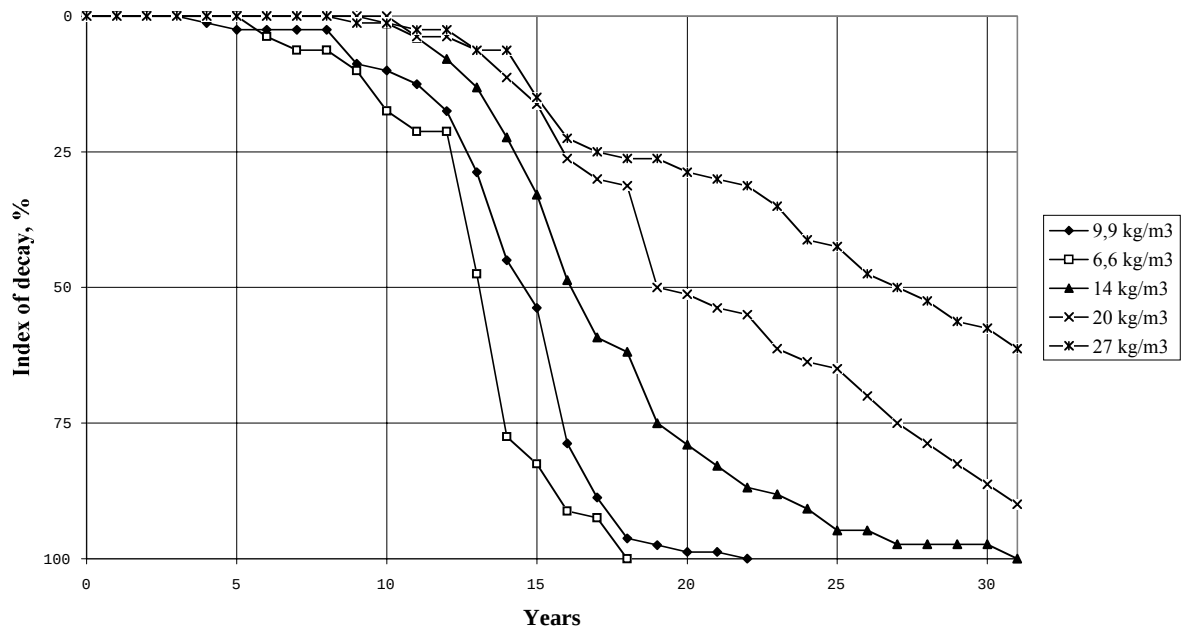
Figure 23. Index of decay in relation to retention after 10 years.

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APPENDIX

Simlångsdalen. Eur redwood. Basilit CFK



Hillerød/Tåstrup. Eur redwood. Basilit CFK

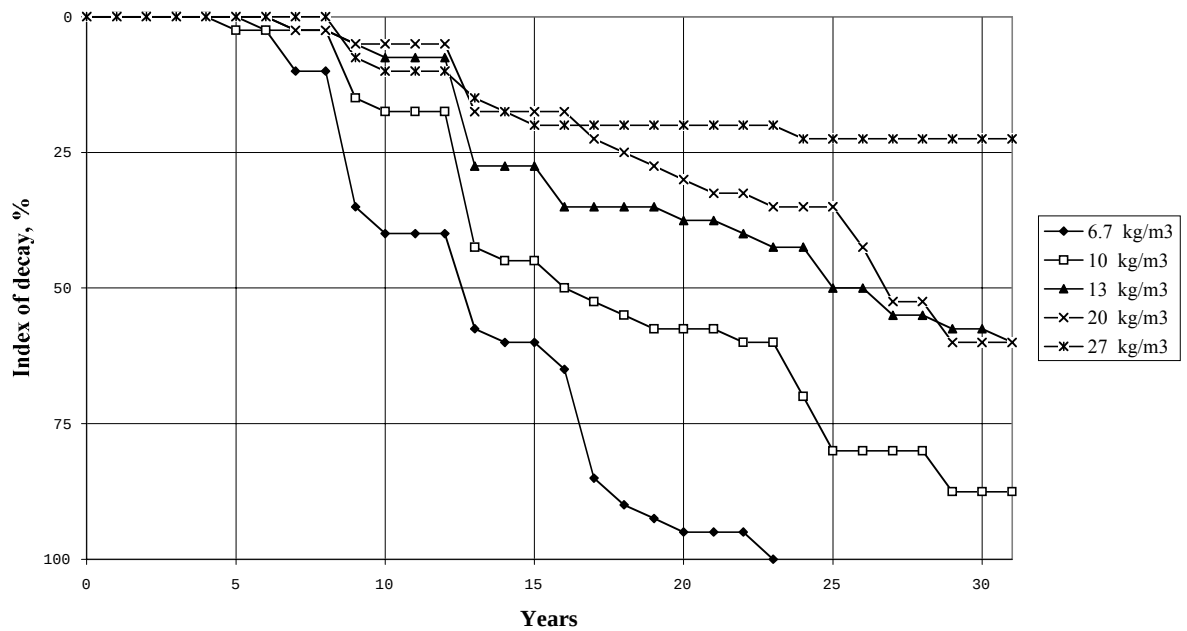
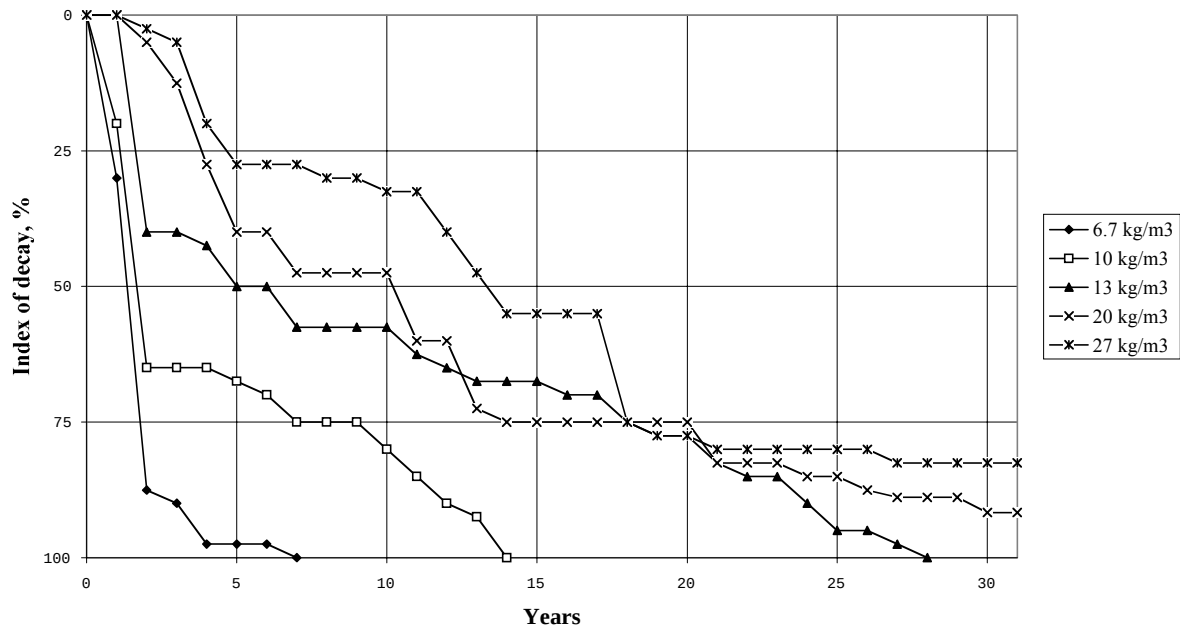


Figure 24. Field trial 1968. Rate of decay for stakes of European redwood treated with Basilit CFK.

Vaasa/Viikki. Eur redwood. Basilit CFK



Sørkedalen. Eur redwood. Basilit CFK

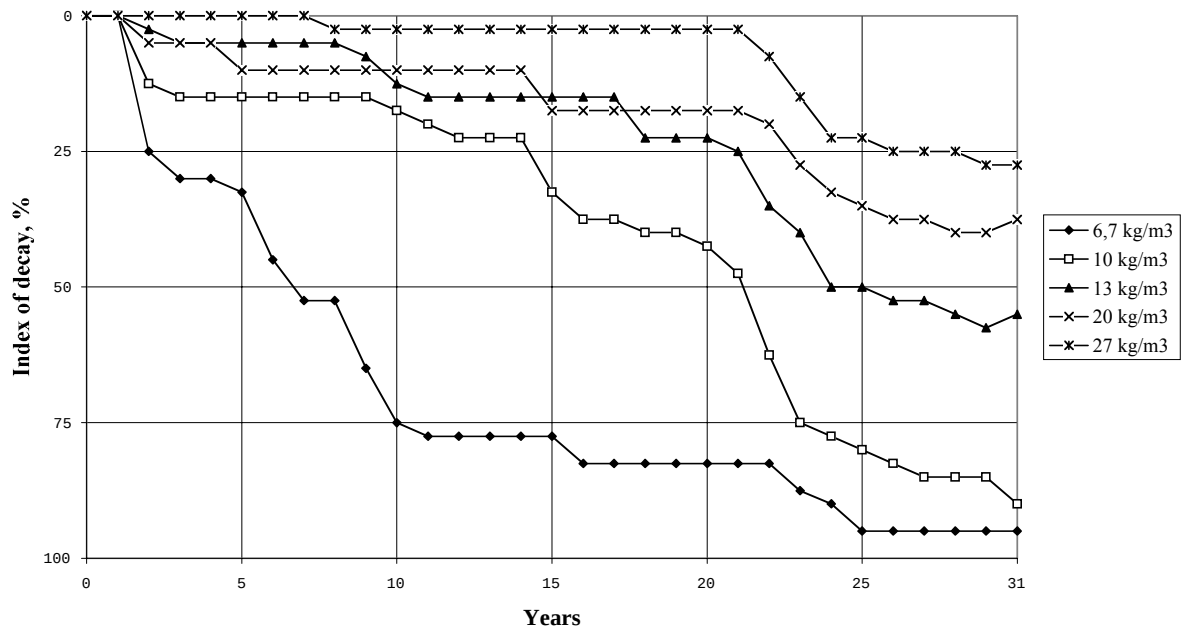
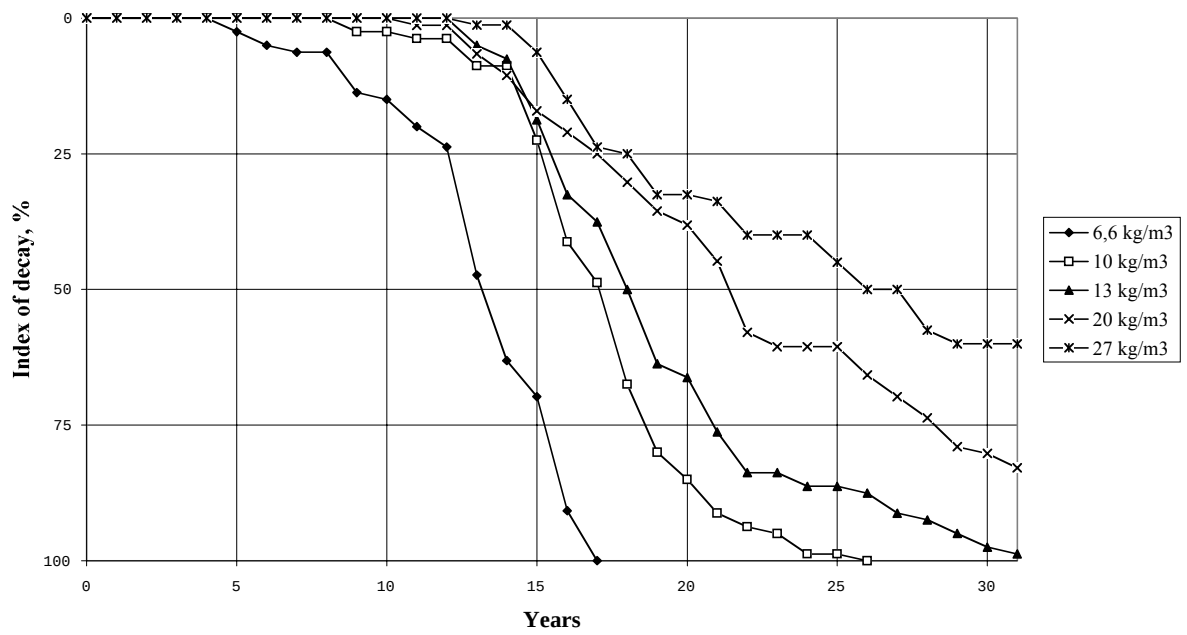


Figure 25. Field trial 1968. Rate of decay for stakes of European redwood treated with Basilit CFK.

Simlångsdalen. Eur redwood. Boliden K33



Hillerød/Tåstrup. Eur redwood. Boliden K33

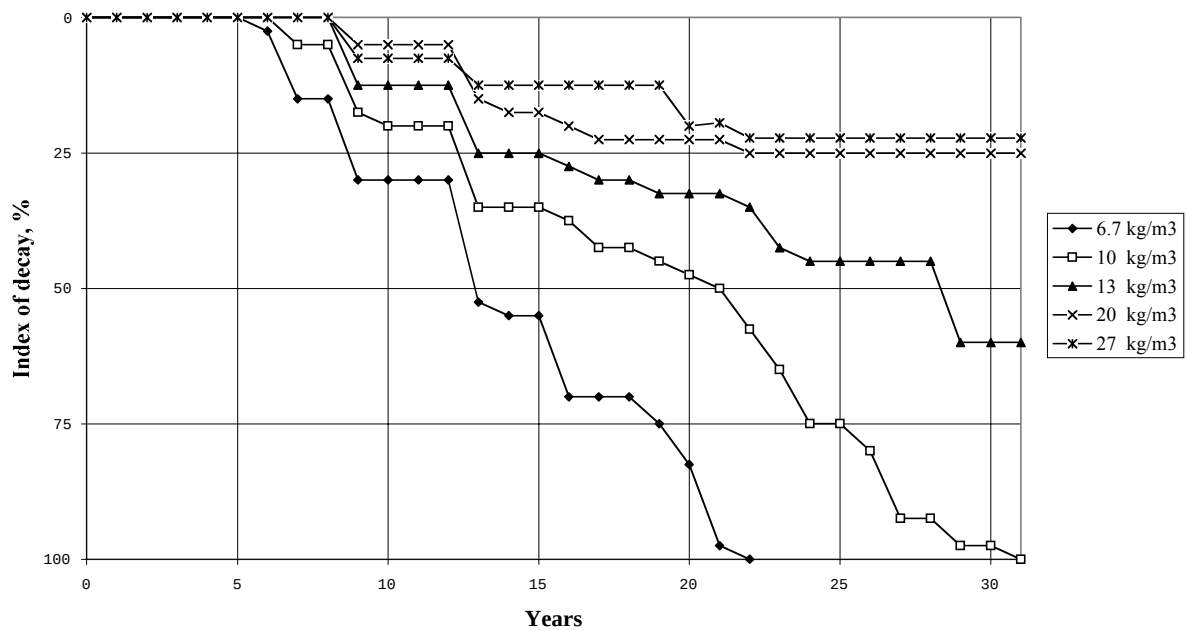
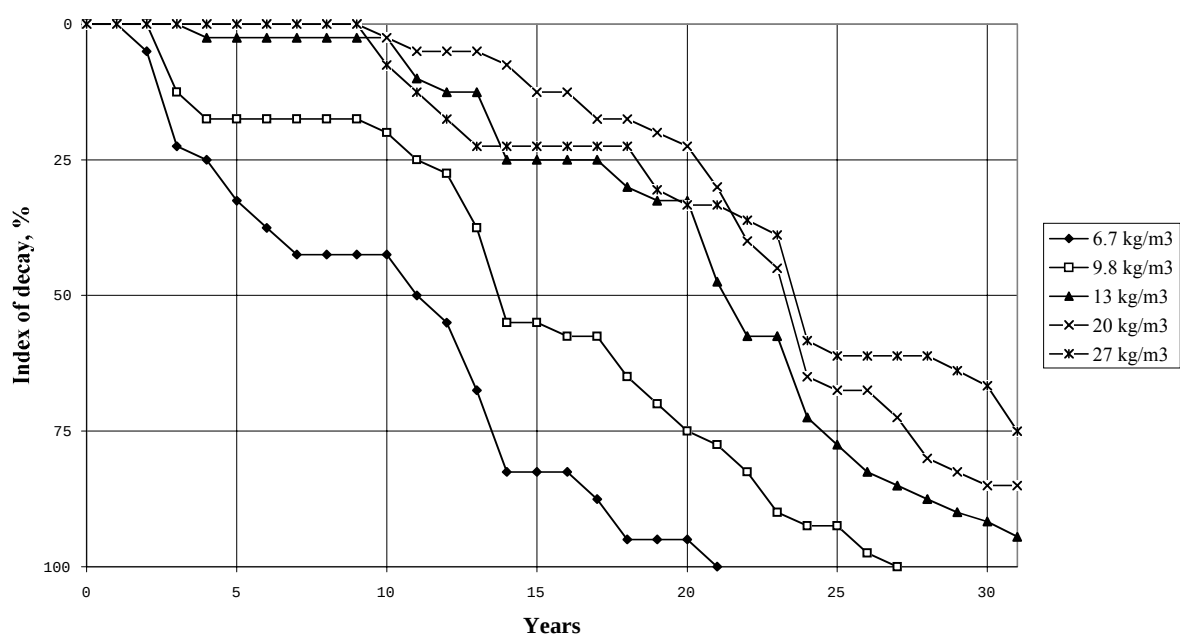


Figure 26. Field trial 1968. Rate of decay for stakes of European redwood treated with Boliden K 33.

Vaasa/Viikki. Eur redwood. Boliden K33



Sørkedalen. Eur redwood. Boliden K33

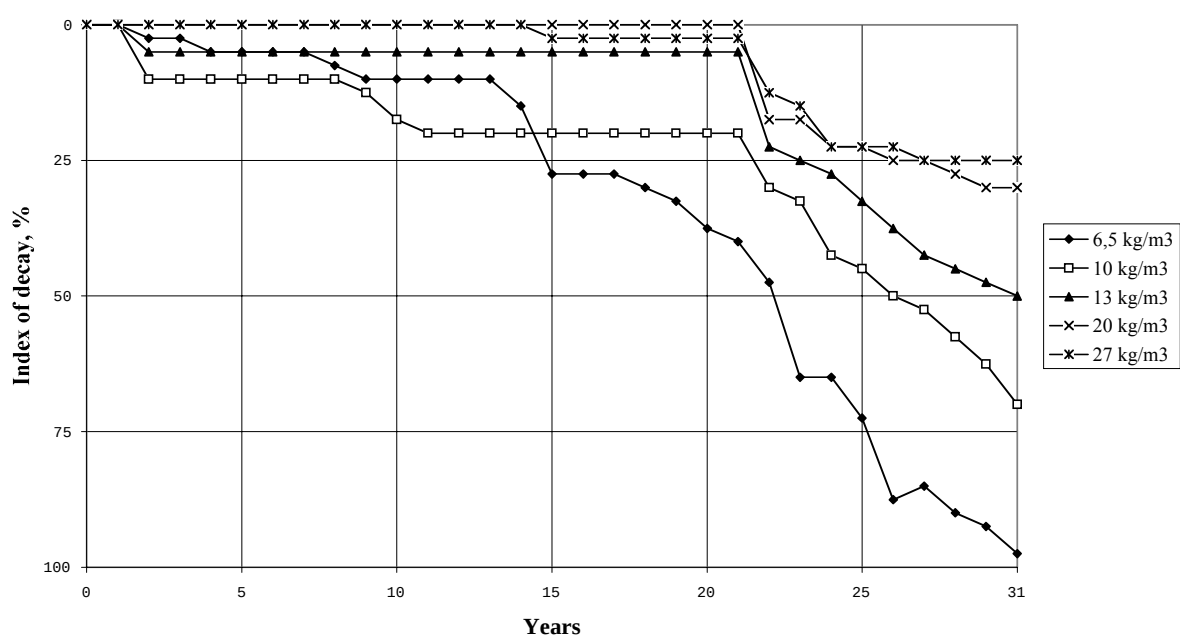
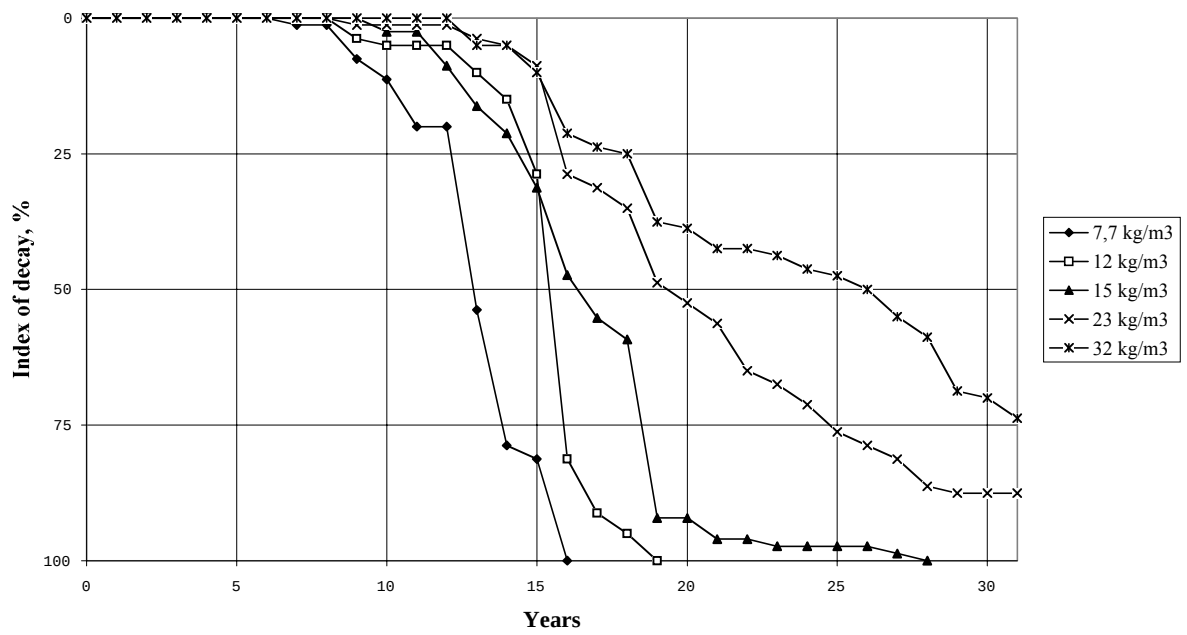


Figure 27. Field trial 1968. Rate of decay for stakes of European redwood treated with Boliden K33.

Simlångsdalen. Eur redwood. Celcure A



Hillerød/Tåstrup. Eur redwood. Celcure A

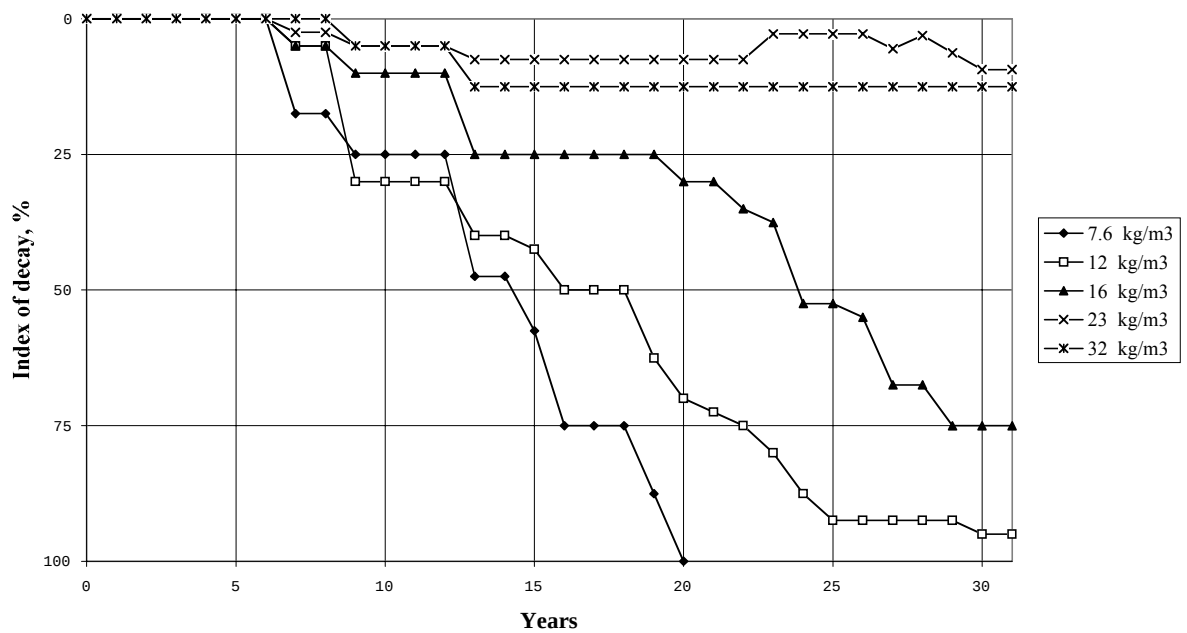
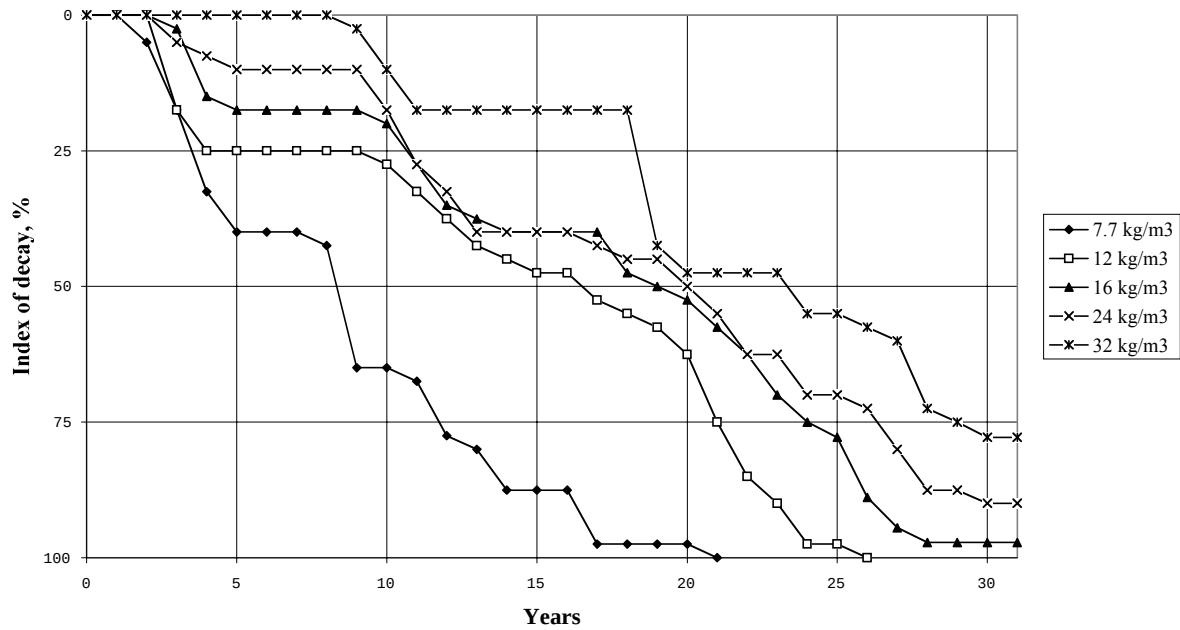


Figure 28. Field trial 1968. Rate of decay for stakes of European redwood treated with Celcure A.

Vaasa/Viikki. Eur redwood. Celcure A



Sørkedalen. Eur redwood. Celcure A

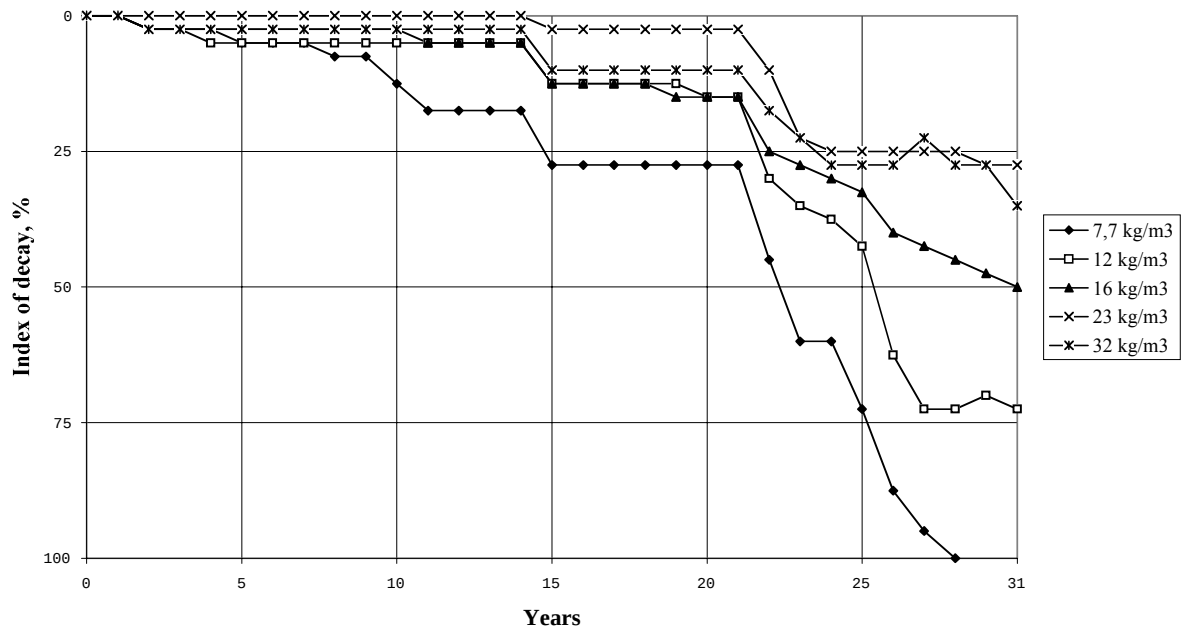
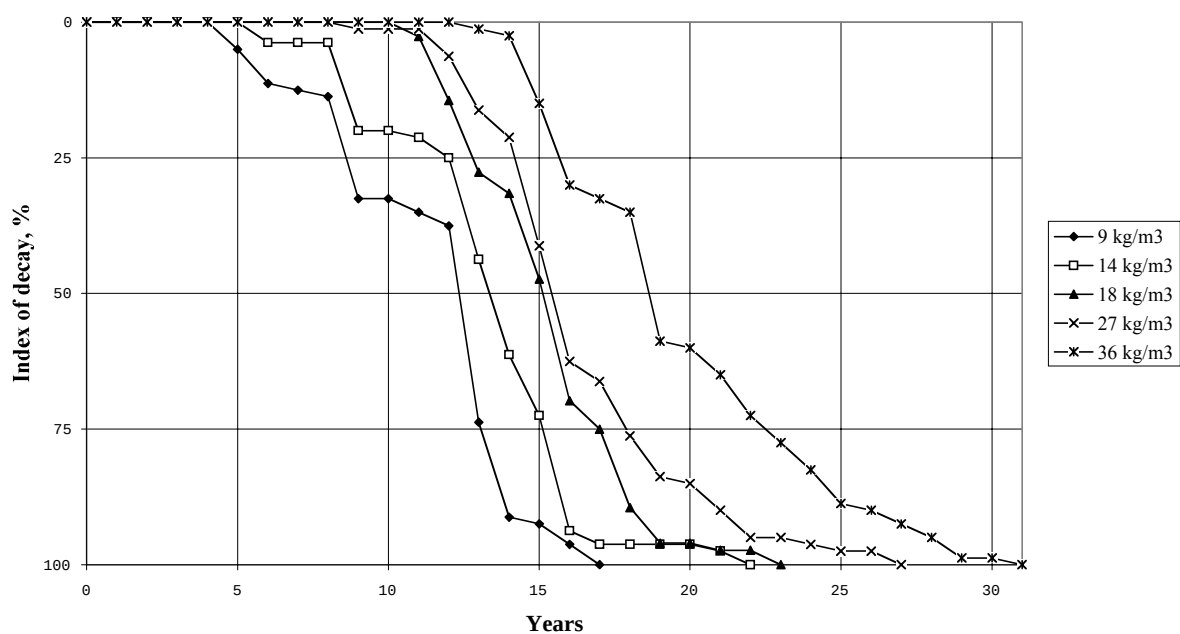


Figure 29. Field trial 1968. Rate of decay for stakes of European redwood treated with Celcure A.

Simlångsdalen. Eur redwood. KP Cuprinol



Hillerød/Tåstrup. Eur redwood. KP Cuprinol

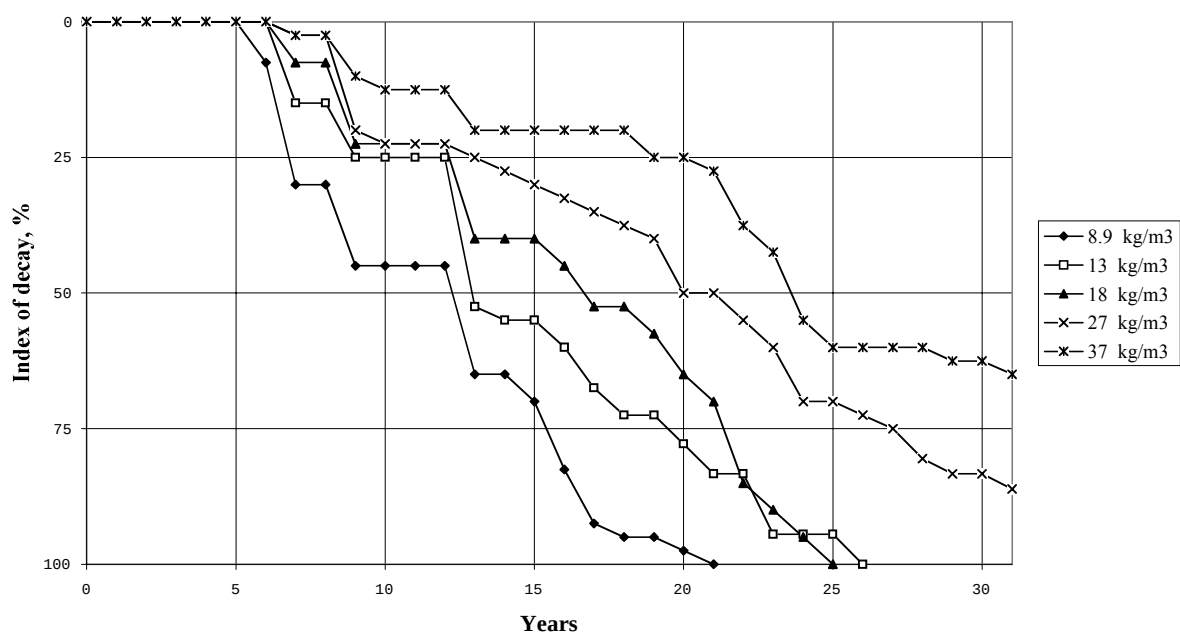
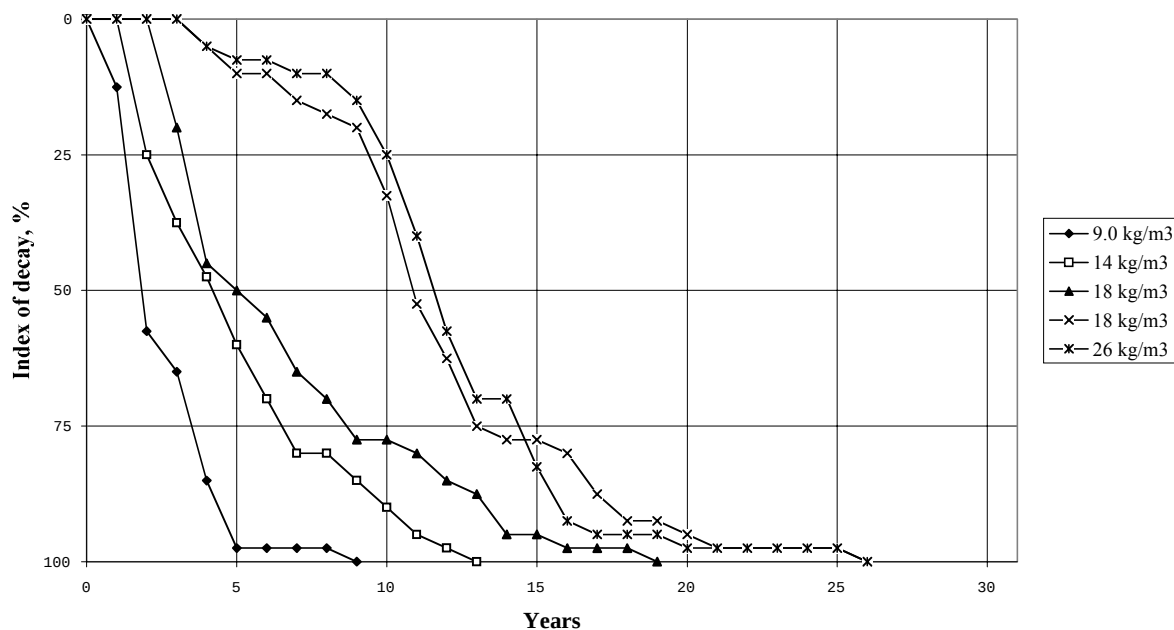


Figure 30. Field trial 1968. Rate of decay for stakes of European redwood treated with KP Cuprinol.

Vaasa/Viikki. Eur redwood. KP Cuprinol



Sørkedalen. Eur redwood. KP Cuprinol

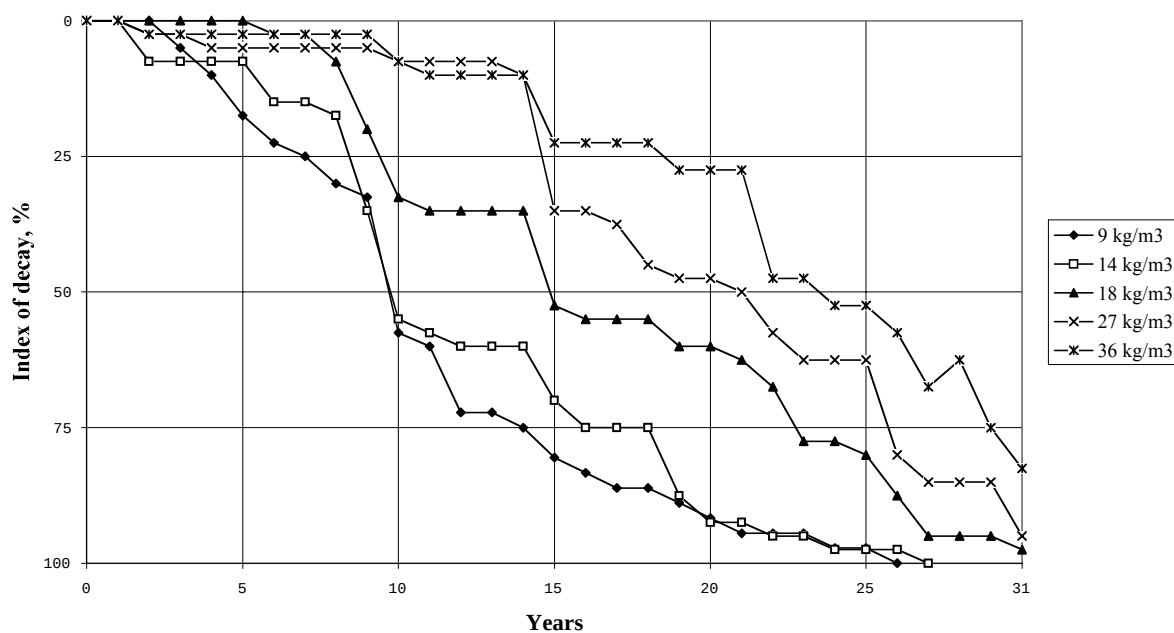
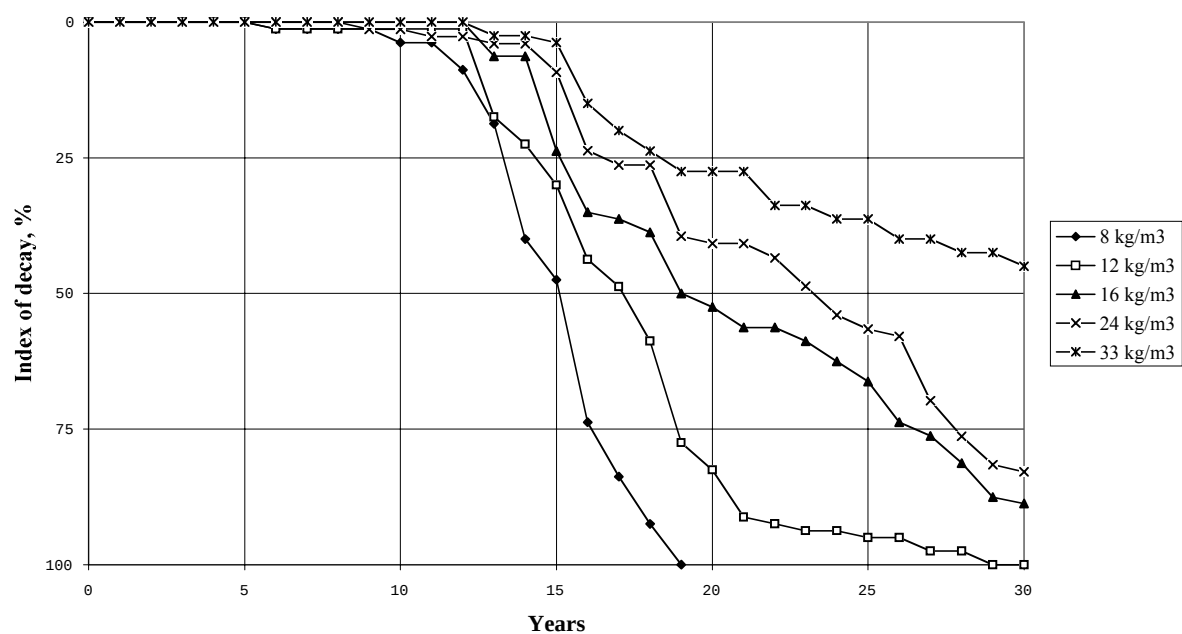


Figure 31. Field trial 1968. Rate of decay for stakes of European redwood treated with KP Cuprinol.

Simlångsdalen. Eur redwood. Tanalith C



Hillerød/Tåstrup. Eur redwood. Tanalith C

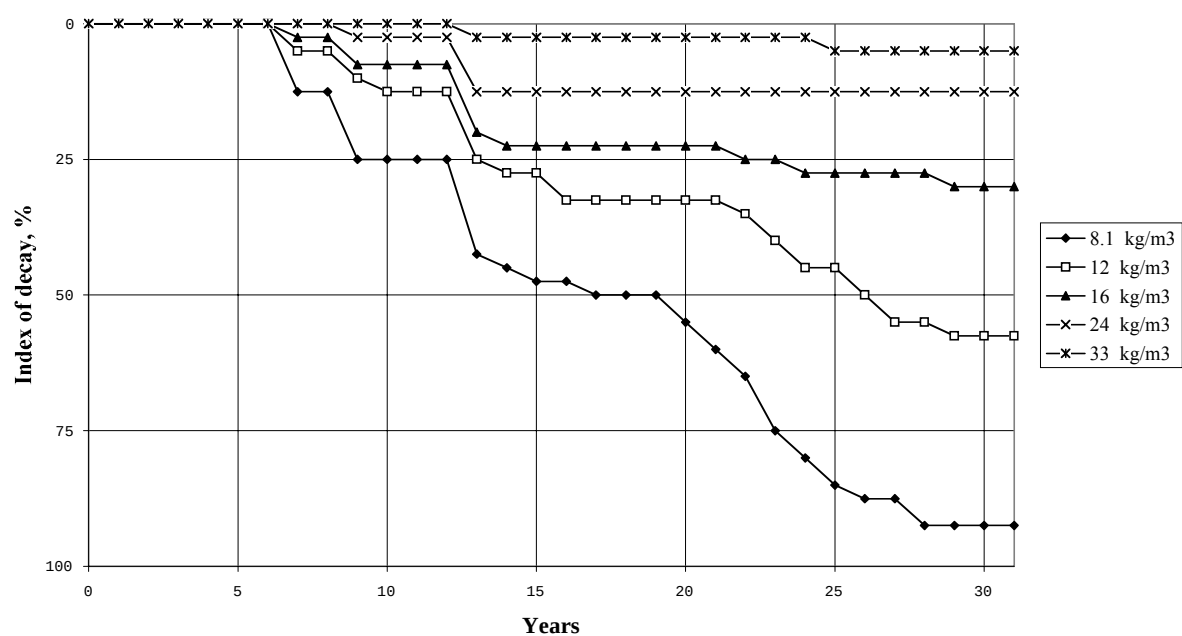
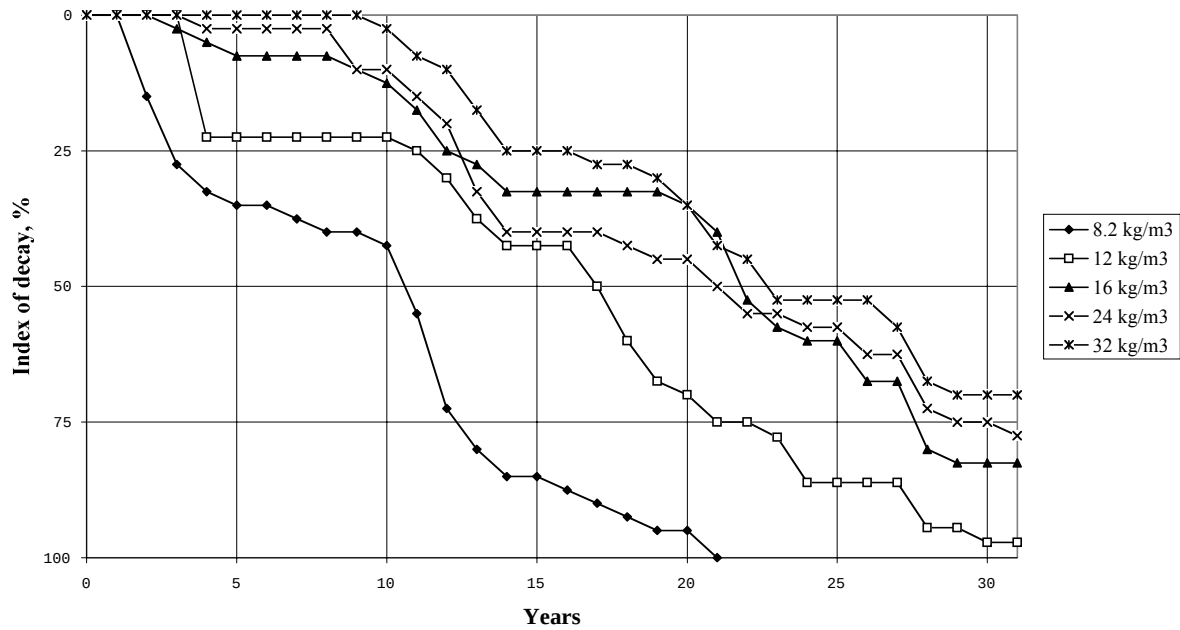


Figure 32. Field trial 1968. Rate of decay for stakes of European redwood treated with Tanalith C.

Vaasa/Viikki. Eur redwood. Tanalith C



Sørkedalen. Eur redwood. Tanalith C

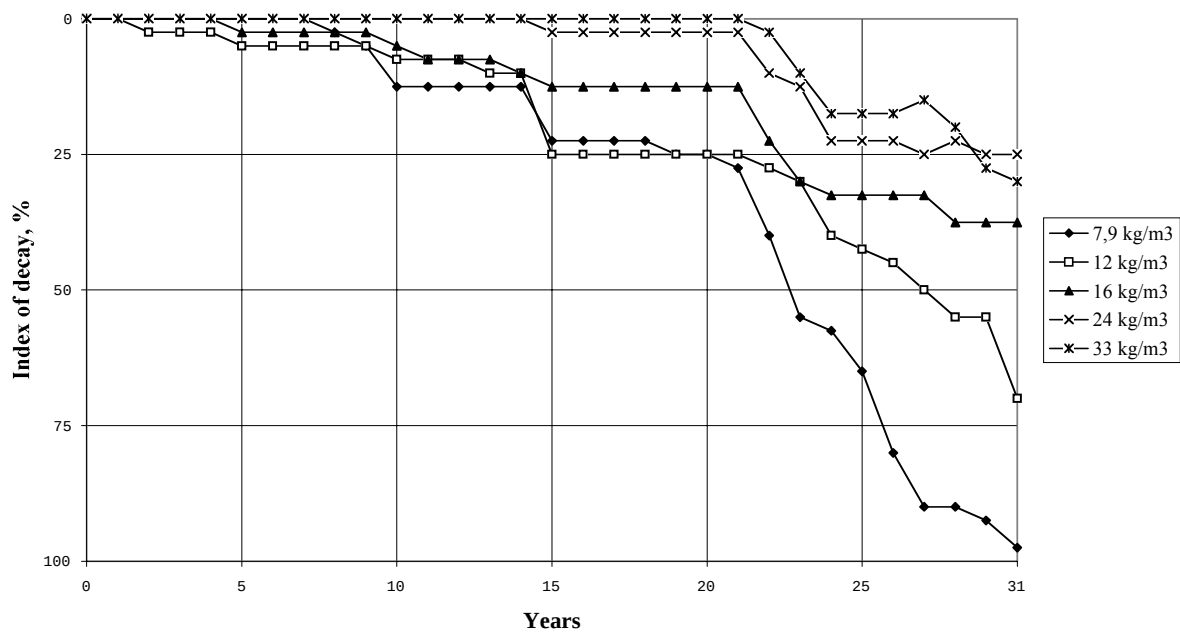


Figure 33. Field trial 1968. Rate of decay for stakes of European redwood treated with Tanalith C.

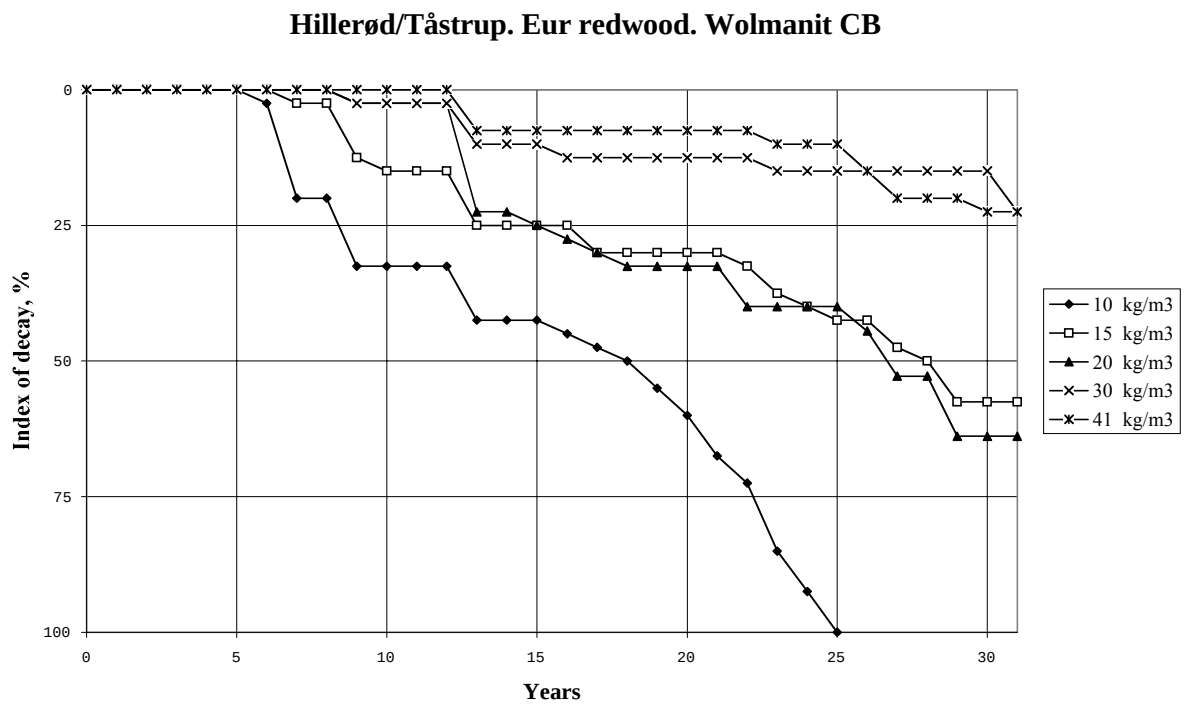
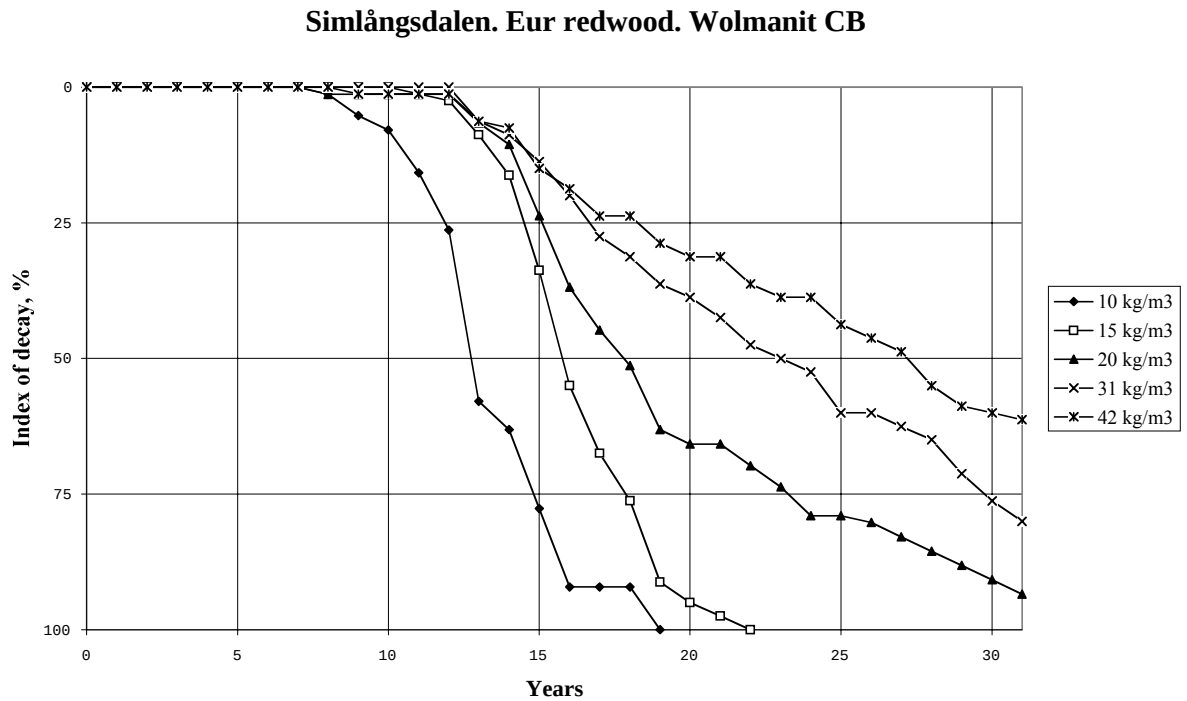
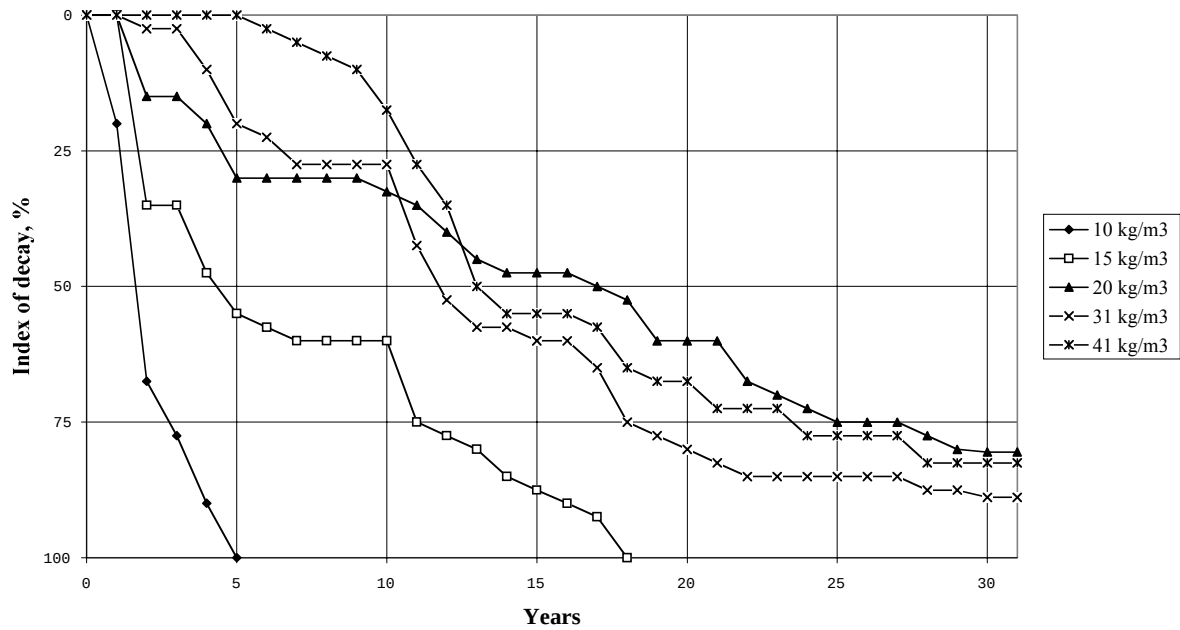


Figure 34. Field trial 1968. Rate of decay for stakes of European redwood treated with Wolmanit CB.

Vaasa/Viikki. Eur redwood. Wolmanit CB



Sørkedalen. Eur redwood. Wolmanit CB

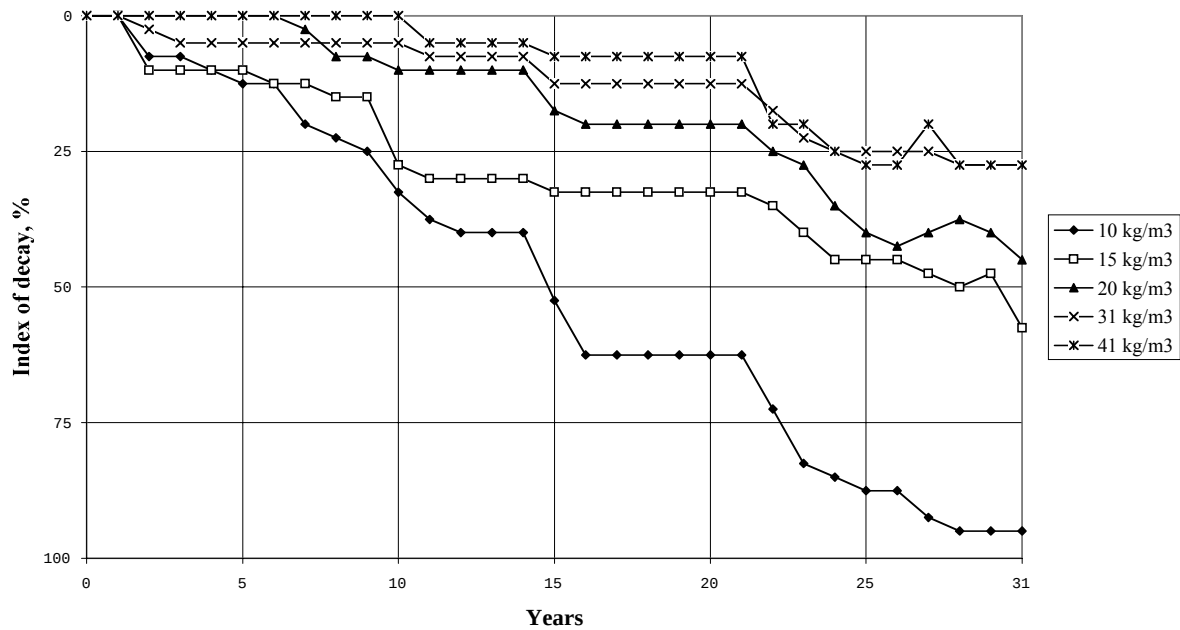
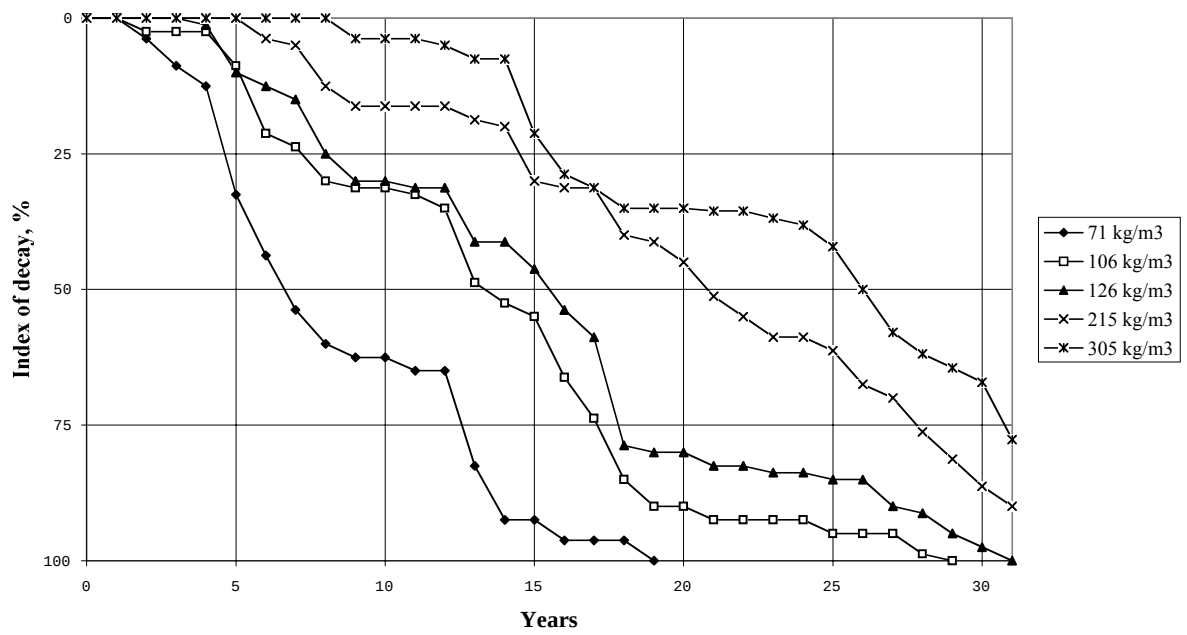


Figure 35. Field trial 1968. Rate of decay for stakes of European redwood treated with Wolmanit CB.

Simlångsdalen. Eur redwood. BP Hylosan



Hillerød/Tåstrup. Eur redwood. BP Hylosan

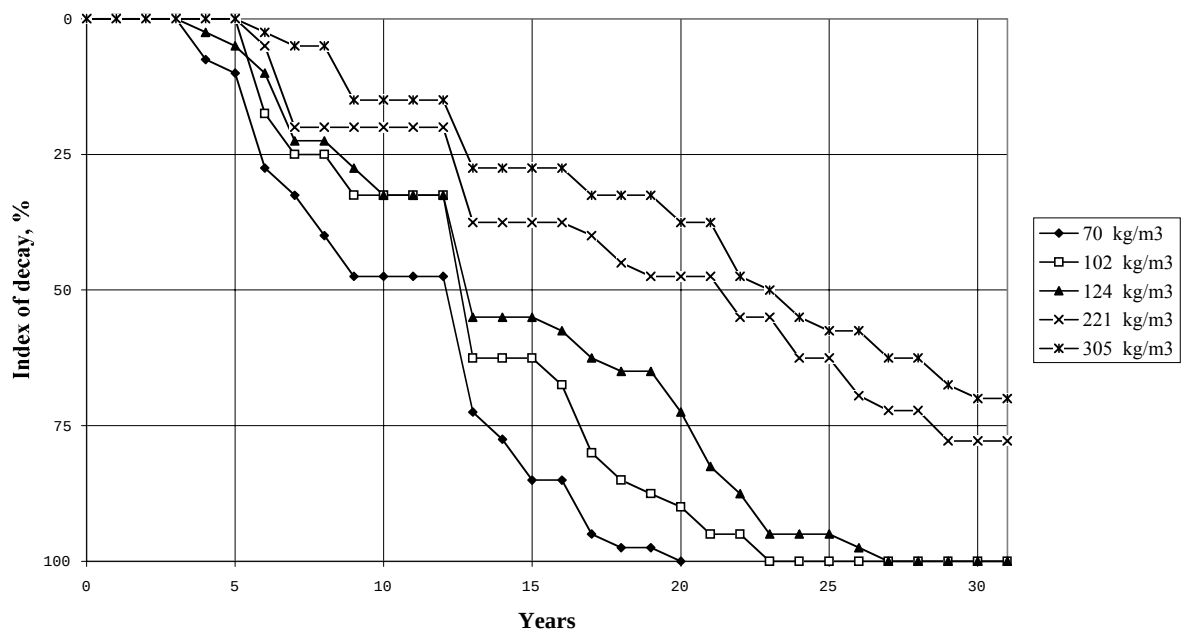
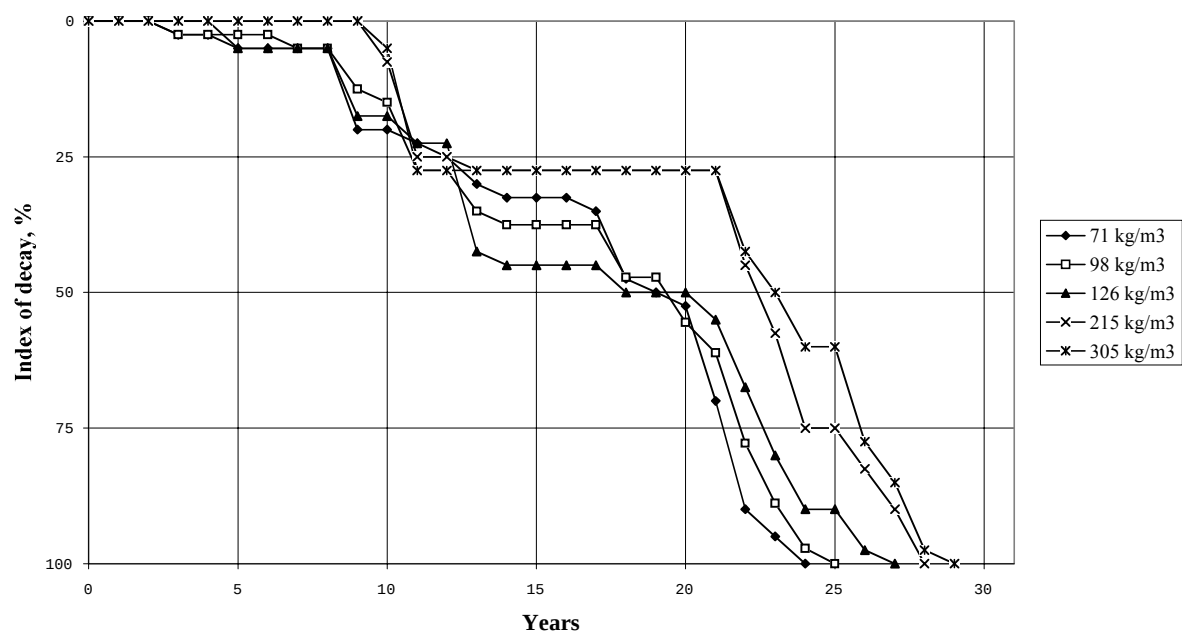


Figure 36. Field trial 1968. Rate of decay for stakes of European redwood treated with BP Hylosan.

Vaasa/Viikki. Eur redwood. BP Hylosan



Sørkedalen. Eur redwood. BP Hylosan

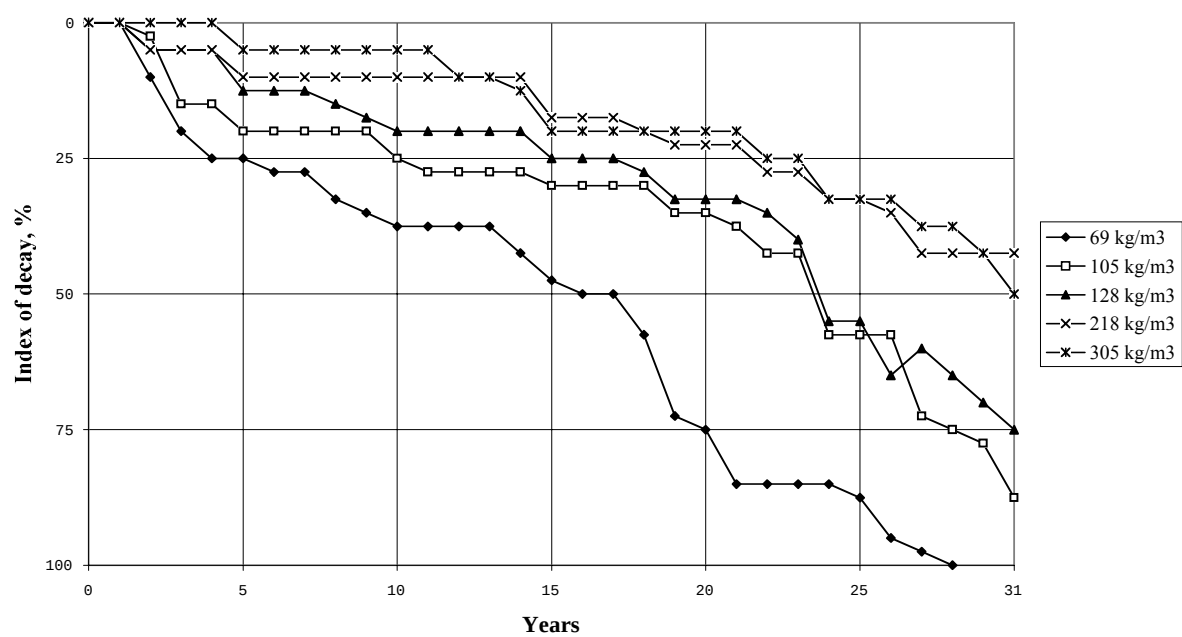
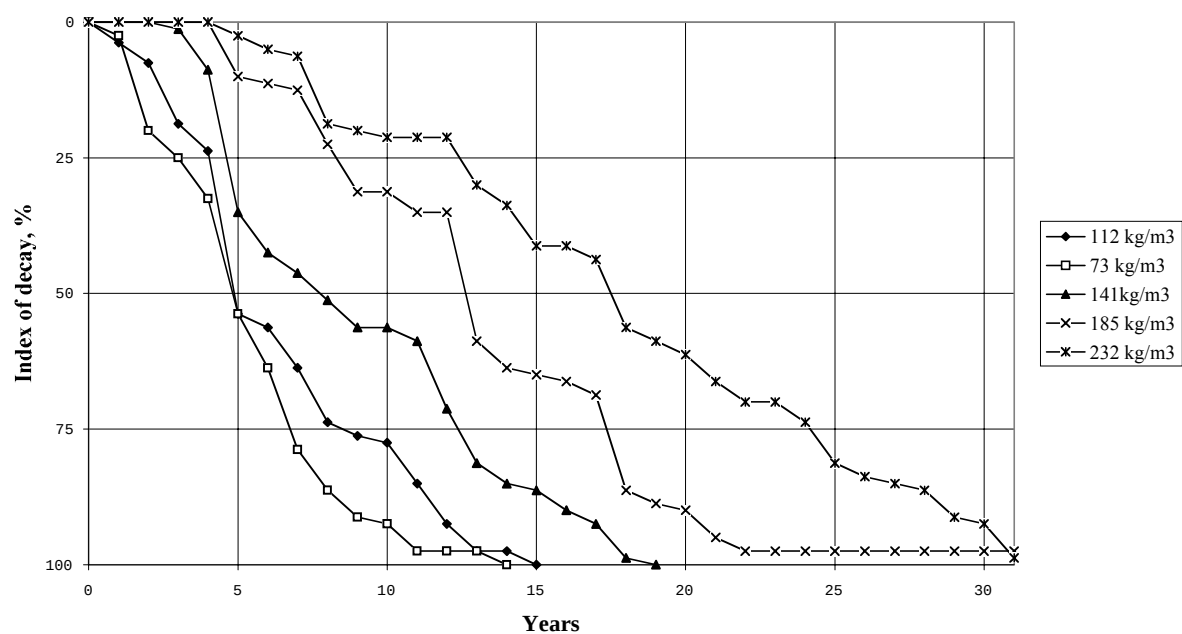


Figure 37. Field trial 1968. Rate of decay for stakes of European redwood treated with BP Hylosan.

Simlångsdalen. Eur redwood. Creosote



Hillerød/Tåstrup. Eur redwood. Creosote

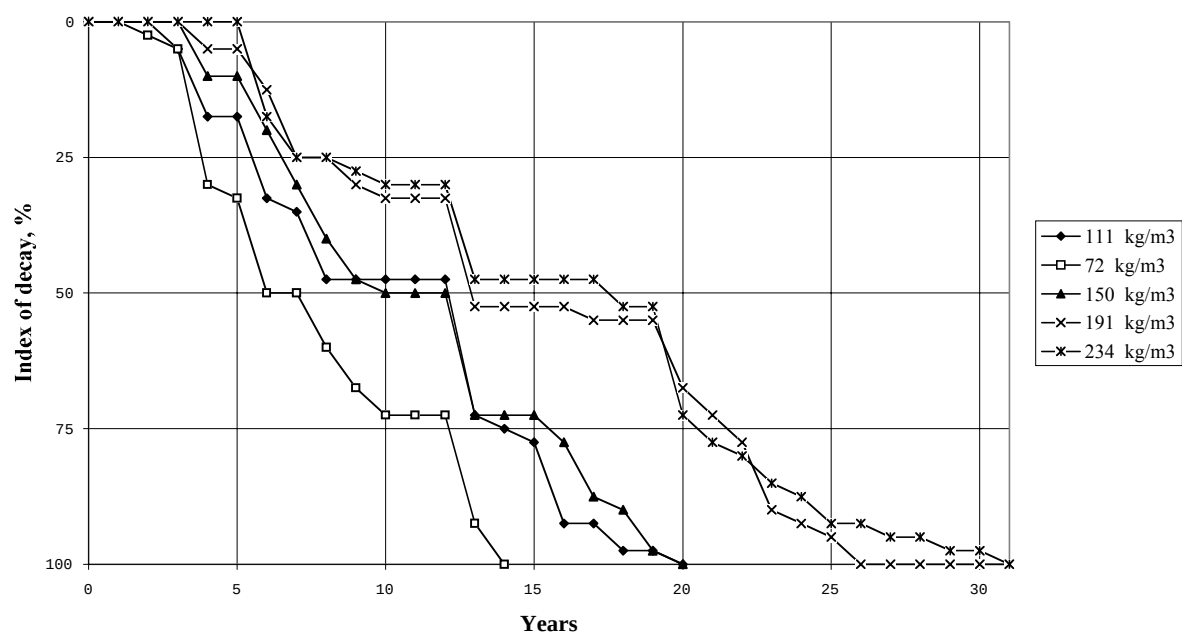
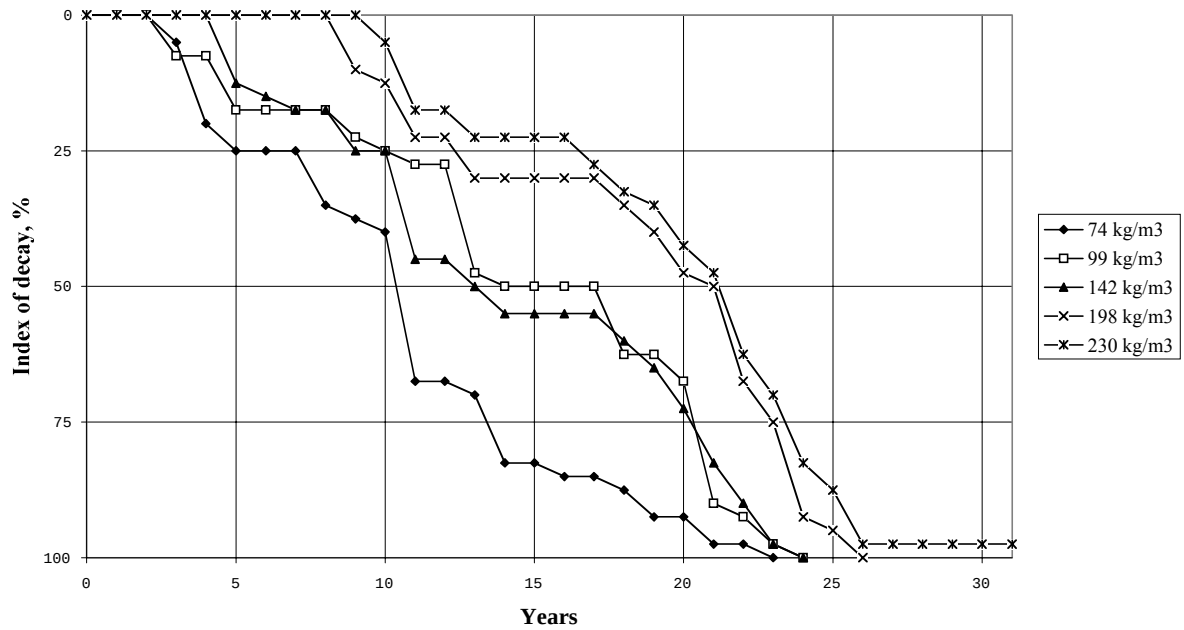


Figure 38. Field trial 1968. Rate of decay for stakes of European redwood treated with creosote.

Vaasa/Viikki. Eur redwood. Creosote



Sørkedalen. Eur redwood. Creosote

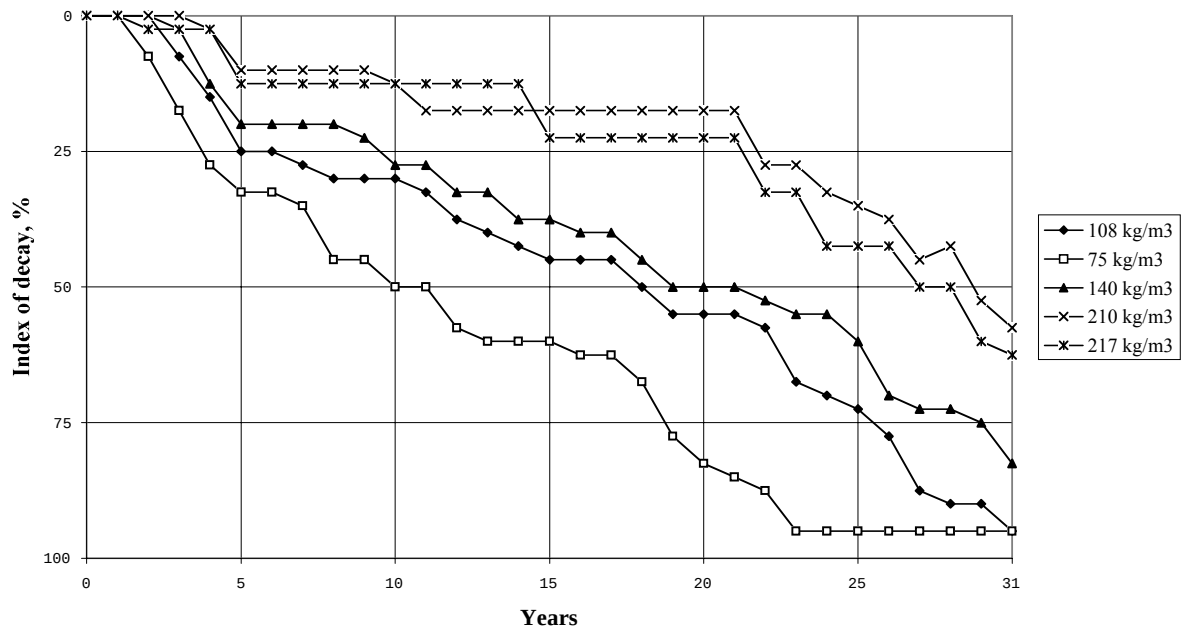


Figure 39. Field trial 1968. Rate of decay for stakes of European redwood treated with creosote.

Simlångsdalen. Eur beech. Basilit CFK

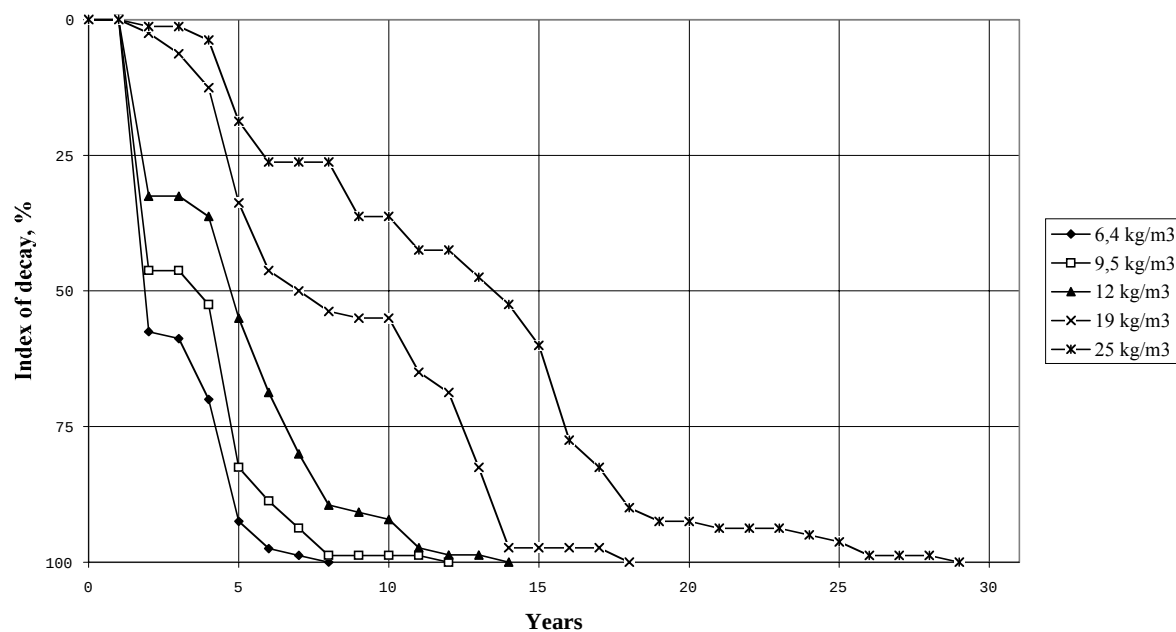


Figure 40. Field trial 1968. Rate of decay for stakes of European beech treated with Basilit.

Simlångsdalen. Eur beech. Boliden K33

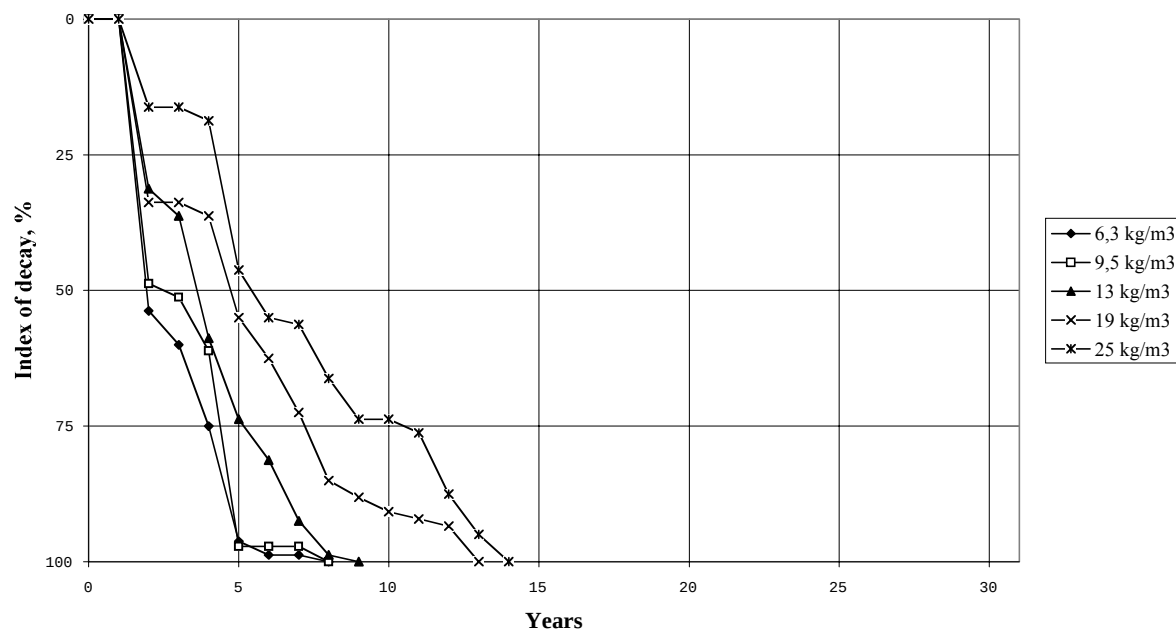


Figure 41. Field trial 1968. Rate of decay for stakes of European beech treated with Boliden K33.

Simlångsdalen. Eur beech. Celcure A

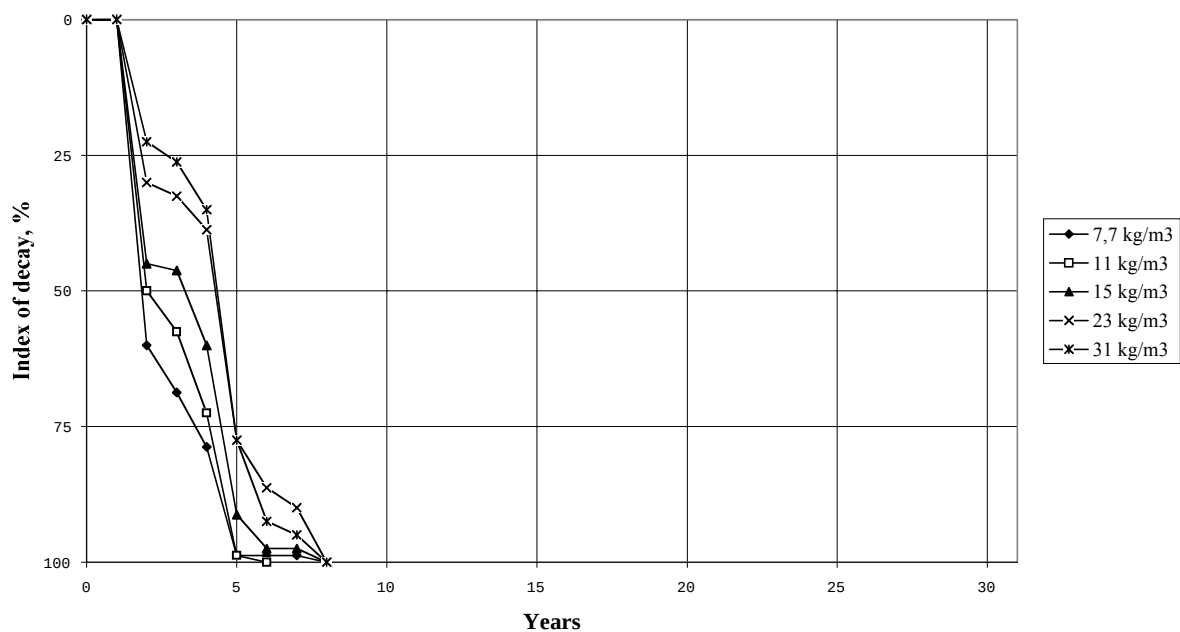


Figure 42. Field trial 1968. Rate of decay for stakes of European beech treated with Celcure A.

Simlångsdalen. Eur beech. KP Cuprinol

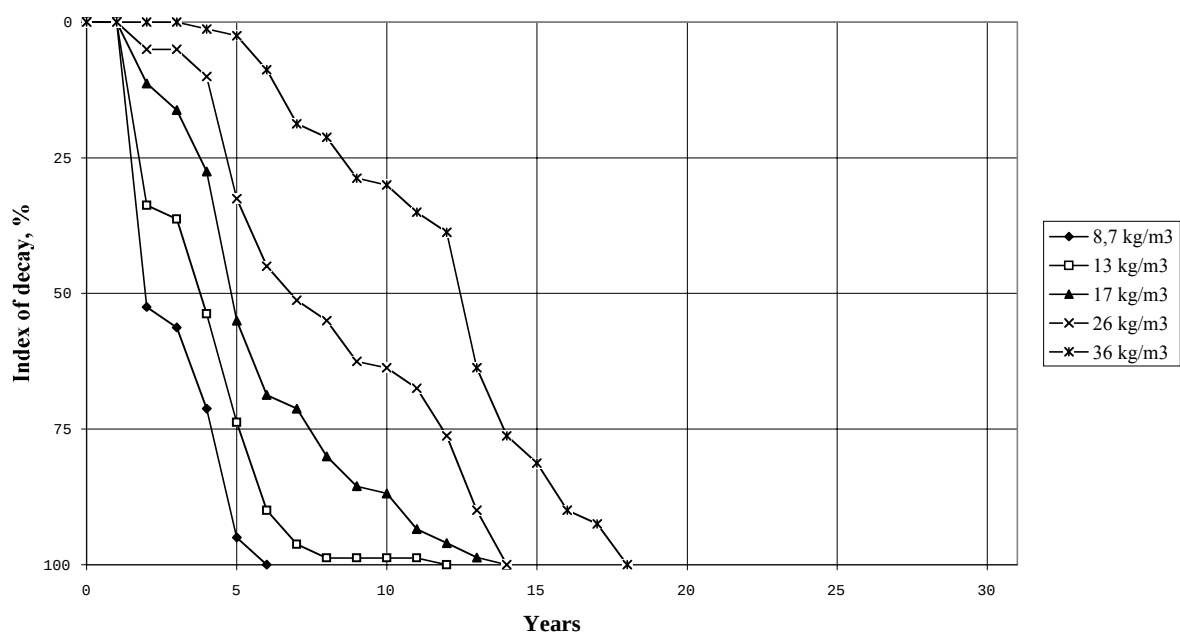


Figure 43. Field trial 1968. Rate of decay for stakes of European beech treated with KP Cuprinol.

Simlångsdalen. Eur beech. Tanalith C

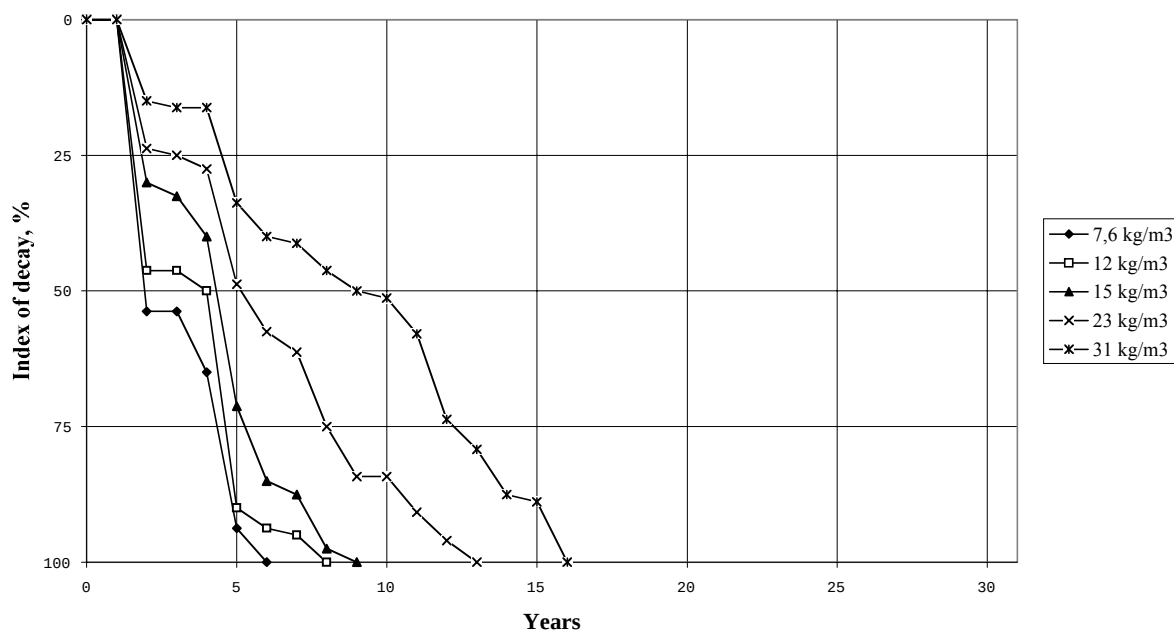


Figure 44. Field trial 1968. Rate of decay for stakes of European beech treated with Tanalith C.

Simlångsdalen. Eur beech. Wolmanit CB

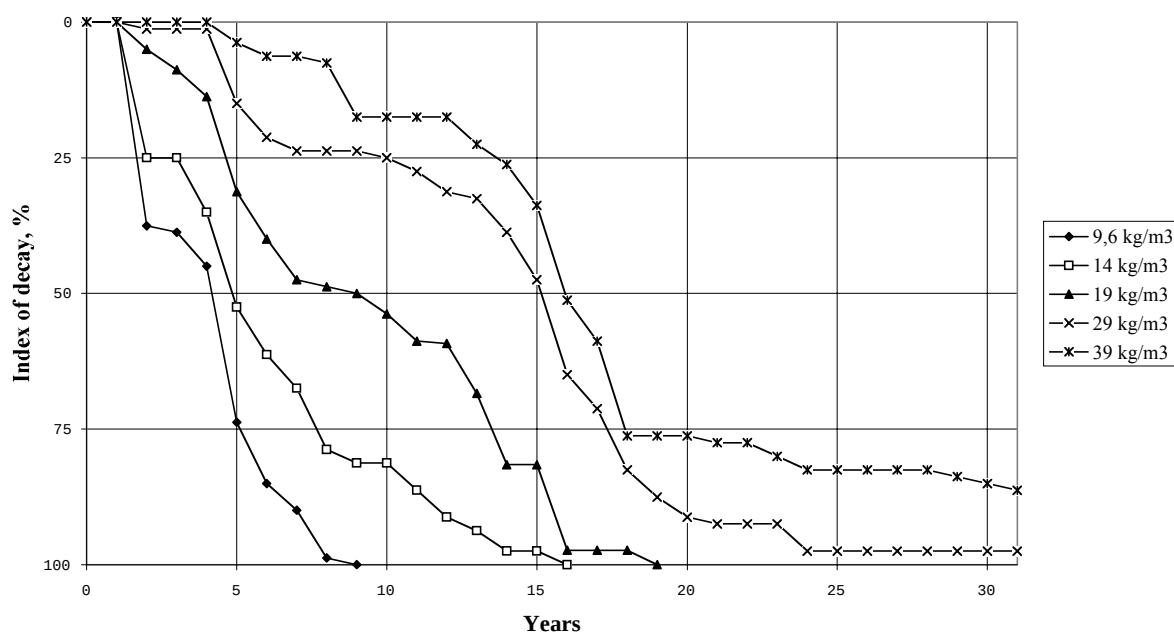


Figure 45. Field trial 1968. Rate of decay for stakes of European beech treated with Wolmanit CB.

Simlångsdalen. Eur beech. BP Hylosan

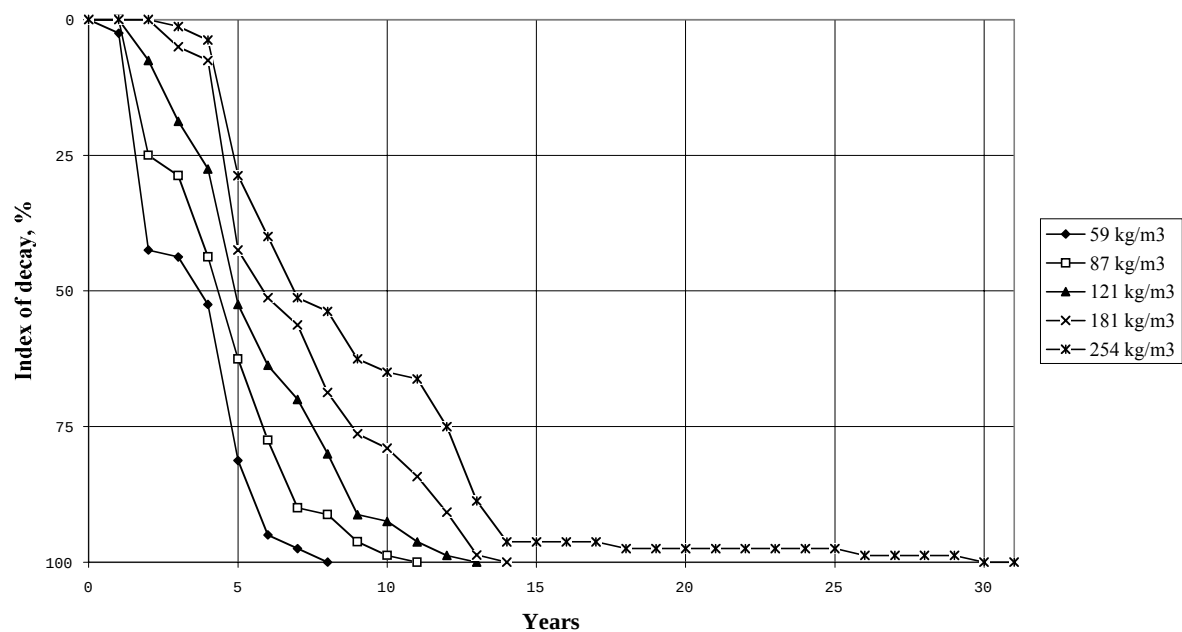


Figure 46. Field trial 1968. Rate of decay for stakes of European beech treated with BP.

Simlångsdalen. Eur beech. Creosote

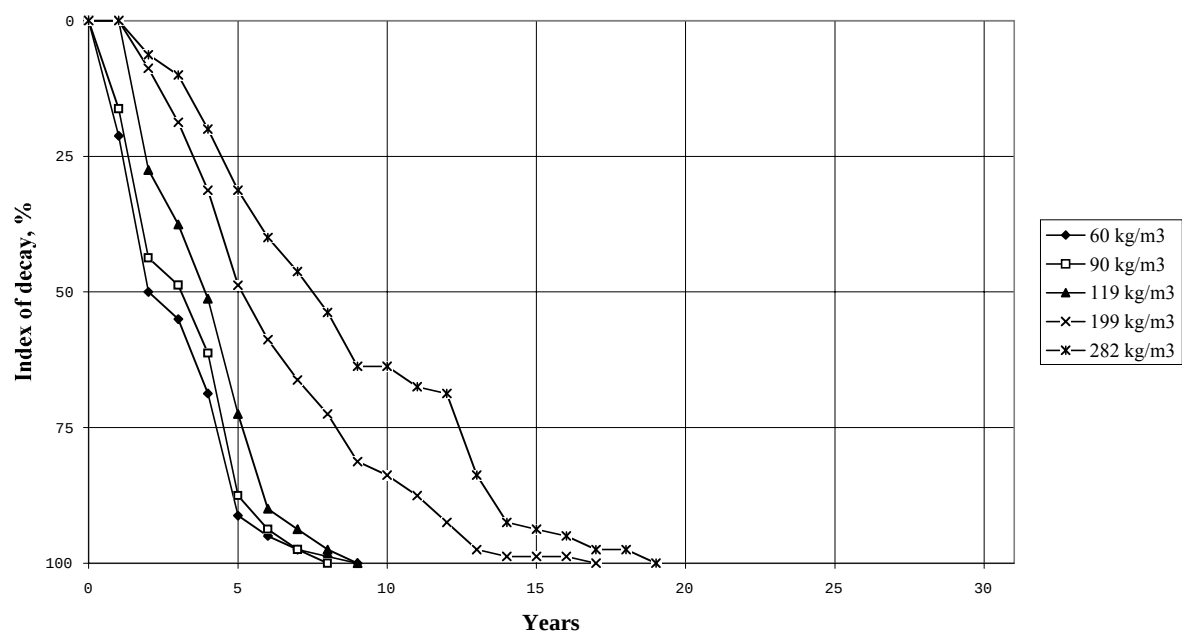


Figure 47. Field trial 1968. Rate of decay for stakes of European beech treated with creosote.

Vaasa/Viikki. Eur birch. Basilit CFK

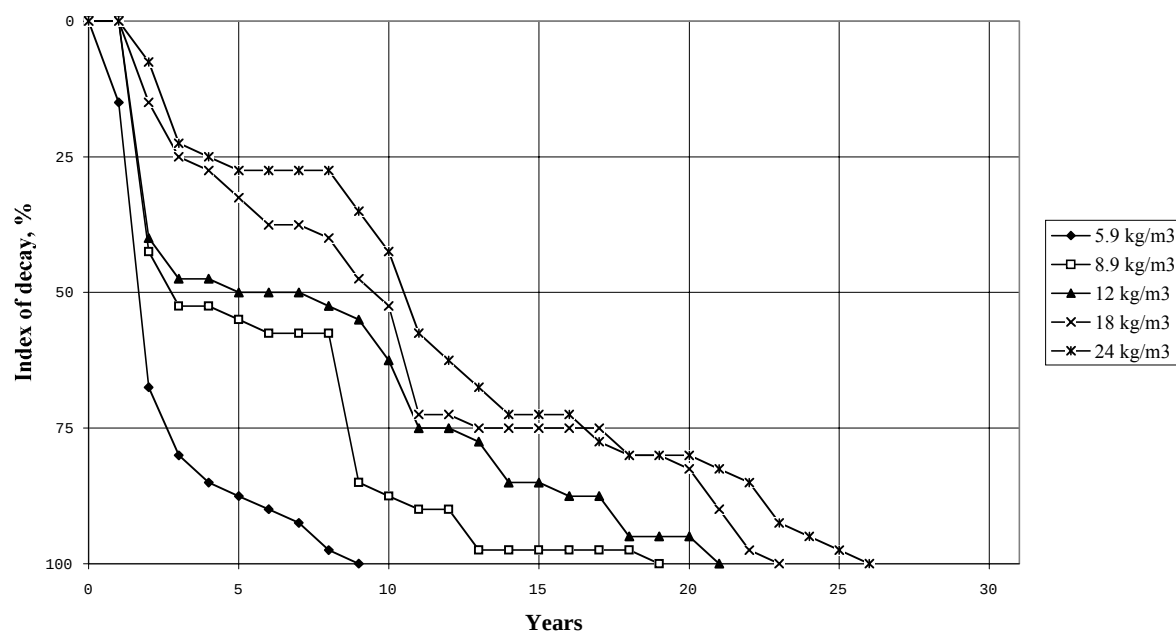


Figure 48. Field trial 1968. Rate of decay for stakes of European birch treated with Basilit CFK.

Vaasa/Viikki. Eur birch. Boliden K33

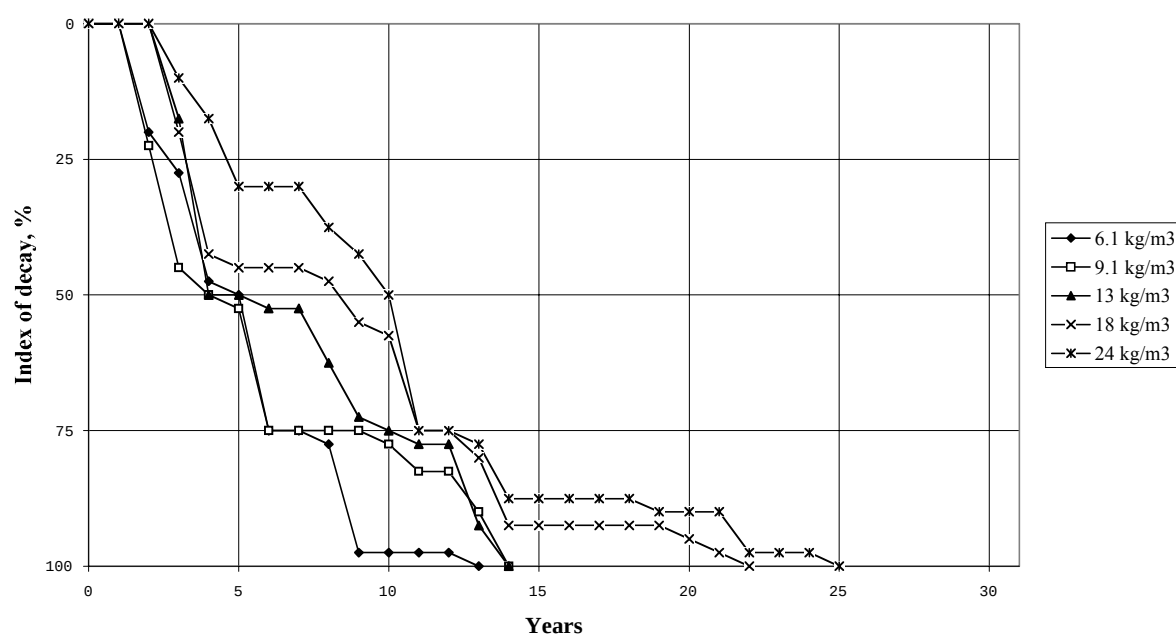


Figure 49. Field trial 1968. Rate of decay for stakes of European birch treated with Boliden K33.

Vaasa/Viikki. Eur birch Celcure A

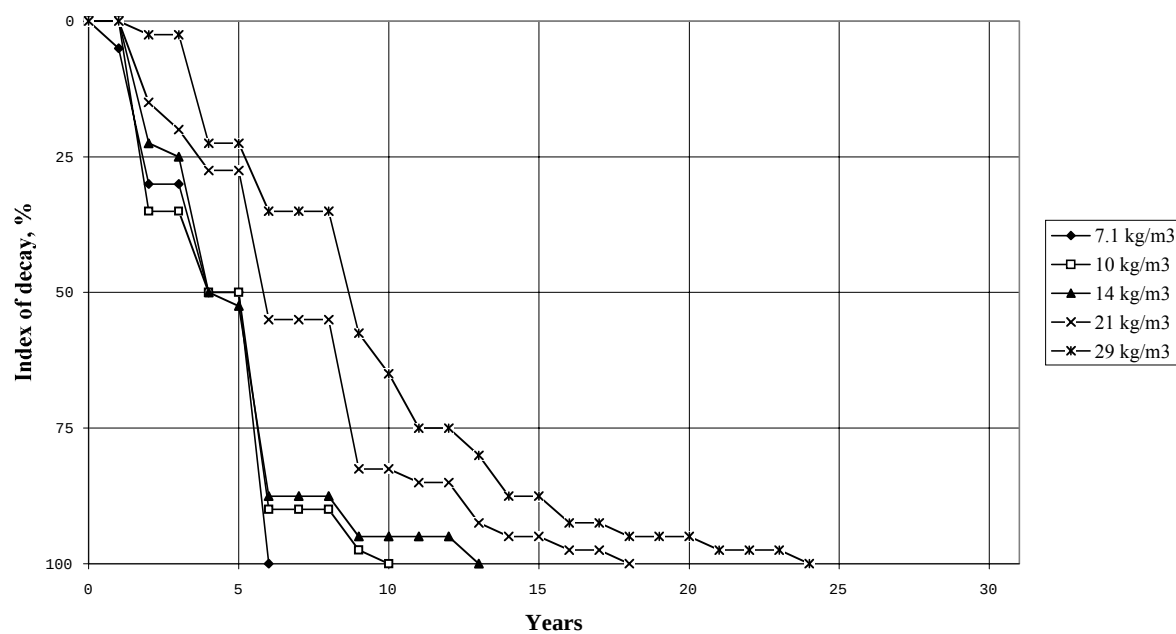


Figure 50. Field trial 1968. Rate of decay for stakes of European birch treated with Celcure A.

Vaasa/Viikki. Eur birch. KP Cuprinol

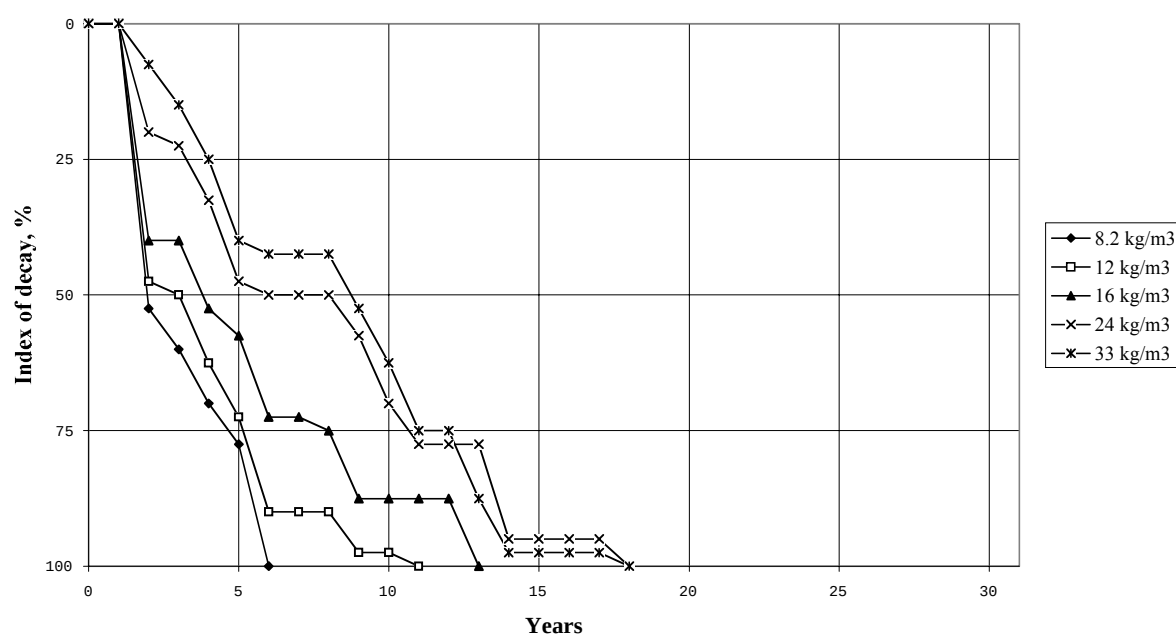


Figure 51. Field trial 1968. Rate of decay for stakes of European birch treated with KP Cuprinol.

Vaasa/Viikki. Eur birch. Tanalith C

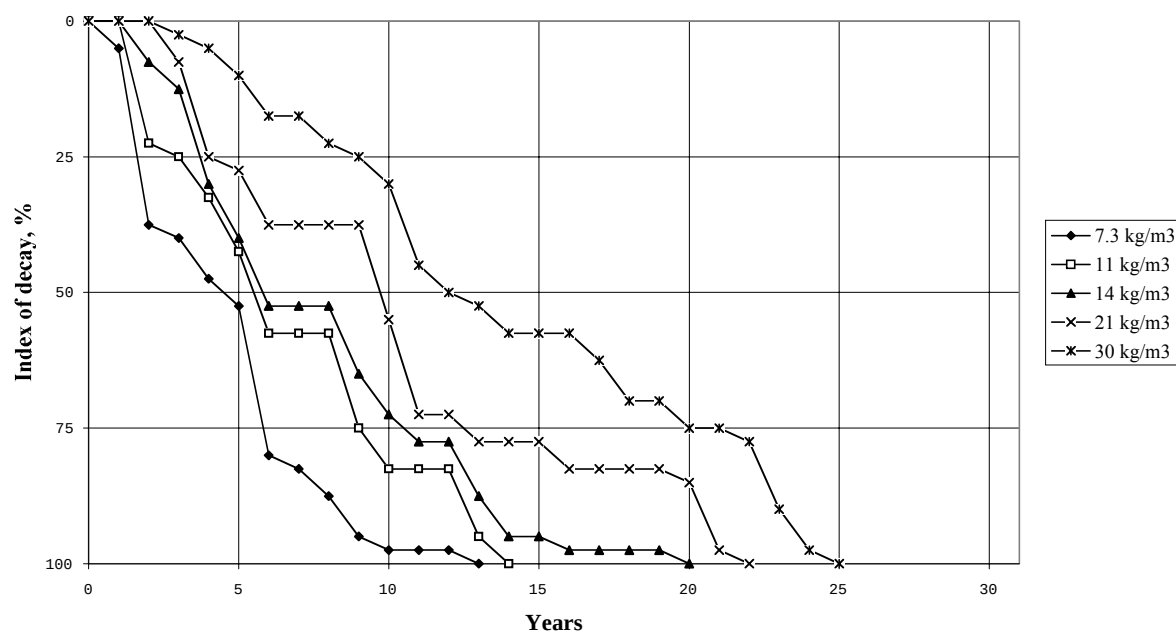


Figure 52. Field trial 1968. Rate of decay for stakes of European birch treated with Tanalith C.

Vaasa/Viikki. Eur birch. Wolmanit CB

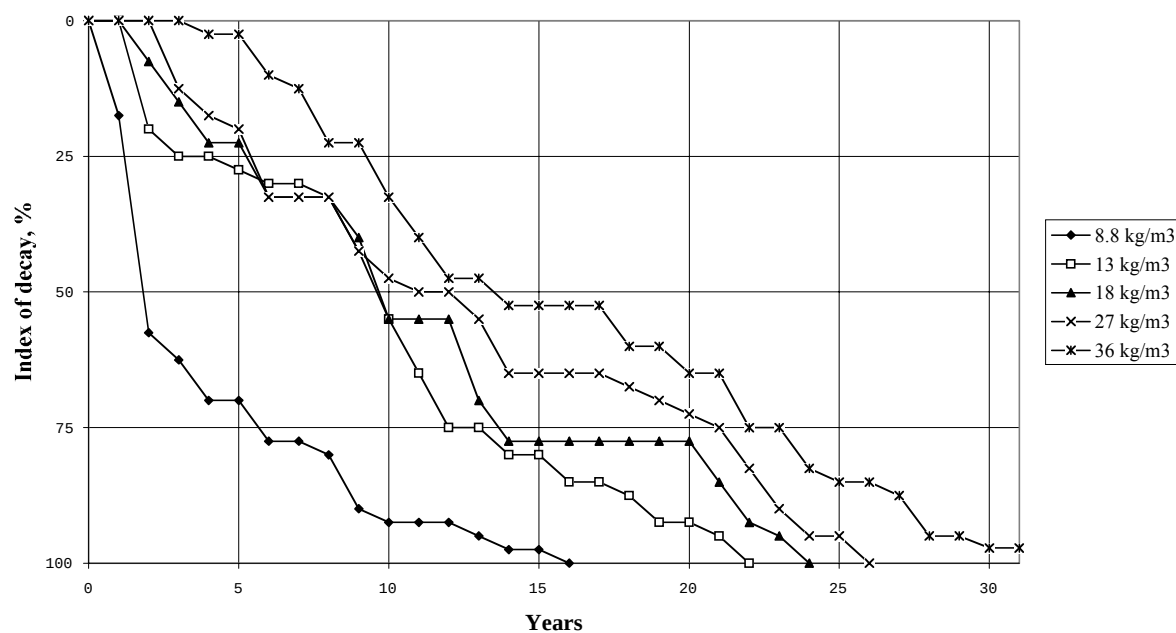


Figure 53. Field trial 1968. Rate of decay for stakes of European birch treated with Wolmanit CB.

Vaasa/Viikki. Eur birch Hylosan BP

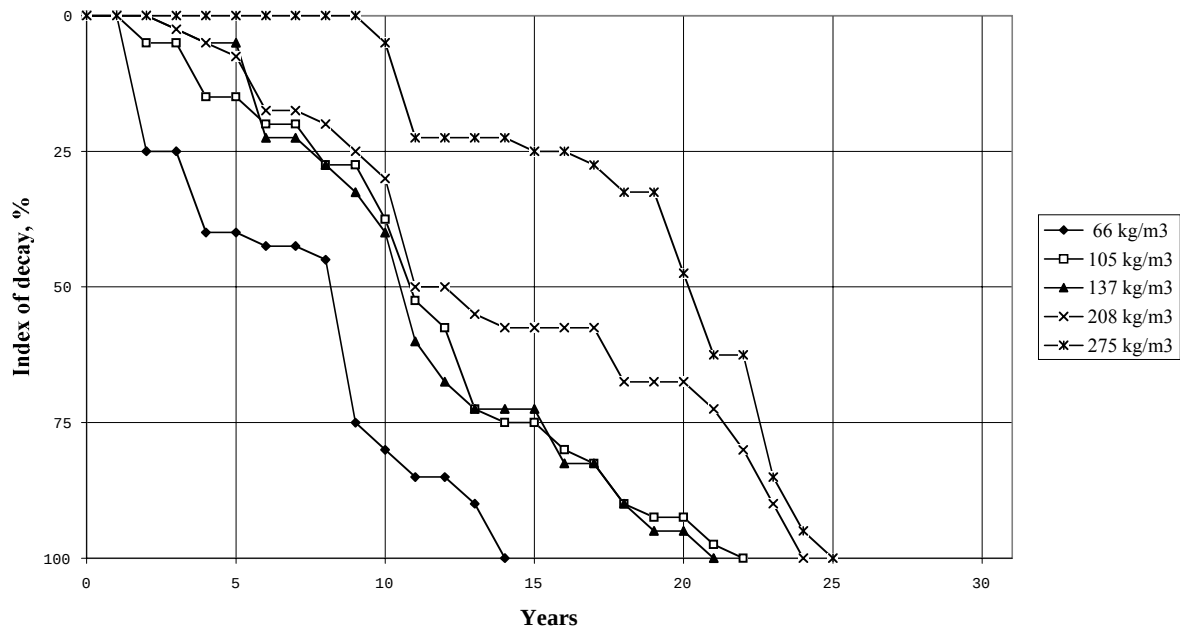


Figure 54. Field trial 1968. Rate of decay for stakes of European birch treated with BP Hylosan.

Vaasa/Viikki. Eur birch. Creosote

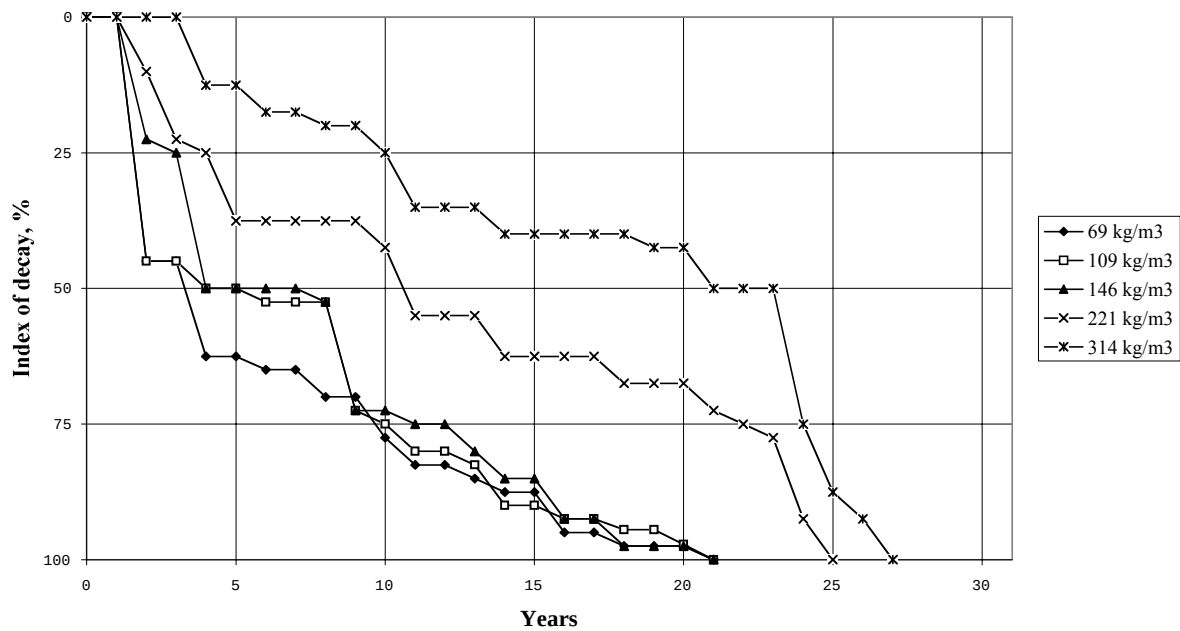


Figure 55. Field trial 1968. Rate of decay for stakes of European birch treated with creosote.

Sørkedalen. Alder. Basilit CFK

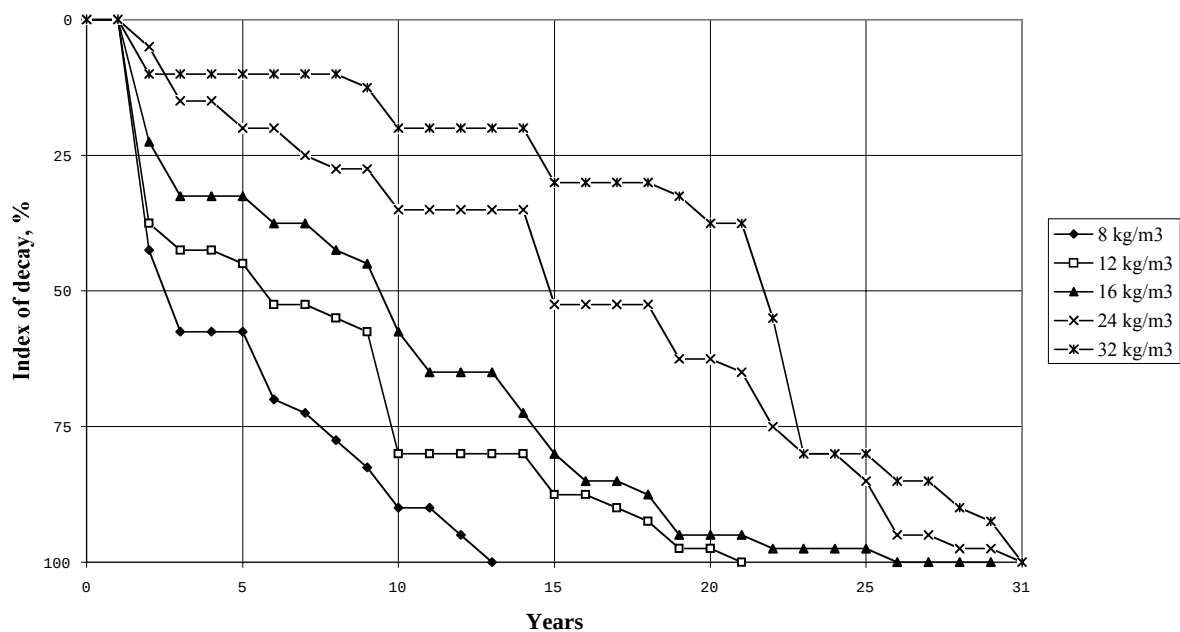


Figure 56. Field trial 1968. Rate of decay for stakes of alder treated with Basilit CFK.

Sørkedalen. Alder. Boliden K33

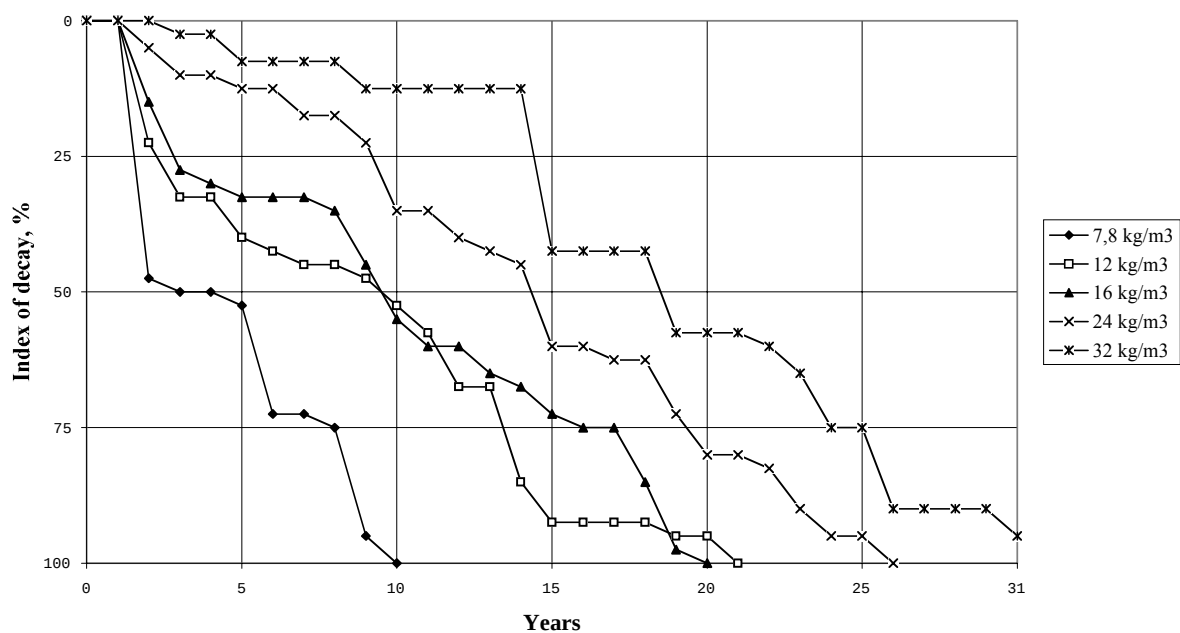


Figure 57. Field trial 1968. Rate of decay for stakes of alder treated with Boliden K33.

Sørkedalen. Alder. Celcure A

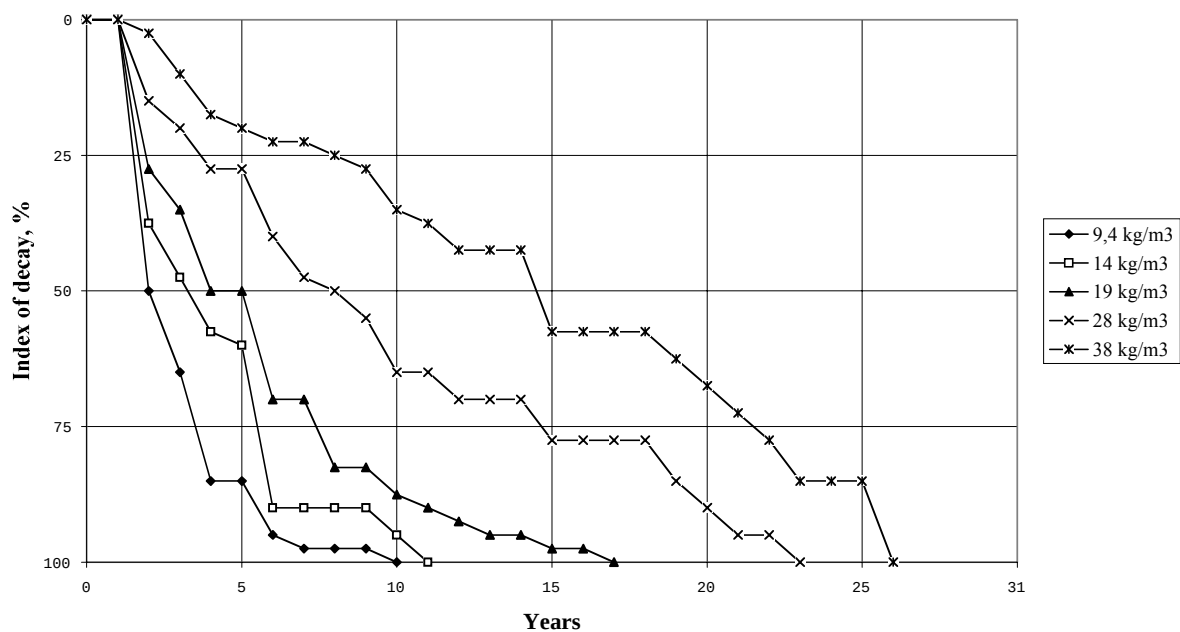


Figure 58. Field trial 1968. Rate of decay for stakes of alder treated with Celcure A.

Sørkedalen. Alder. KP Cuprinol

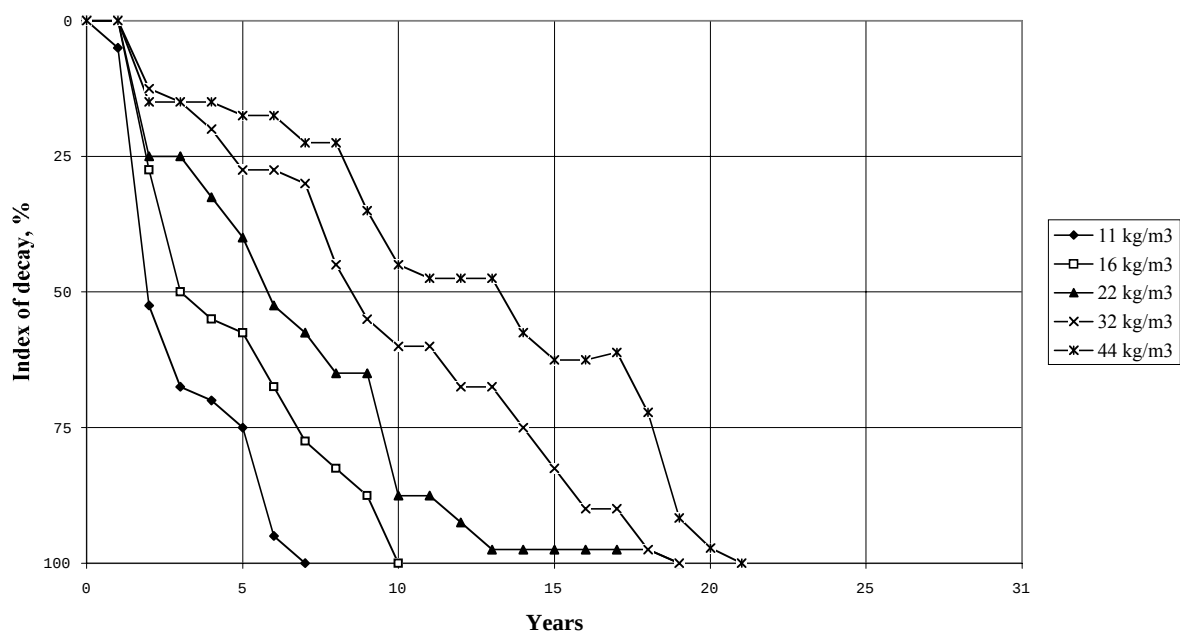


Figure 59. Field trial 1968. Rate of decay for stakes of alder treated with KP Cuprinol.

Sørkedalen. Alder. Tanalith C

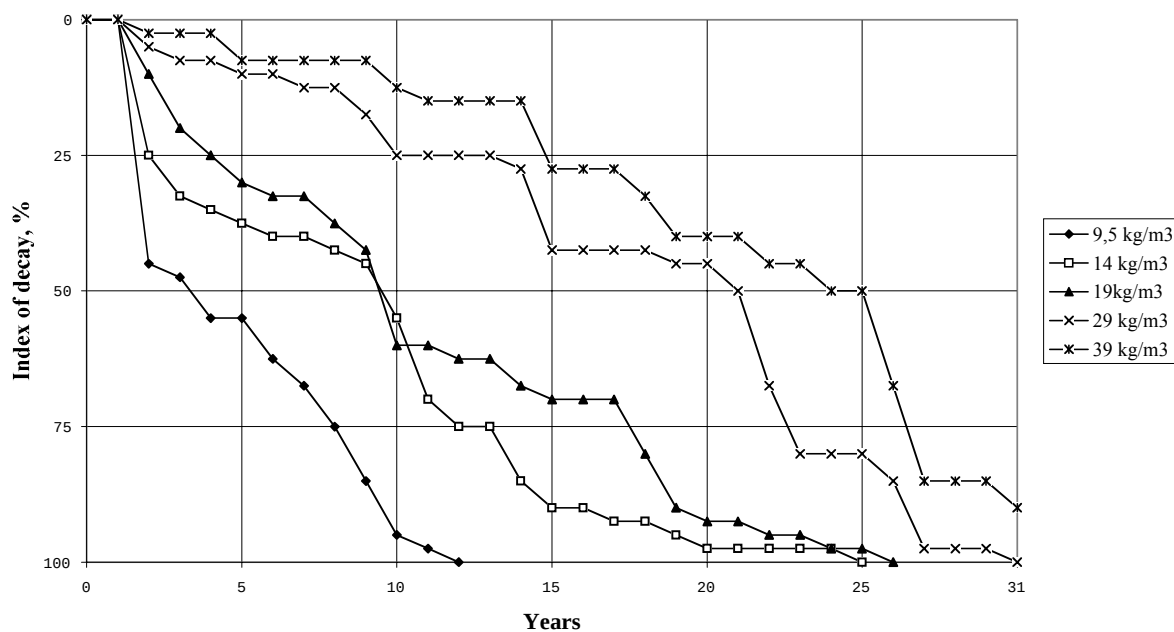


Figure 60. Field trial 1968. Rate of decay for stakes of alder treated with Tanalith C.

Sørkedalen. Alder. Wolmanit CB

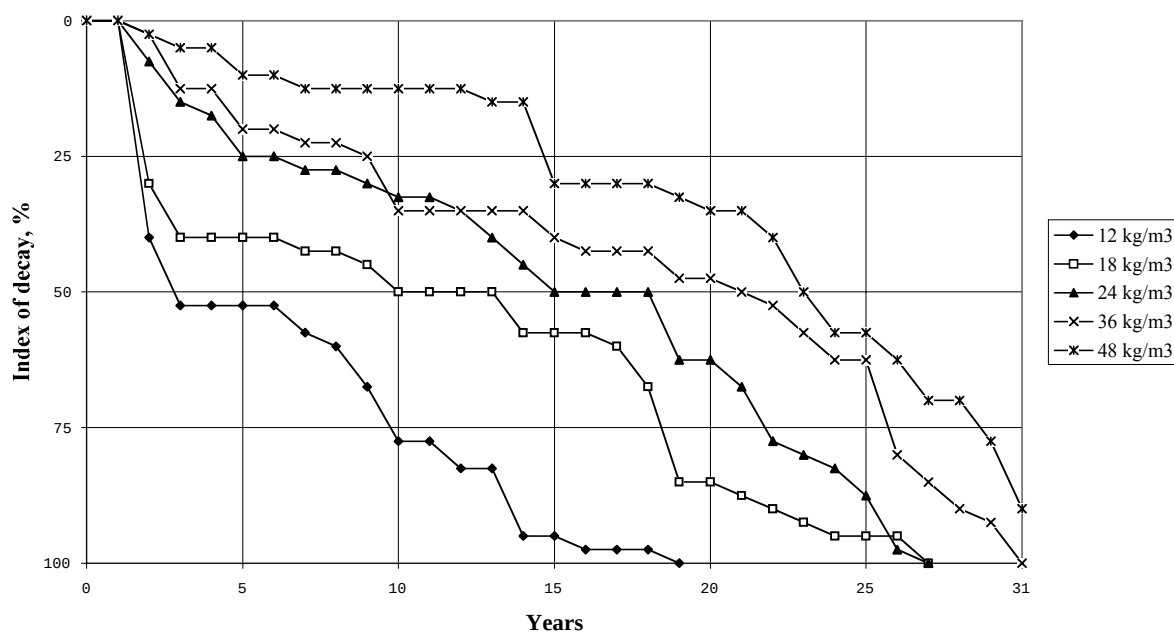


Figure 61. Field trial 1968. Rate of decay for stakes of alder treated with Wolmanit CB.

Sørkedalen. Alder. BP Hylosan

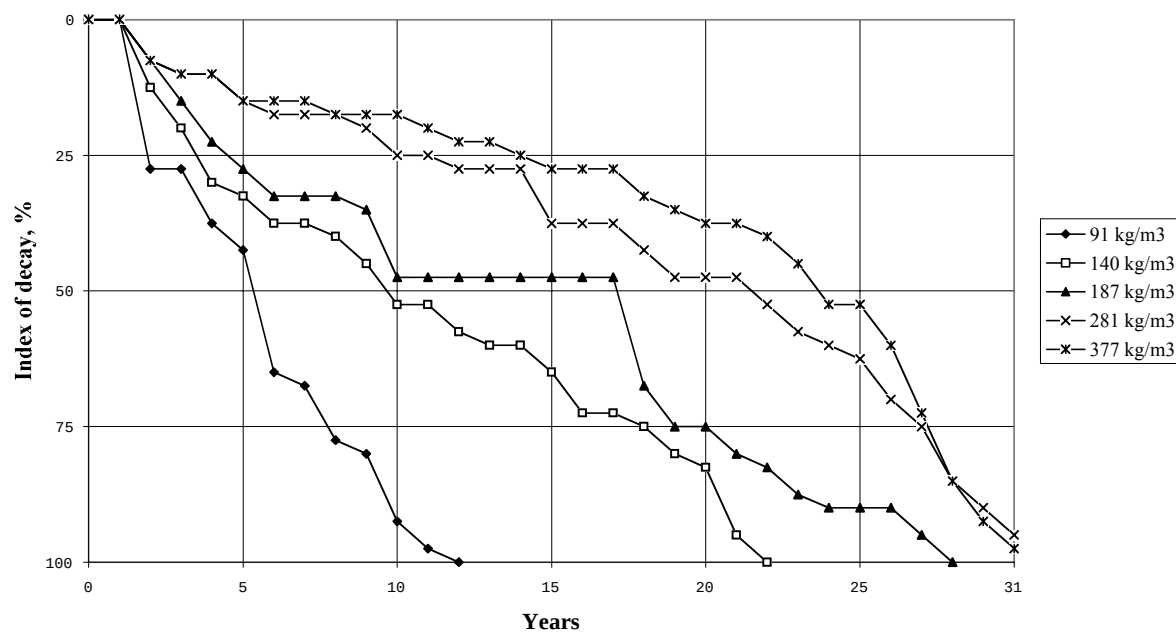


Figure 62. Field trial 1968. Rate of decay for stakes of alder treated with BP Hylosan.

Sørkedalen. Alder. Creosote

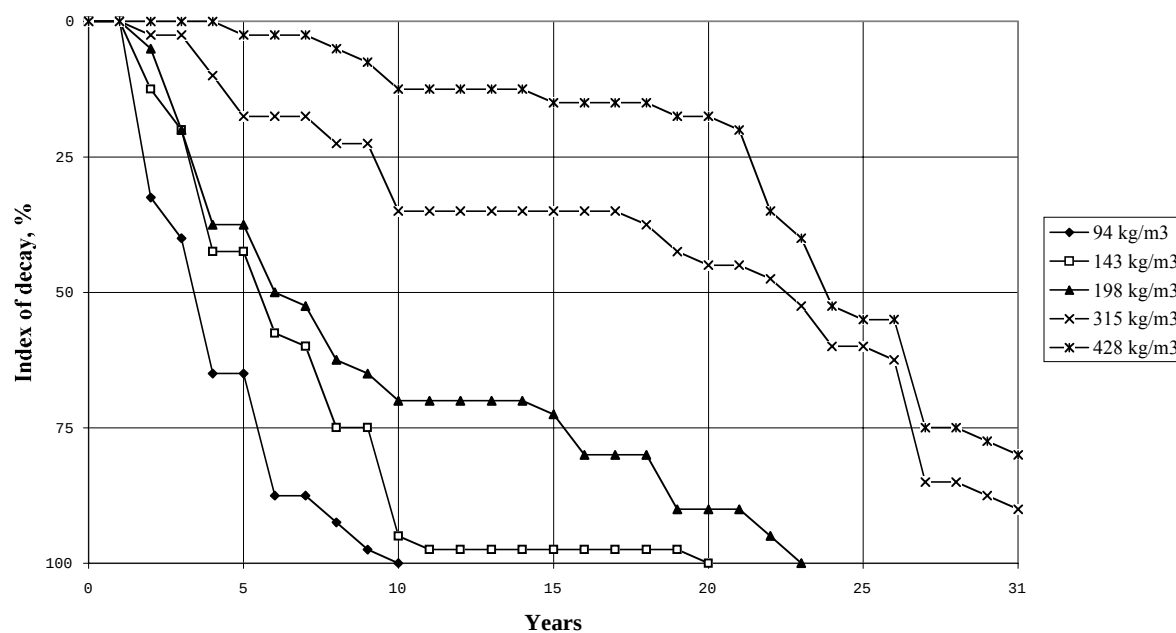
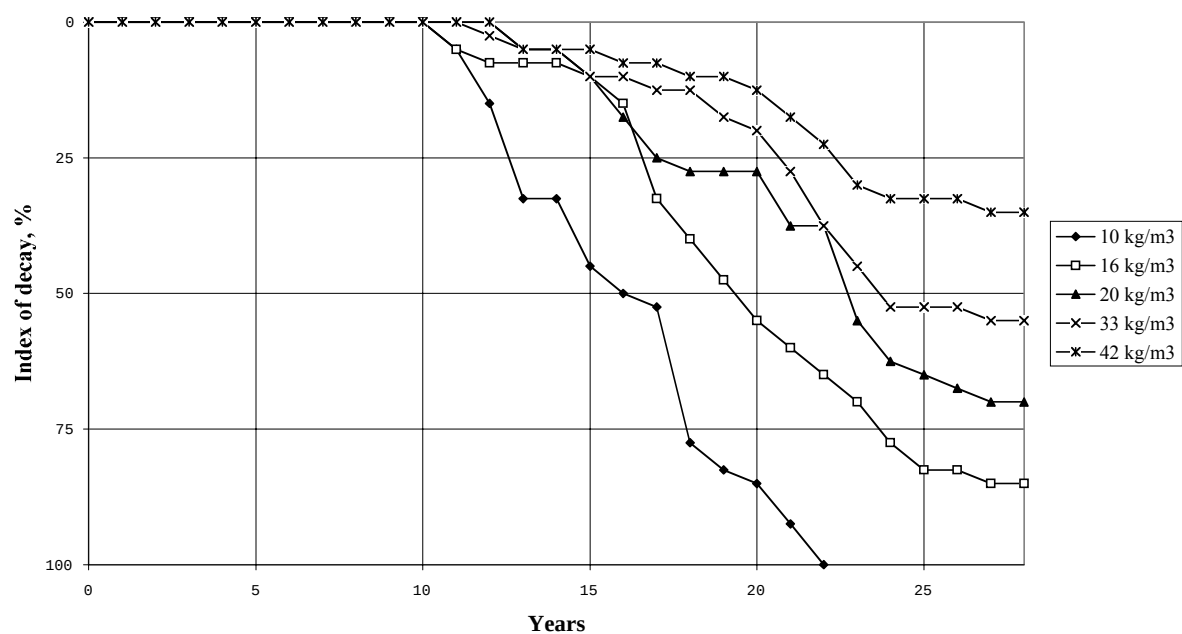


Figure 63. Field trial 1968. Rate of decay for stakes of alder treated with creosote.

Simlångsdalen. Eur redwood. Celcure M



Vaasa/Viikki. Eur redwood. Celcure M

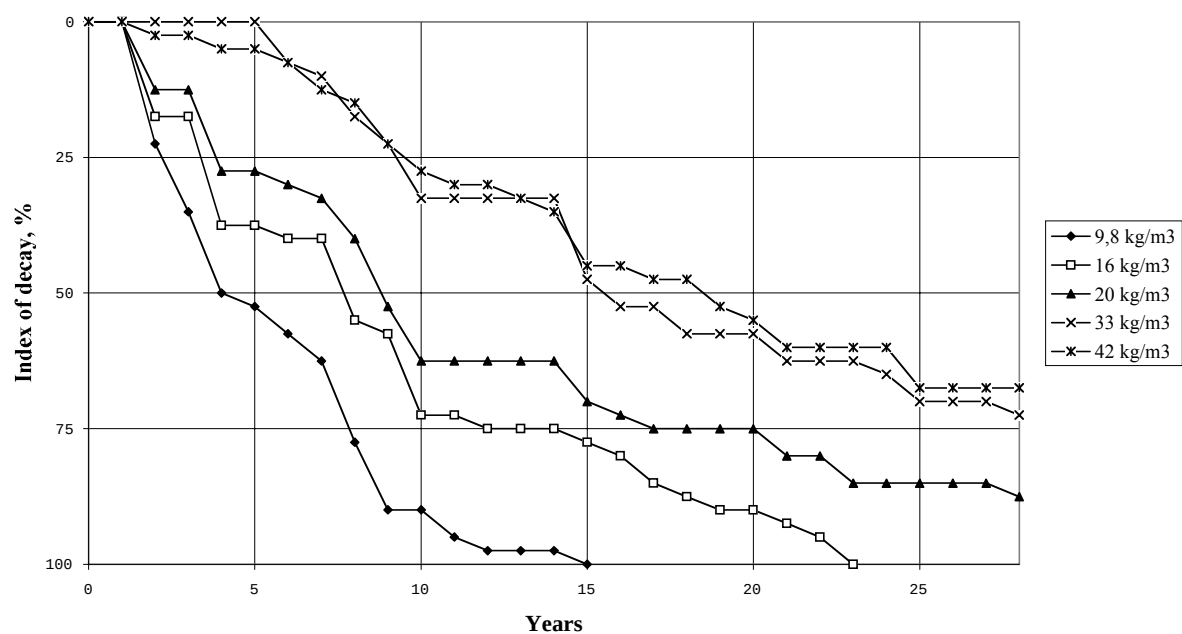
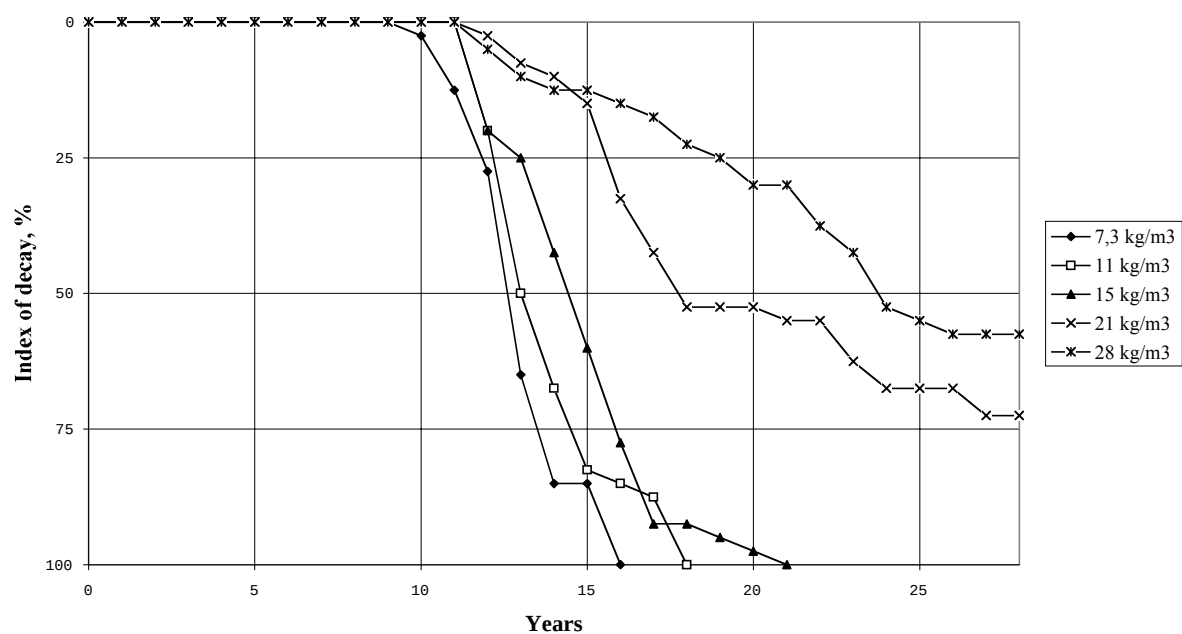


Figure 64. Field trial 1971. Rate of decay for stakes treated with Celcure M.

Simlångsdalen. Eur redwood. Celcure SM



Vaasa/Viikki. Eur redwood. Celcure SM

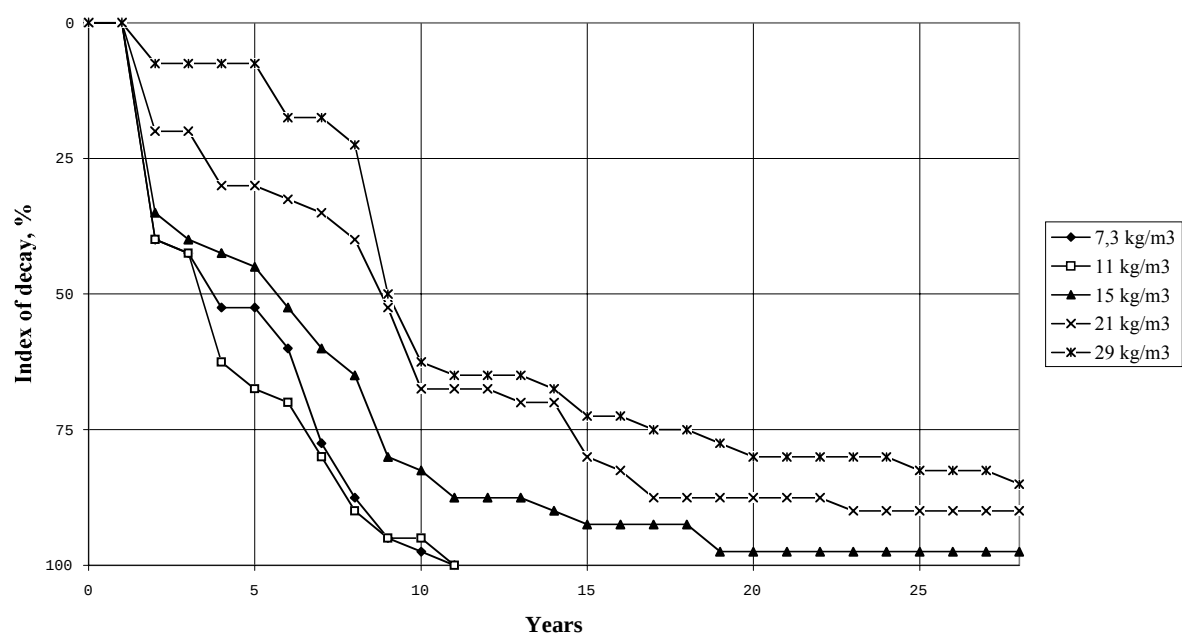
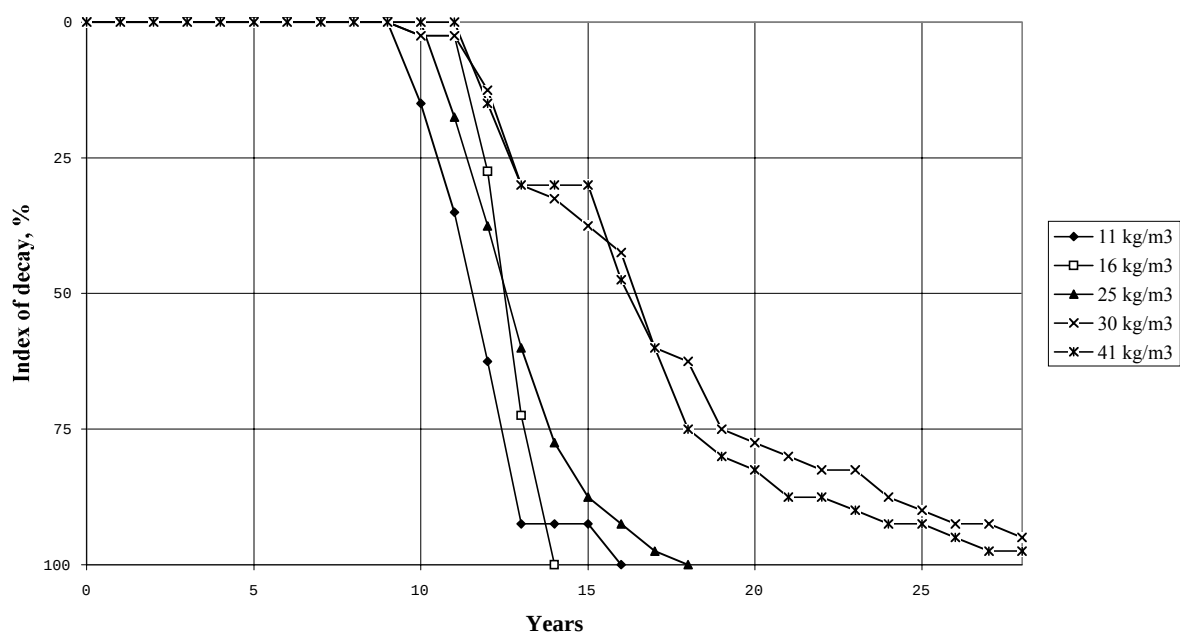


Figure 65. Field trial 1971. Rate of decay for stakes treated with Celcure SM.

Simlångsdalen. Eur redwood. KP Cuprinol



Vaasa/Viikki. Eur redwood. KP Cuprinol

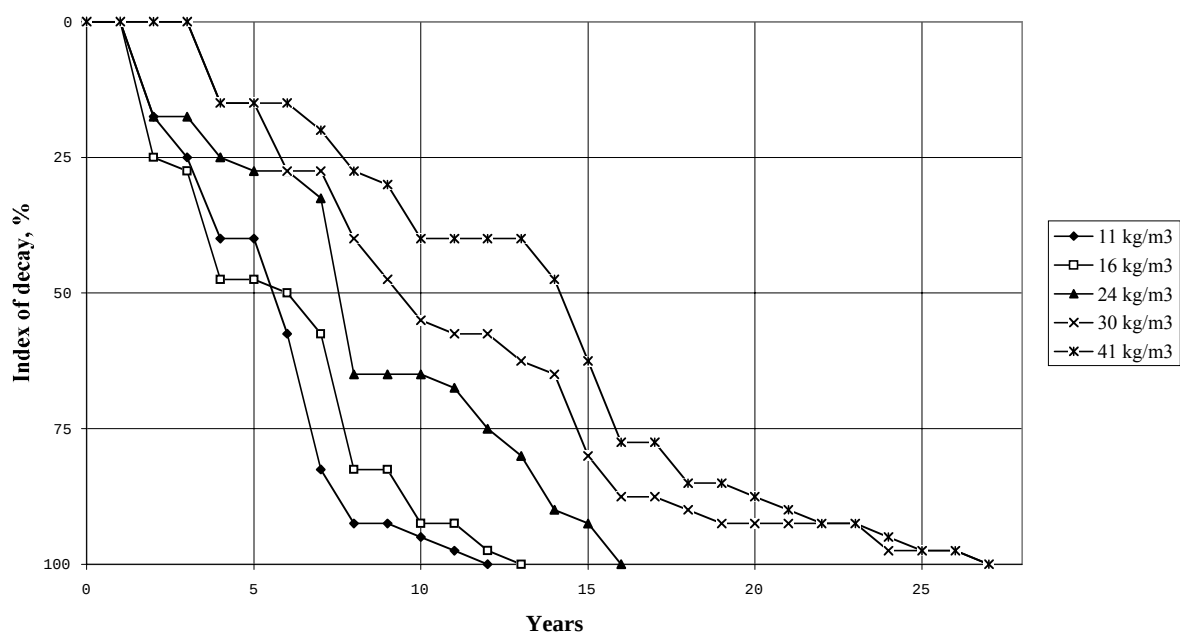
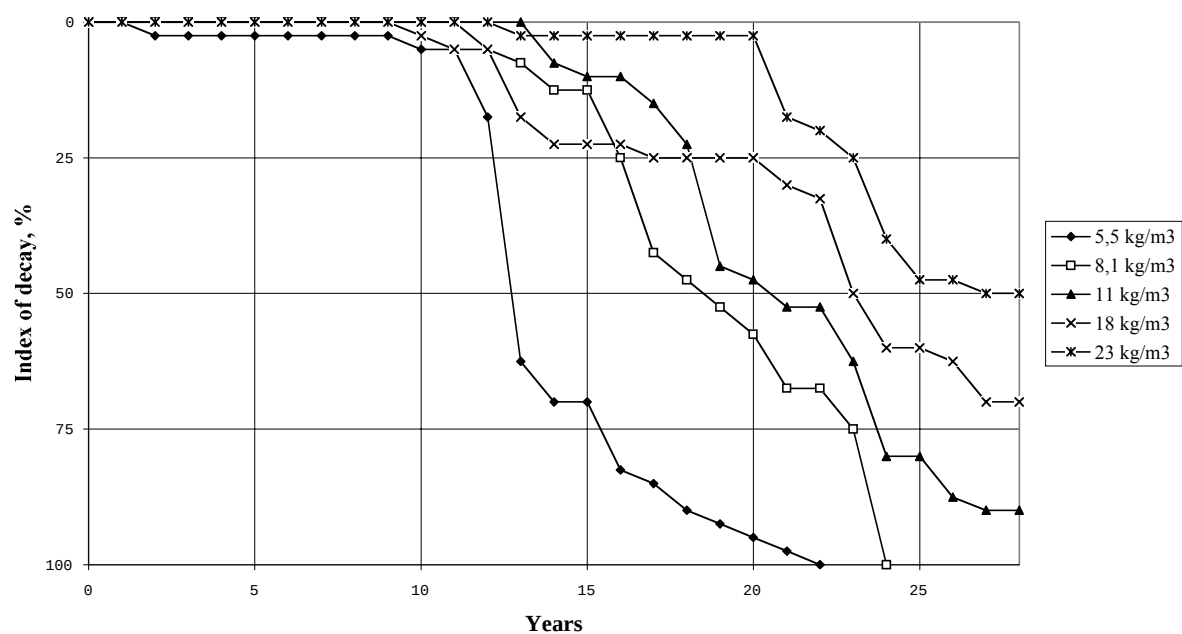


Figure 66. Field trial 1971. Rate of decay for stakes treated with KP Cuprinol.

Simlångsdalen. Eur redwood. Kemira K64



Vaasa/Viikki. Eur redwood. Kemira K64

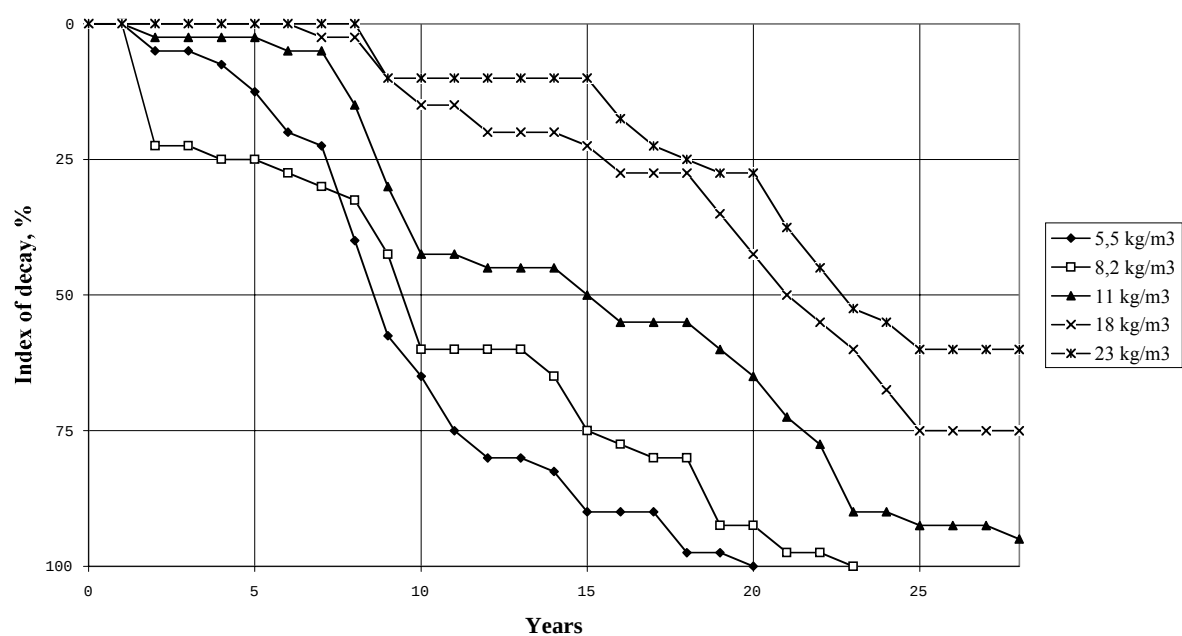
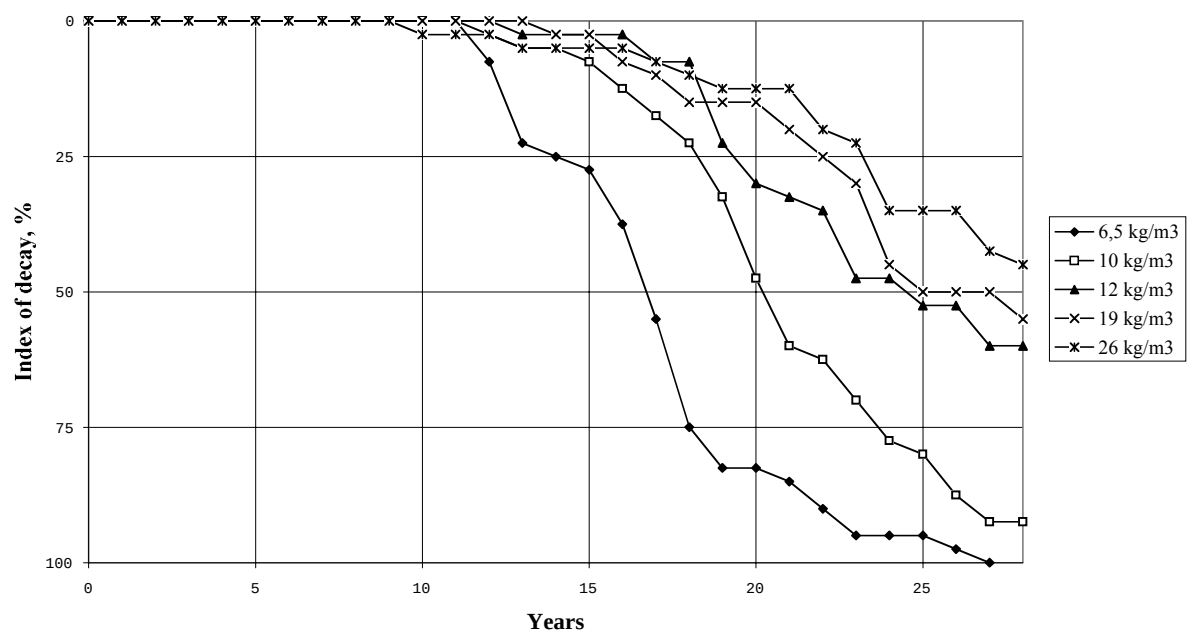


Figure 67. Field trial 1971. Rate of decay for stakes treated with Kemira K64.

Simlångsdalen. Eur redwood. Kemira C64.



Vaasa/Viikki. Eur redwood. Kemira C64

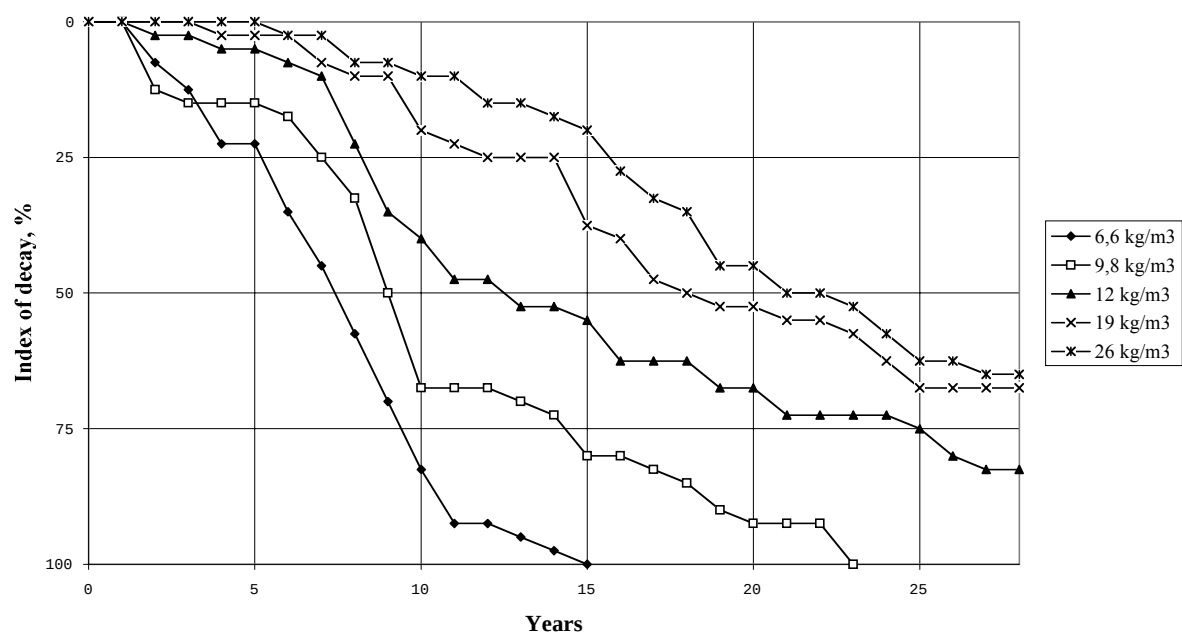


Figure 68 . Field trial 1971. Rate of decay for stakes treated with Kemira C64.

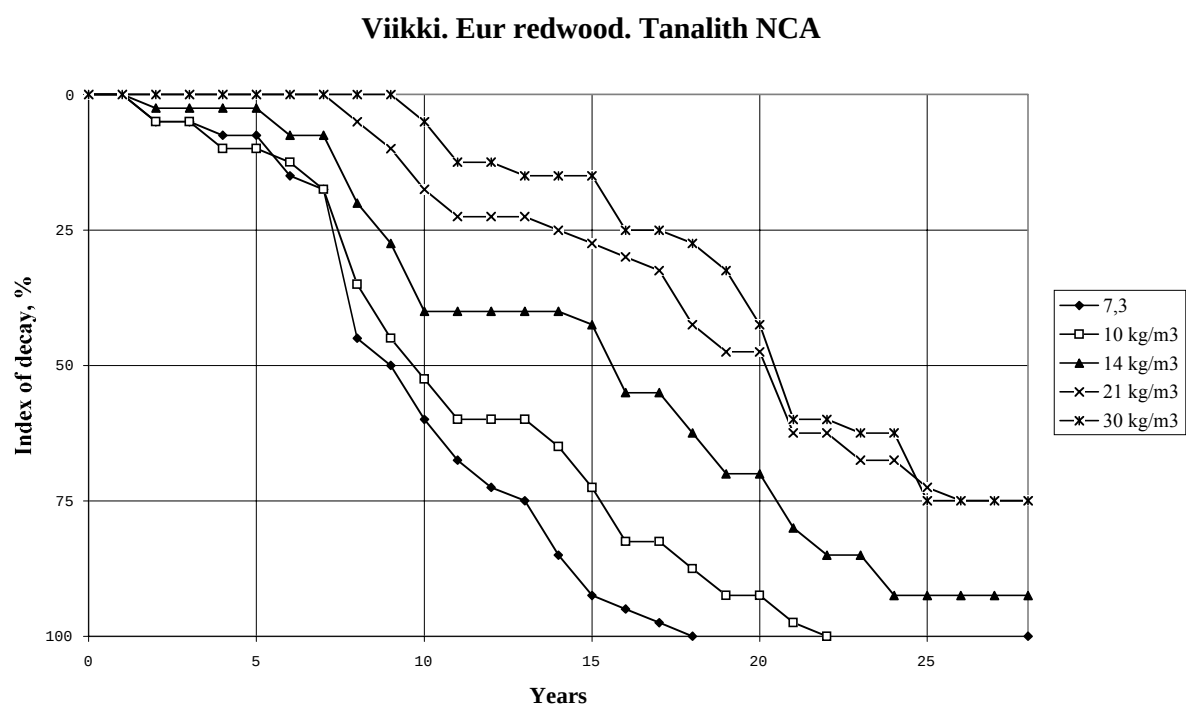
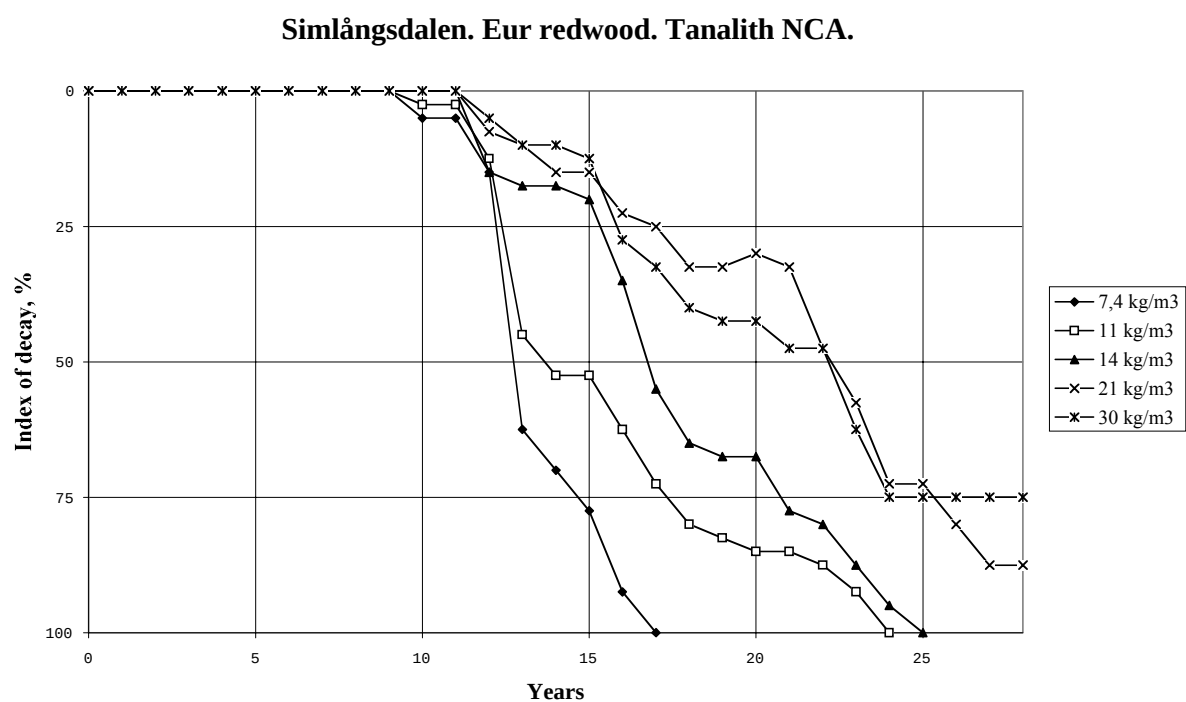
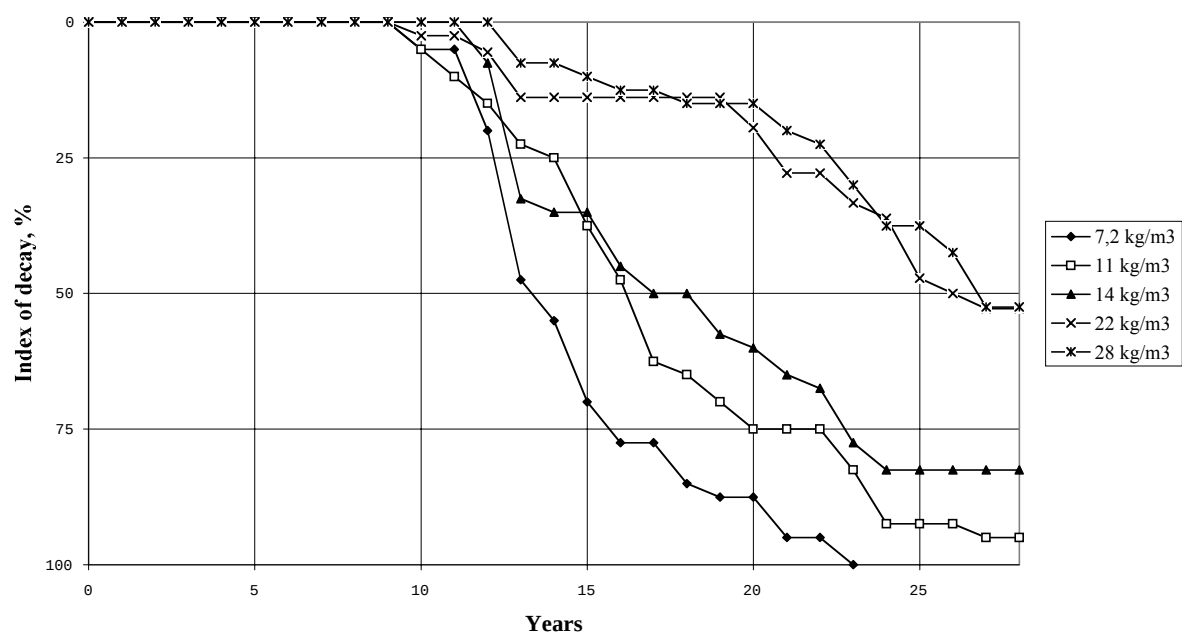


Figure 69. Field trial 1971. Rate of decay for stakes treated with Tanalith NCA.

Simlångsdalen. Eur redwood. Boliden APUS



Sørkedalen. Eur redwood. Boliden APUS

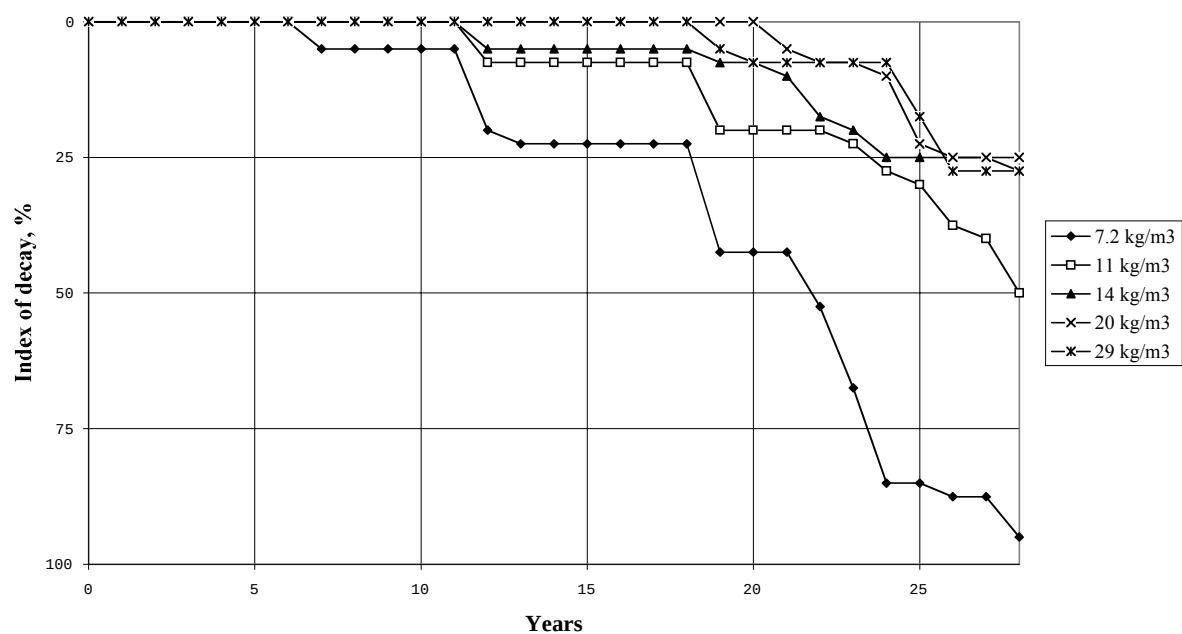
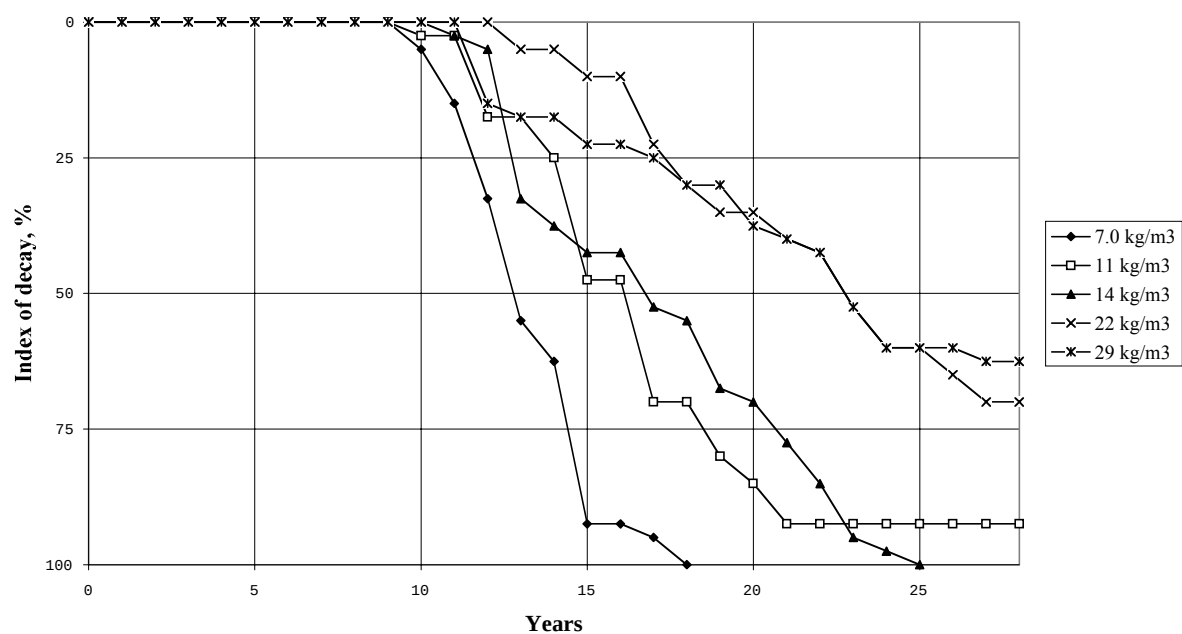


Figure 70. Field trial 1971. Rate of decay for stakes treated with Boliden APUS.

Simlångsdalen. Eur redwood. Boliden P50



Sørkedalen. Eur redwood. Boliden P50

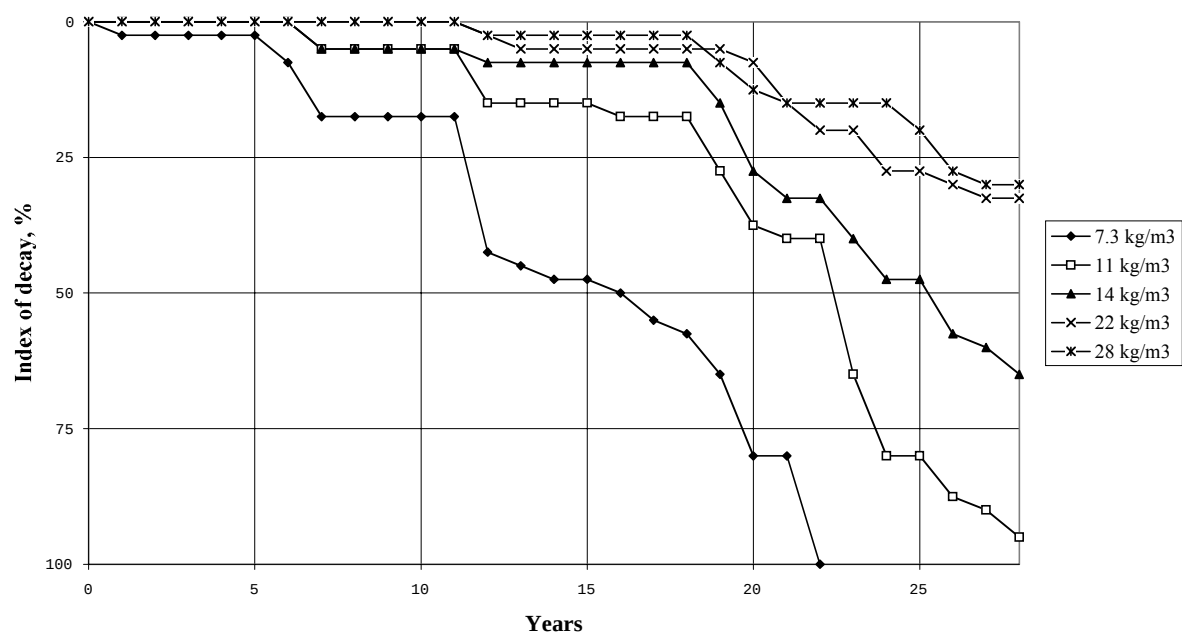


Figure 71. Field trial 1971. Rate of decay for stakes treated with Boliden P50.

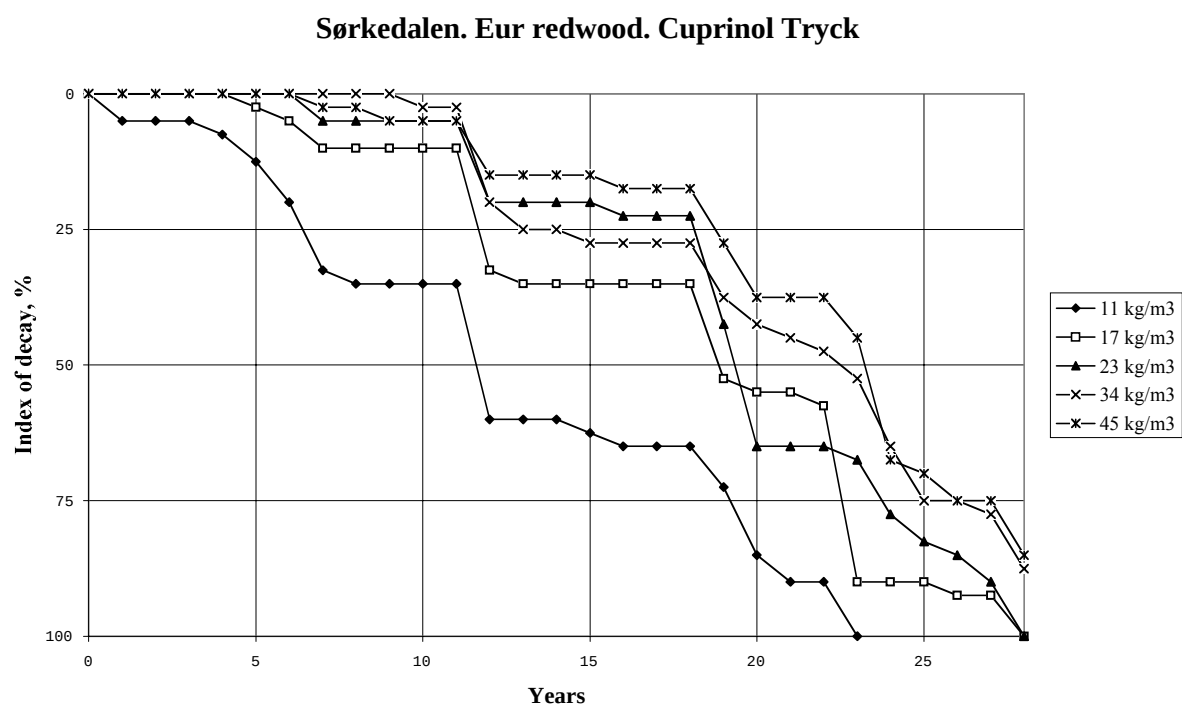
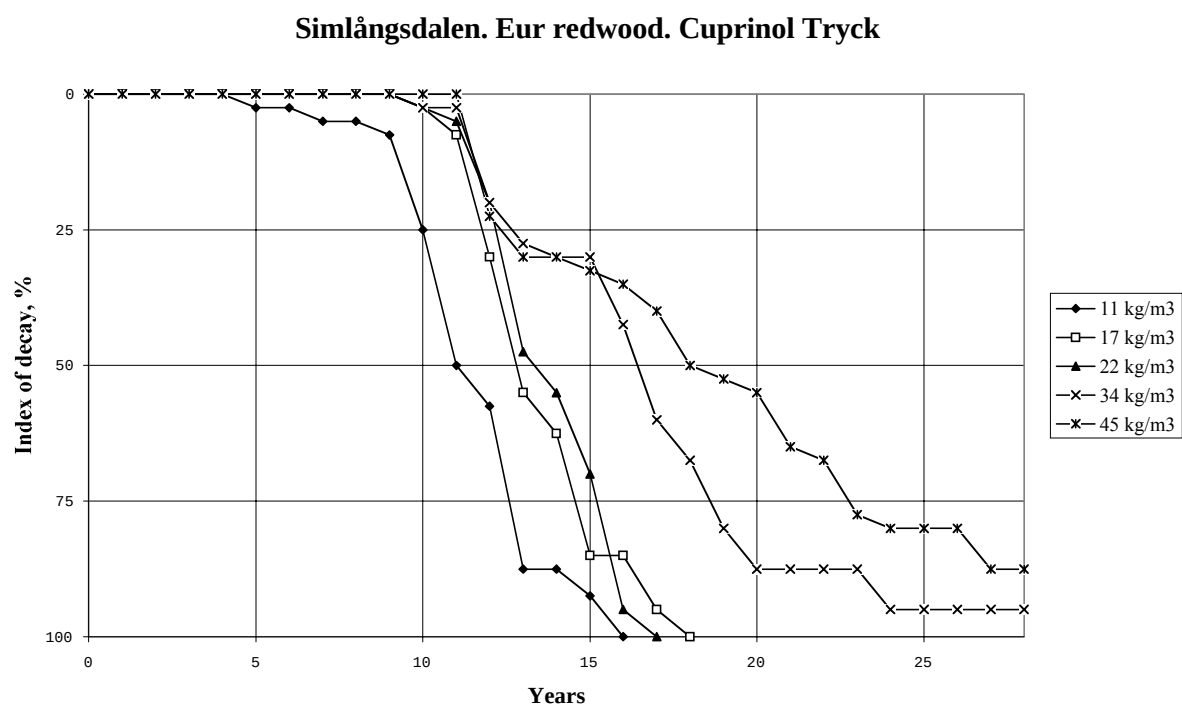
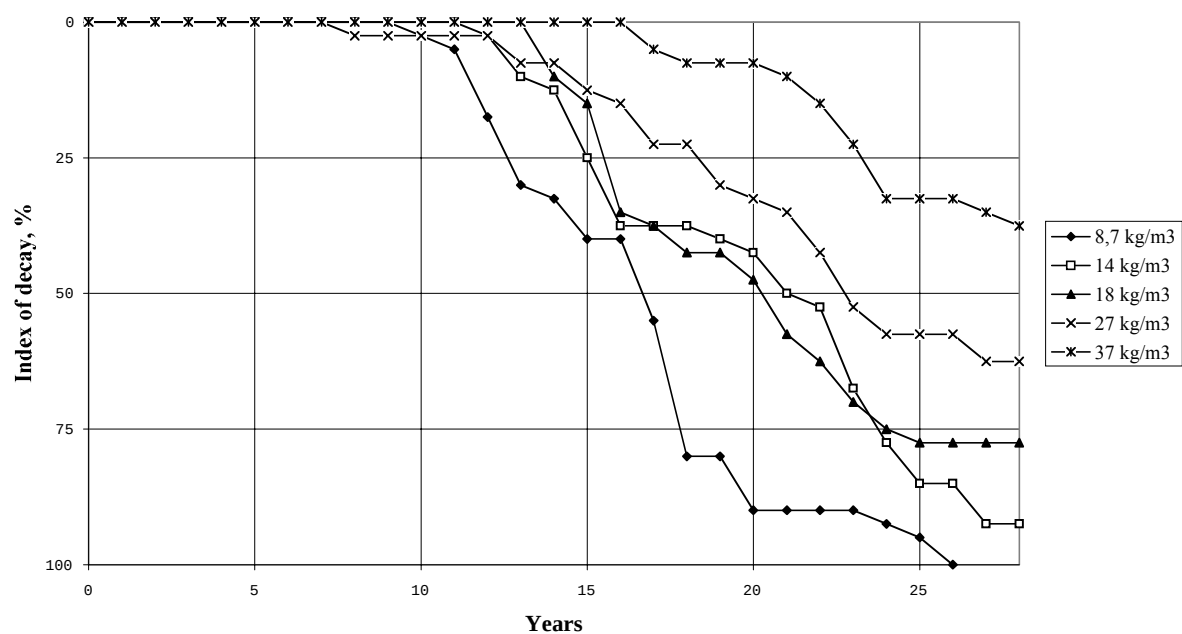


Figure 72. Field trial 1971. Rate of decay for stakes treated with Cuprinol Tryck.

Simlångsdalen. Eur redwood. CCB A



Sørkedalen. Eur redwood. CCB A

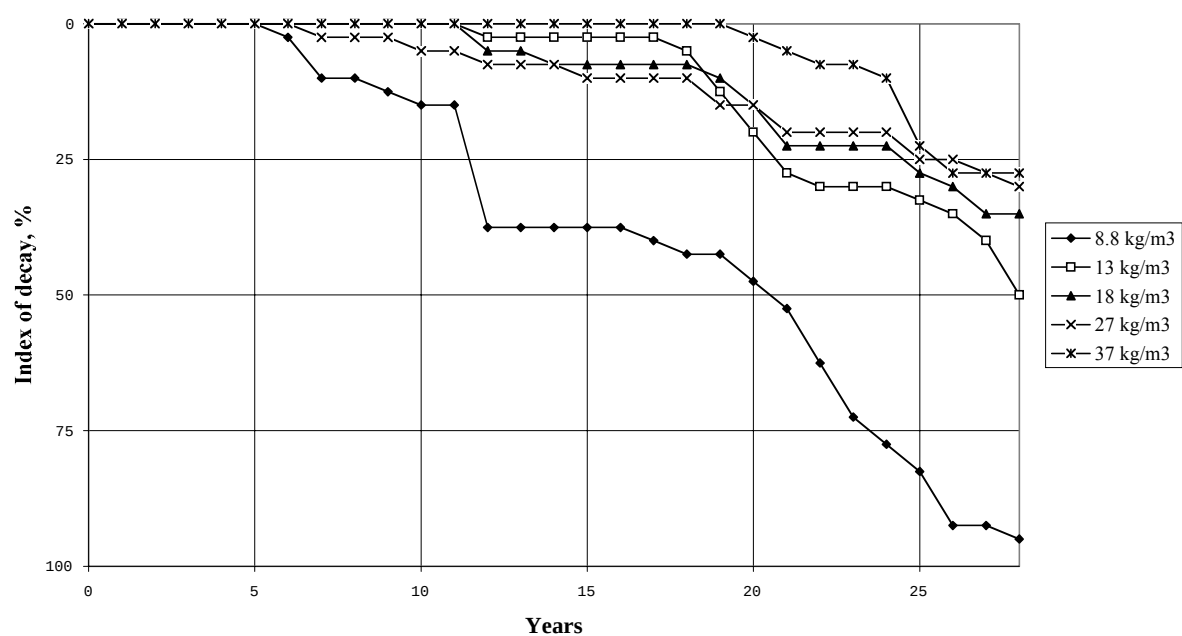
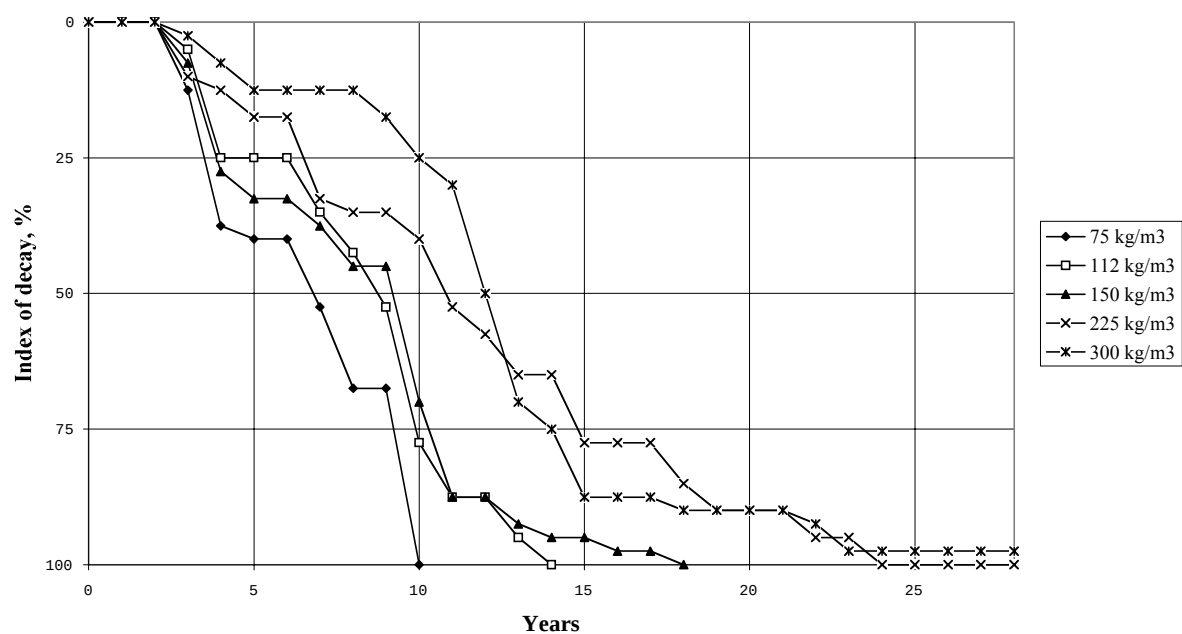


Figure 73. Field trial 1971. Rate of decay for stakes treated with CCB A.

Simlångsdalen. Eur redwood. BP SUN/WP



Sørkedalen. Eur redwood. BP SUN/WP

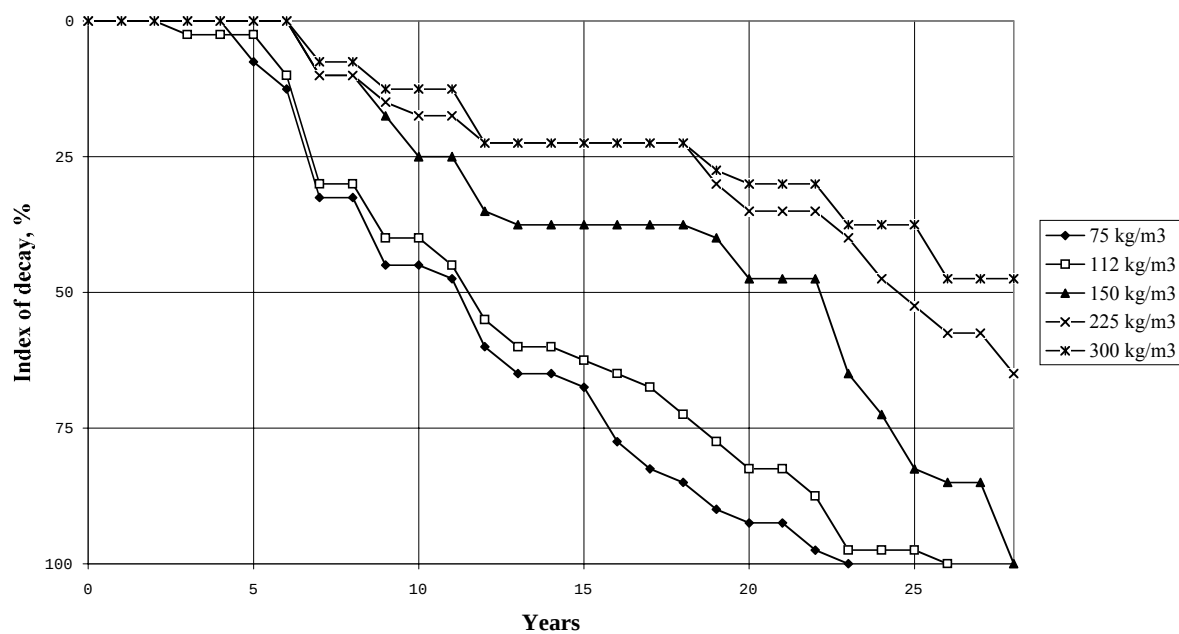
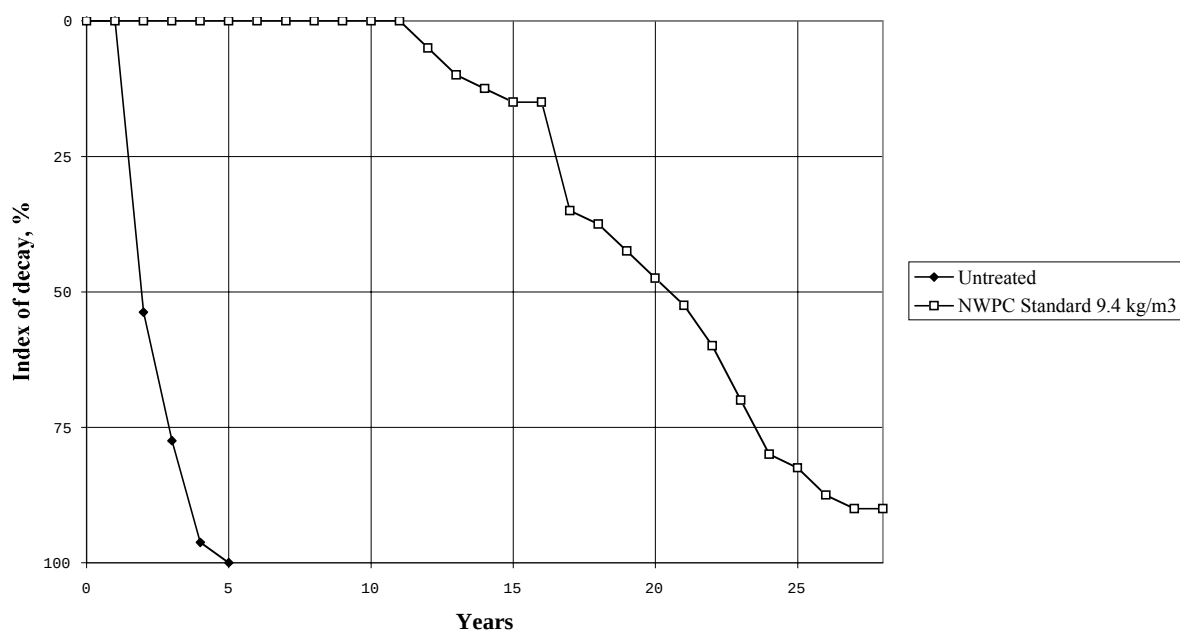


Figure 74. Field trial 1971. Rate of decay for stakes treated with BP SUN/WP.

Simlångsdalen. Eur redwood.



Vaasa/Viikki. Eur redwood.

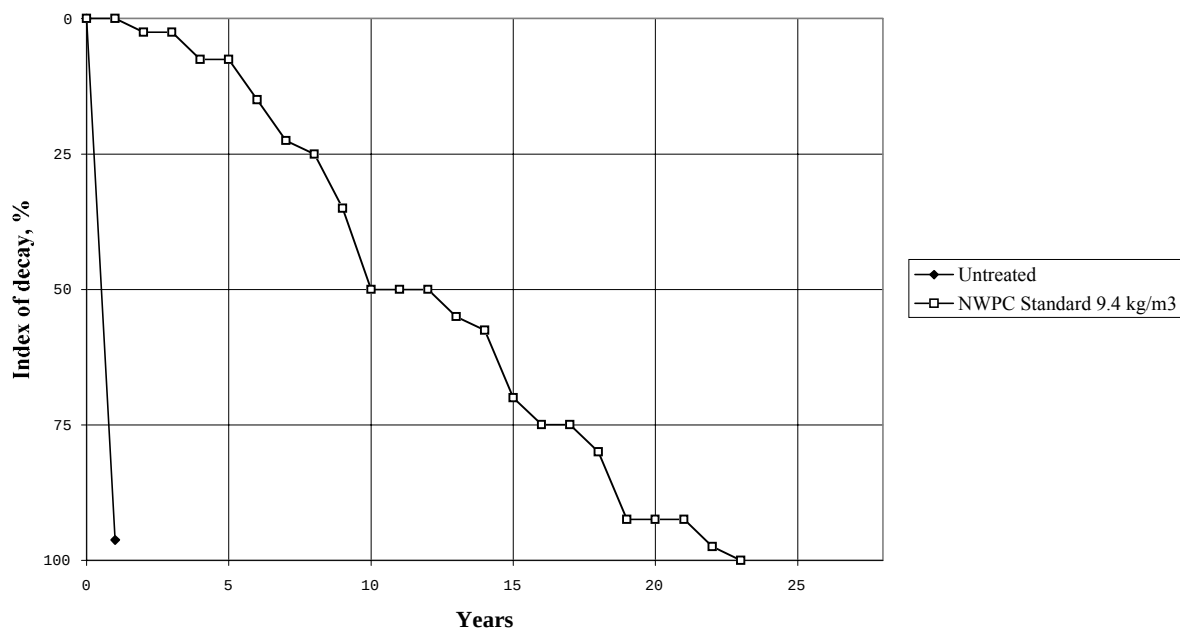


Figure 75a. Field trial 1971. Rate of decay for stakes treated with NWPC Standard Preservatives No. 1 and untreated stakes.

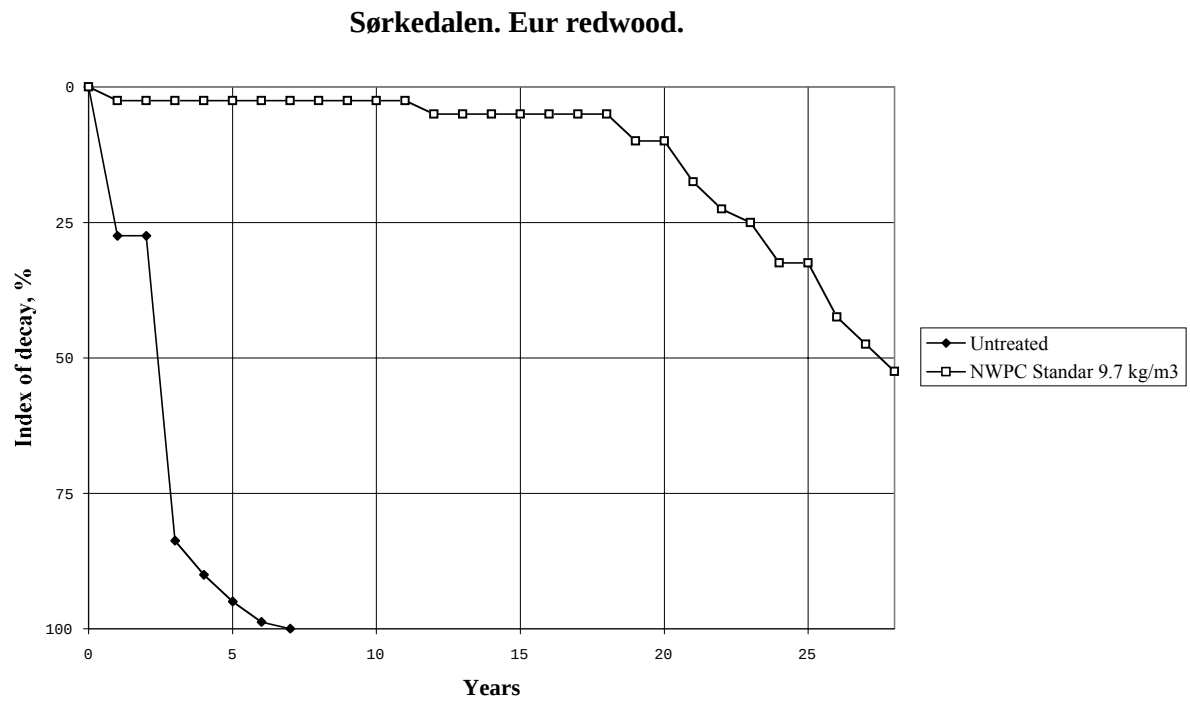
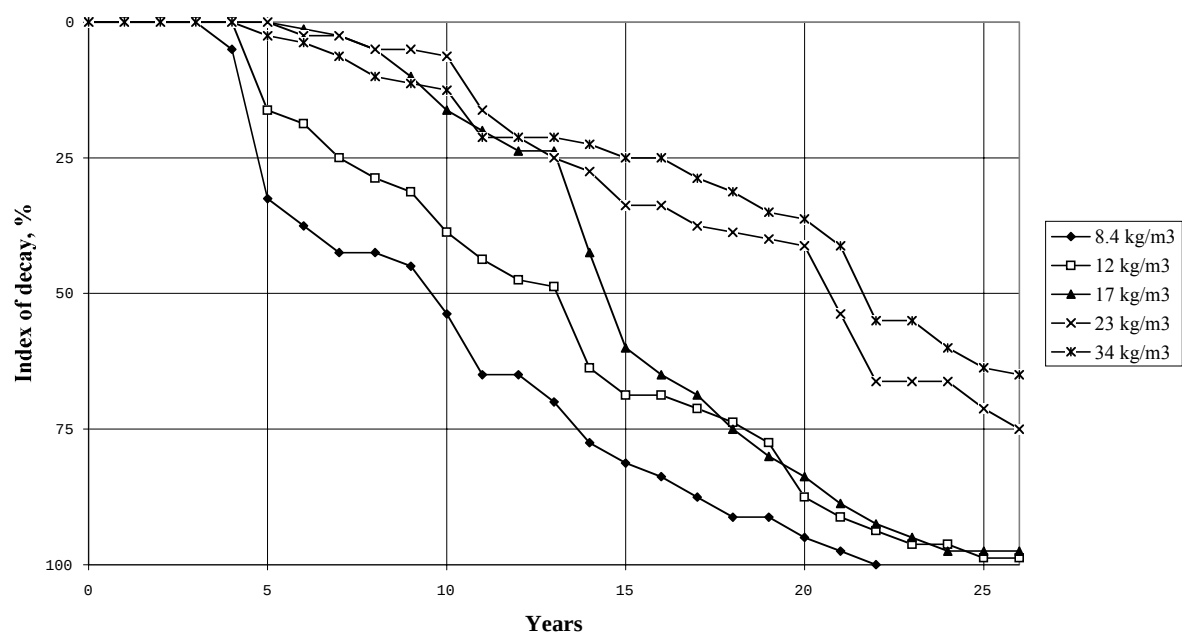


Figure 75b. Field trial 1971. Rate of decay for stakes treated with NWPC Standard Preservatives No. 1 and untreated stakes.

Simlångsdalen. Eur redwood. Boliden P50 B



Tåstrup. Eur redwood. Boliden P50 B

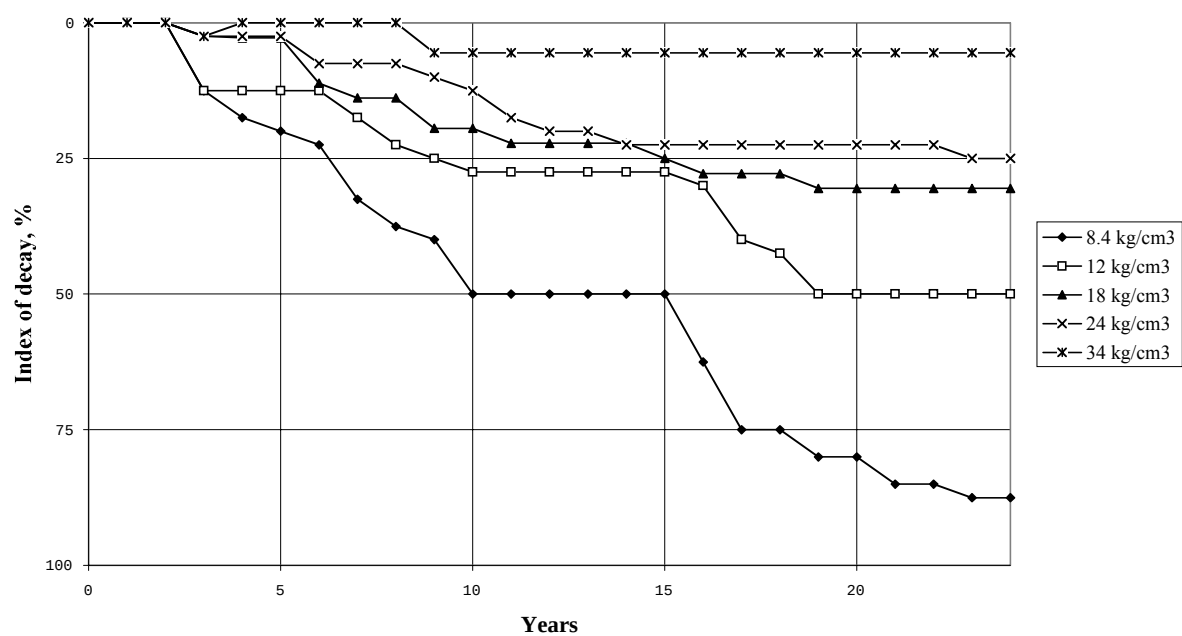
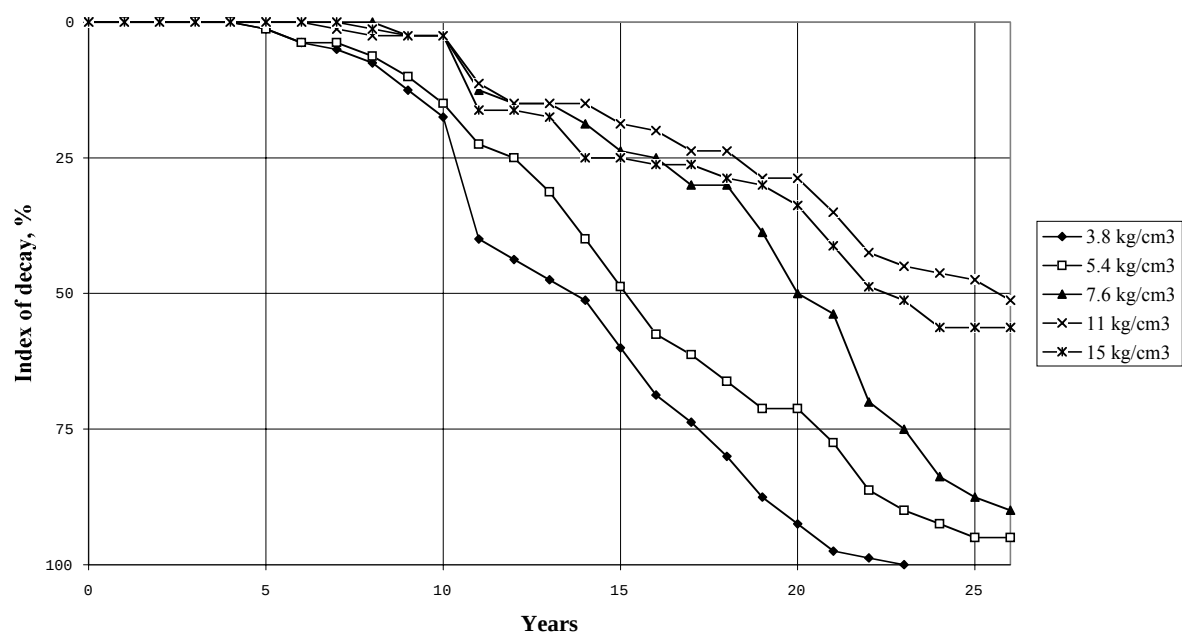


Figure 76. Field trial 1973. Rate of decay for stakes treated with Boliden P50 B.

Simlångsdalen. Eur redwood. Kemira KCA-73



Tåstrup. Eur redwood. Kemira KCA-73

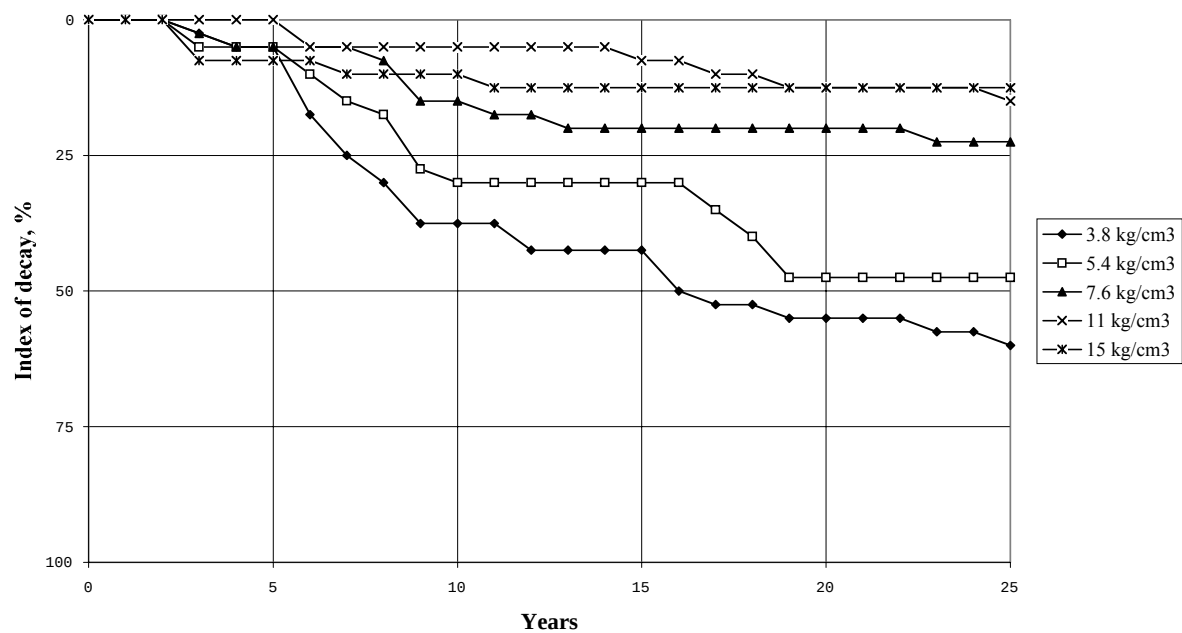
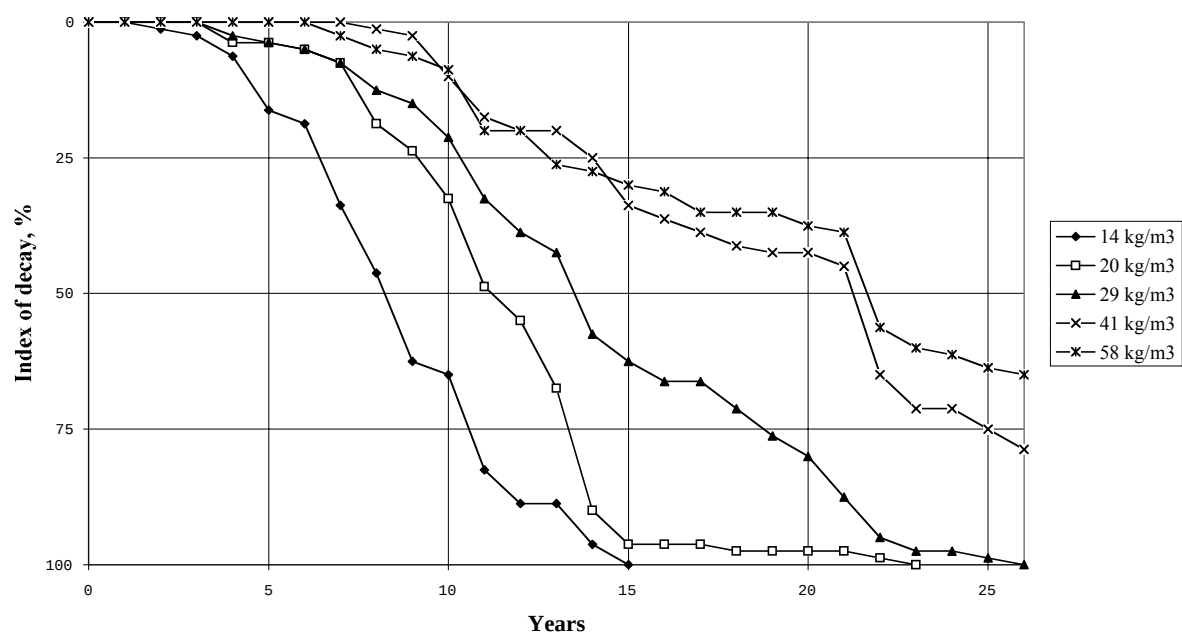


Figure 77. Field trial 1973. Rate of decay for stakes treated with Kemira KCA-73.

Simlångsdalen. Eur redwood. Amline



Vaasa/Viikki. Eur redwood. Amline

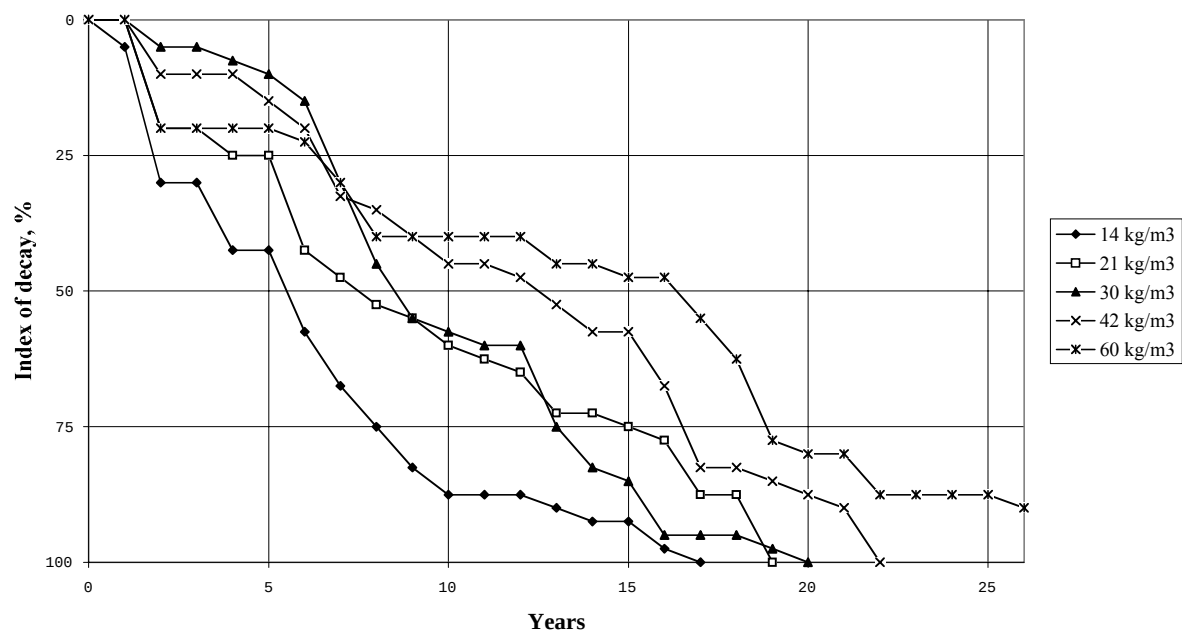
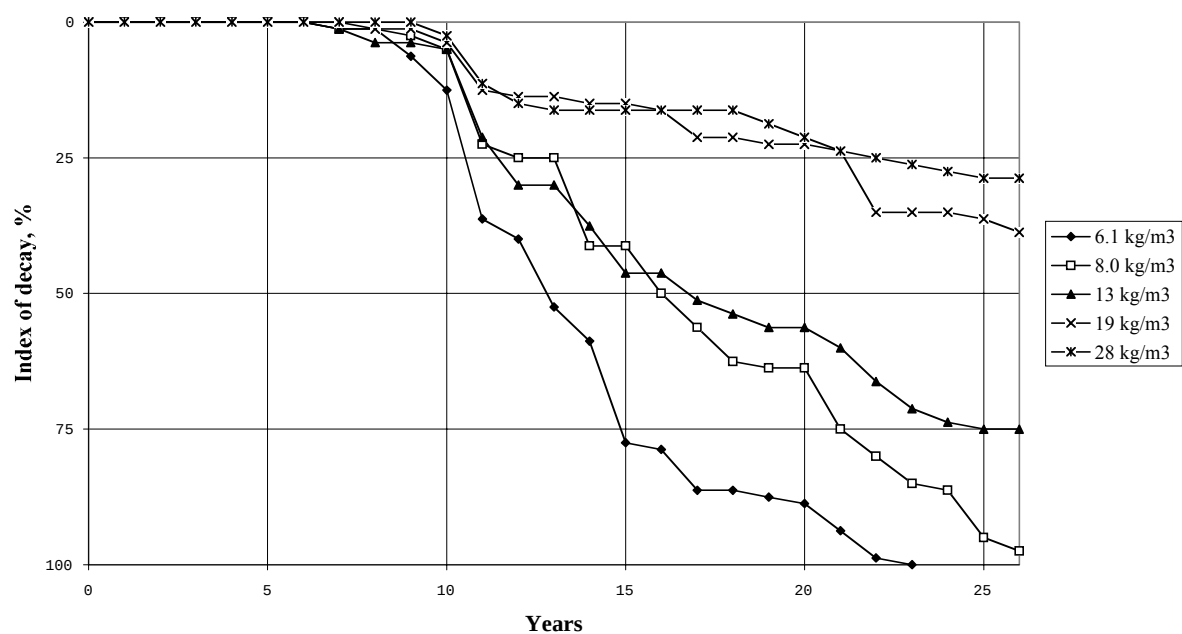


Figure 78. Field trial 1973. Rate of decay for stakes treated with Amline.

Simlångsdalen. Eur redwood. Celcure AP5



Vaasa/Viikki. Eur redwood. Celcure AP5

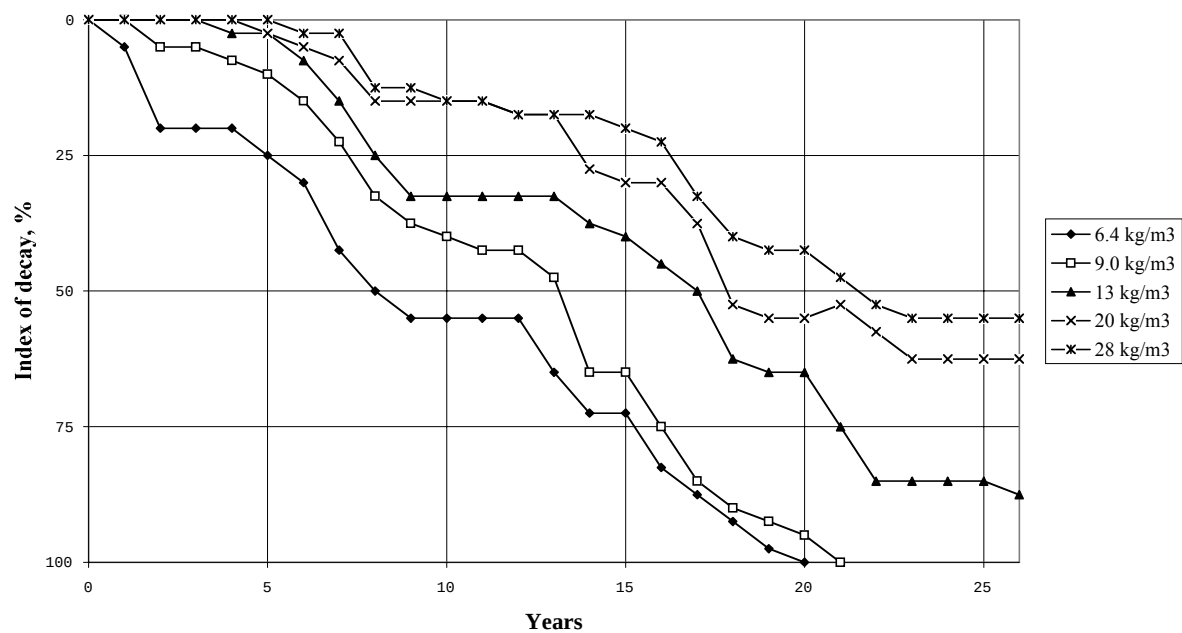
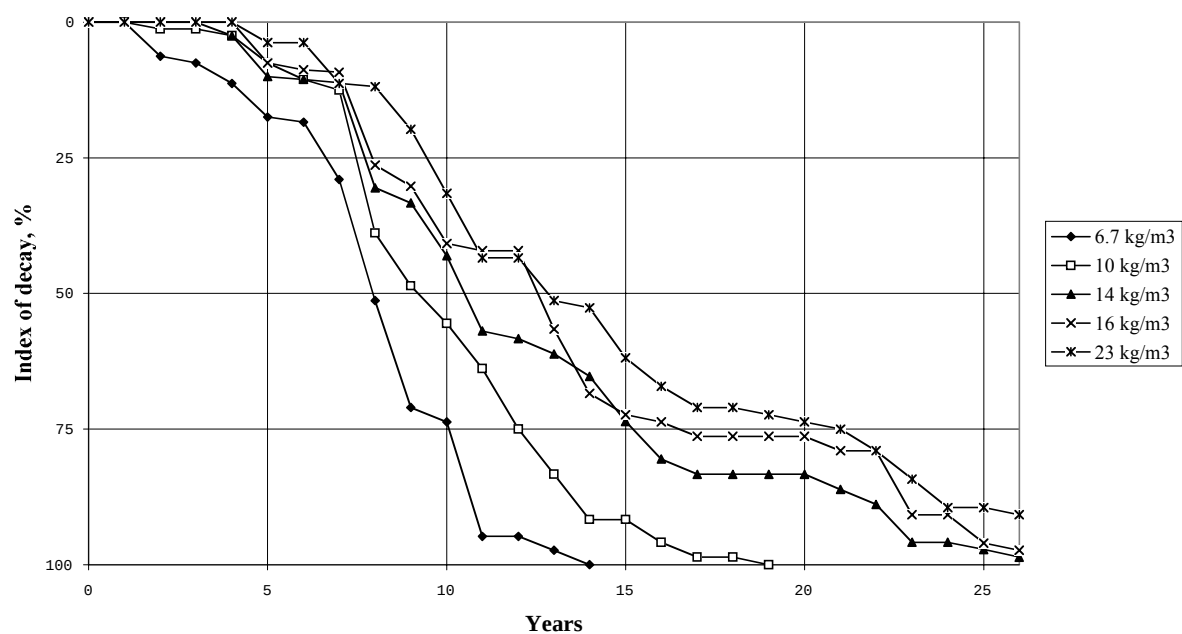


Figure 79. Field trial 1973. Rate of decay for stakes treated with Celcure AP5.

Simlångsdalen. Eur redwood. Hylosan PT



Vaasa/Viikki. Eur redwood. Hylosan PT

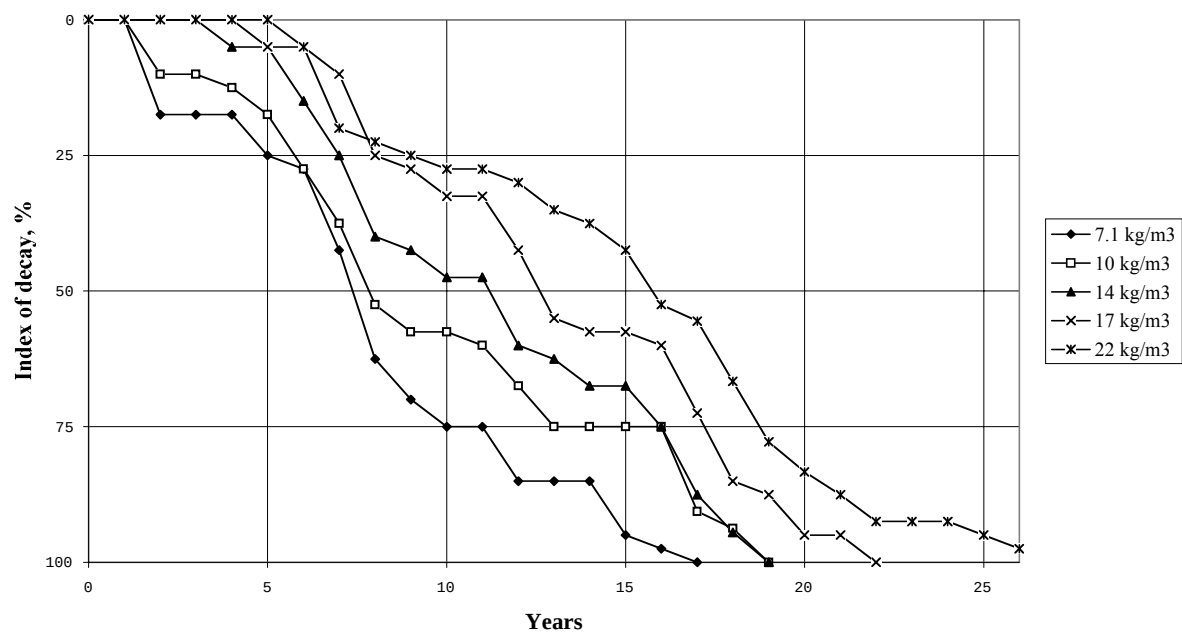
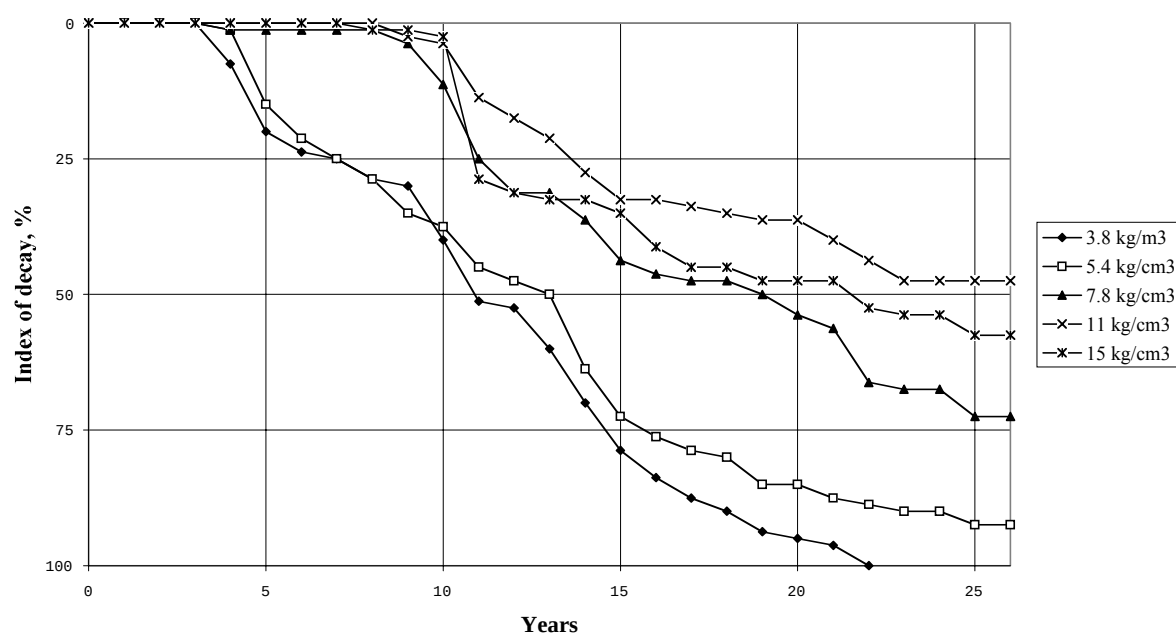


Figure 80. Field trial 1973. Rate of decay for stakes treated with Hylosan PT.

Simlångsdalen. Eur redwood. Kemira KC-73



Sørkedalen. Eur redwood. Kemira KC-73

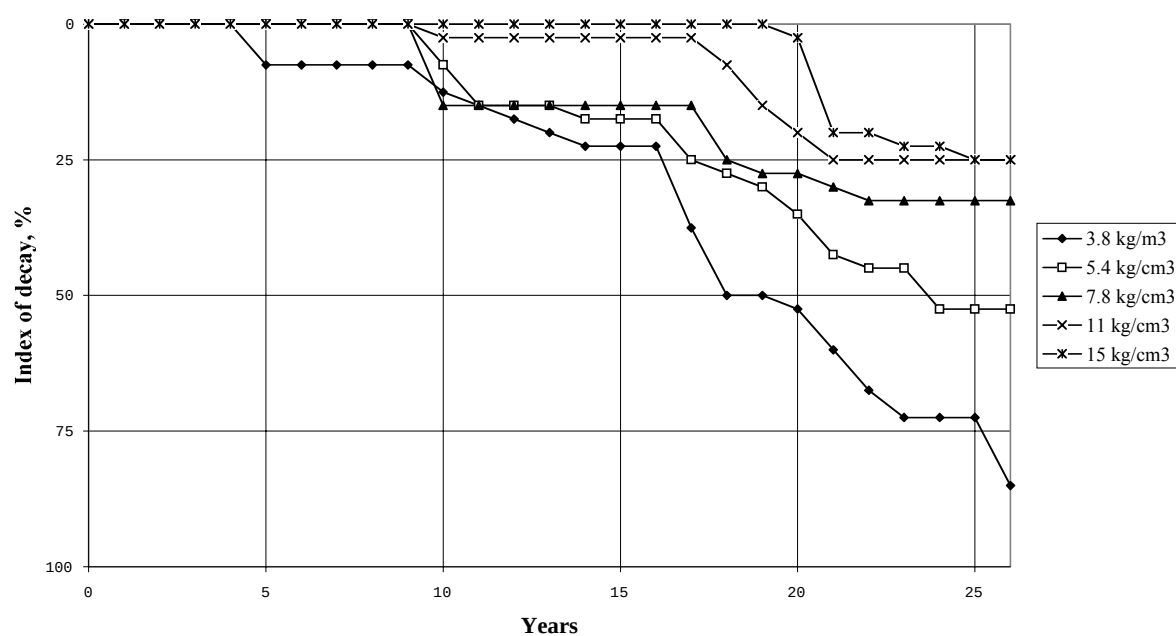
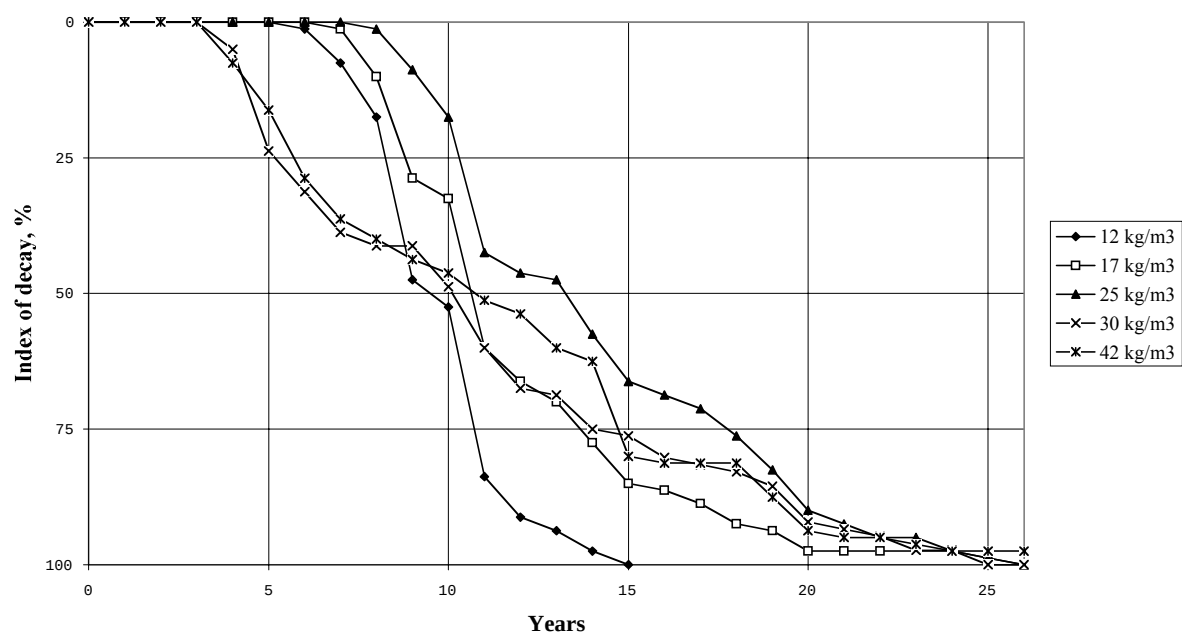


Figure 81. Field trial 1973. Rate of decay for stakes treated with Kemira KC 73.

Simlångsdalen. Eur redwood. Kemira KFN-73



Sørkedalen. Eur redwood. Kemira KFN-73

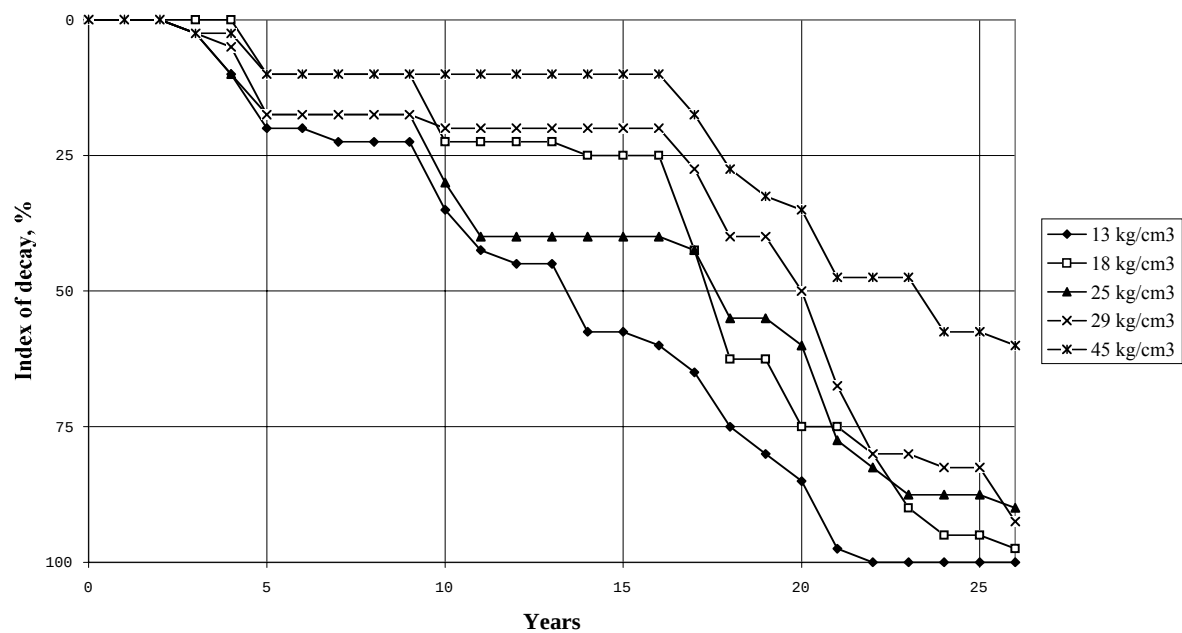


Figure 82. Field trial 1973. Rate of decay for stakes treated with Kemira KFN-73.

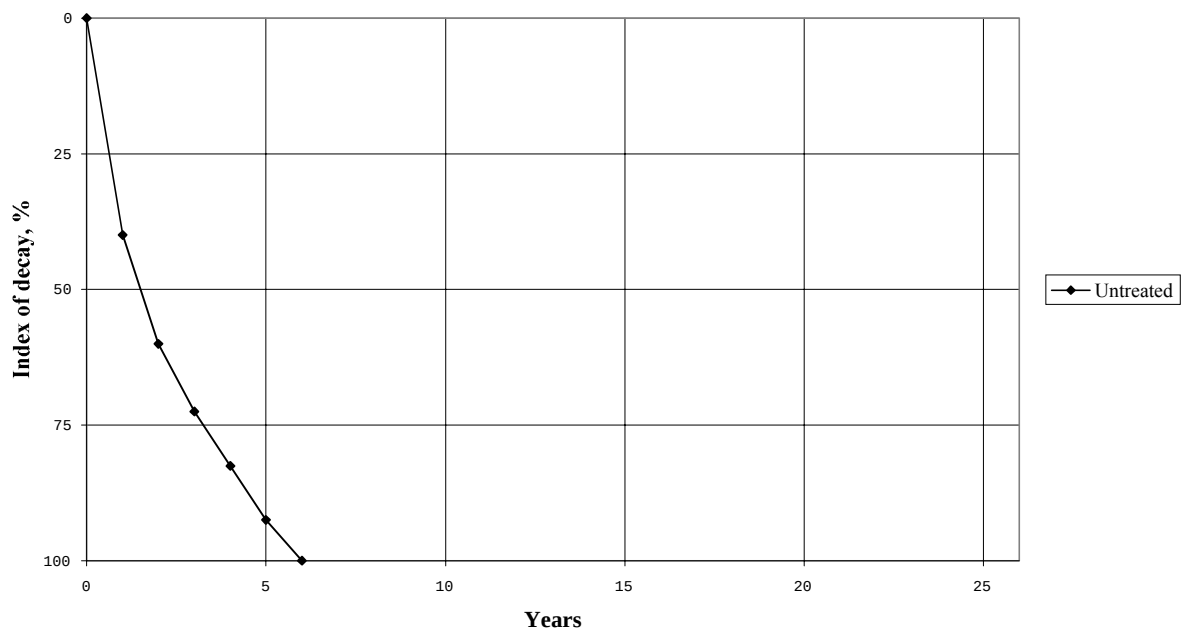
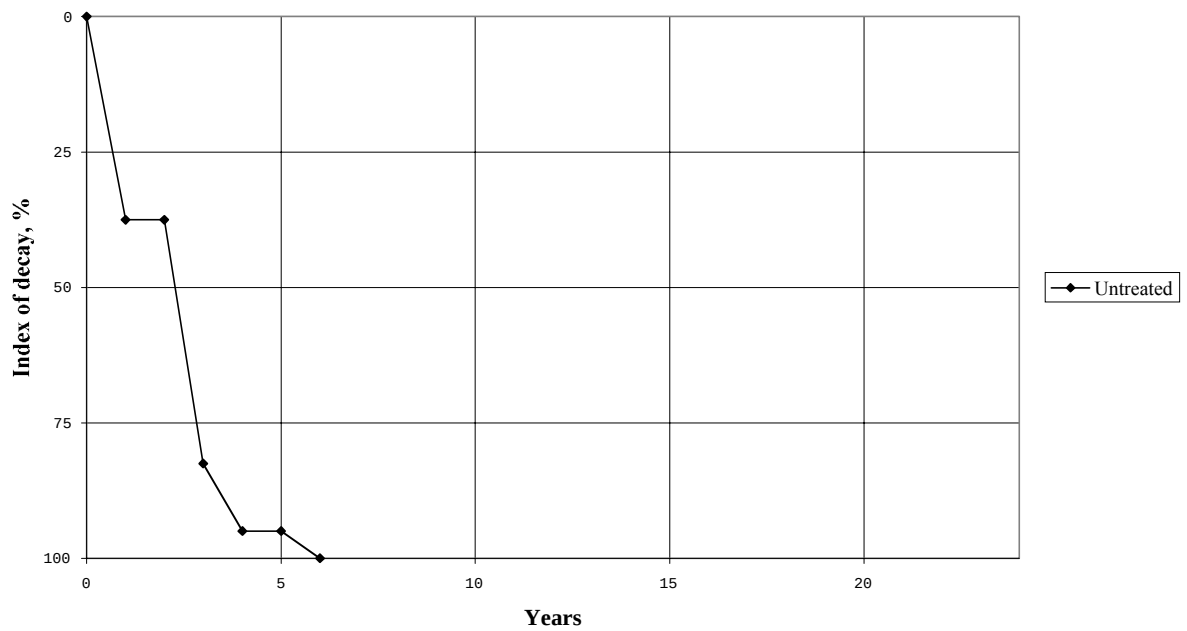
Simlångsdalen. Eur redwood.**Tåstrup. Eur redwood.**

Figure 83a. Field trial 1973. Rate of decay for untreated stakes.

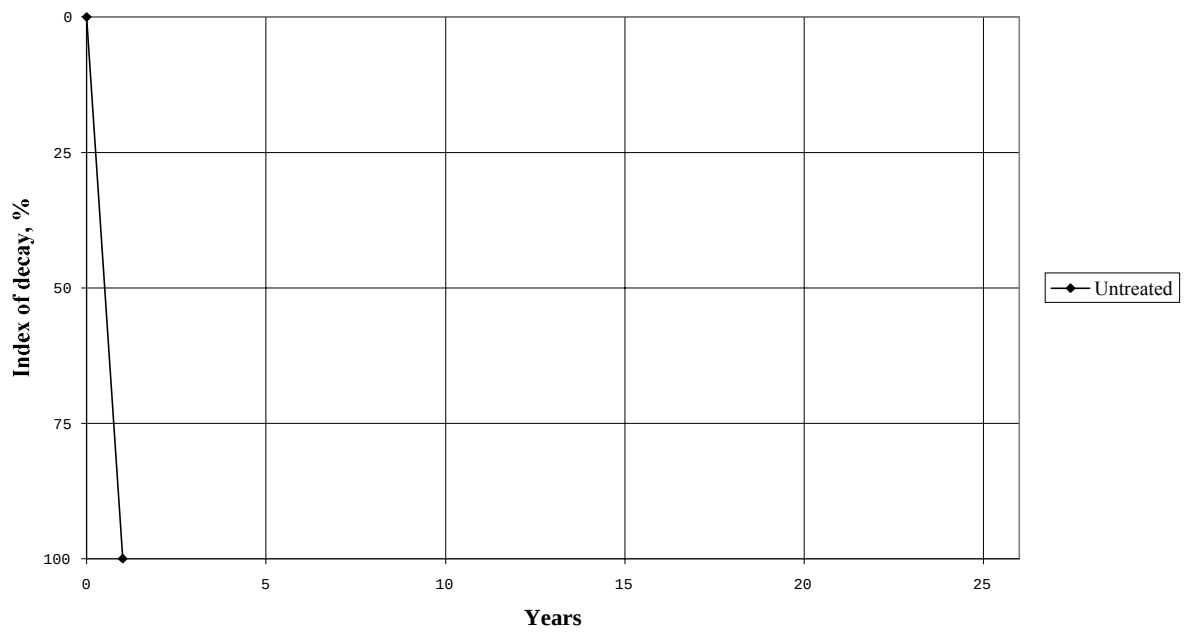
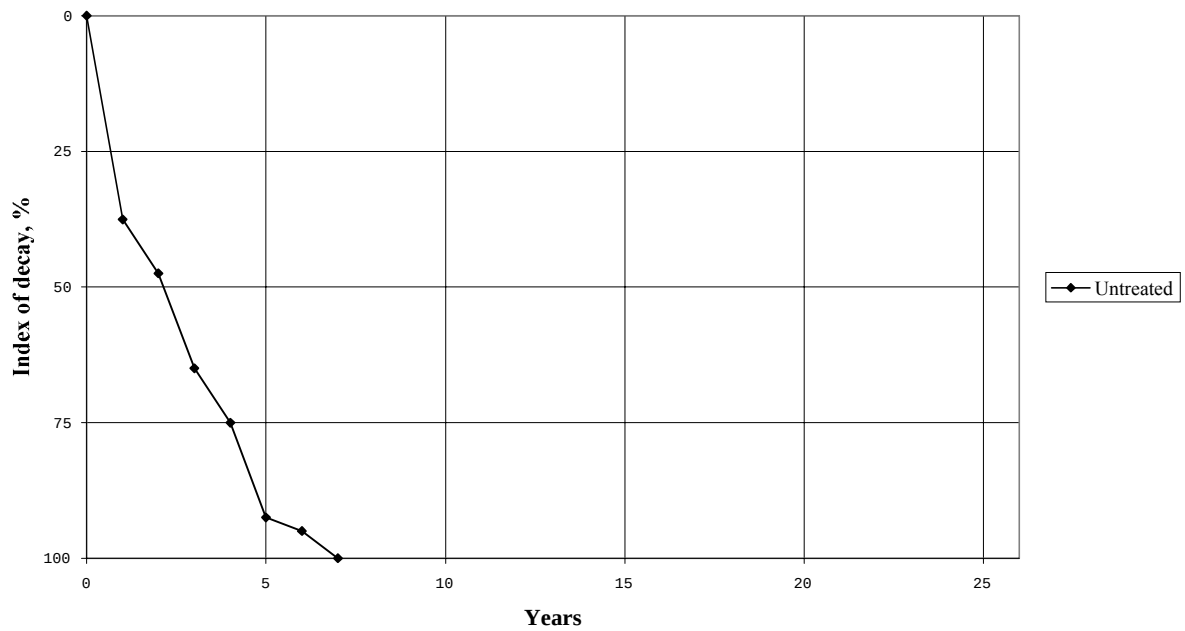
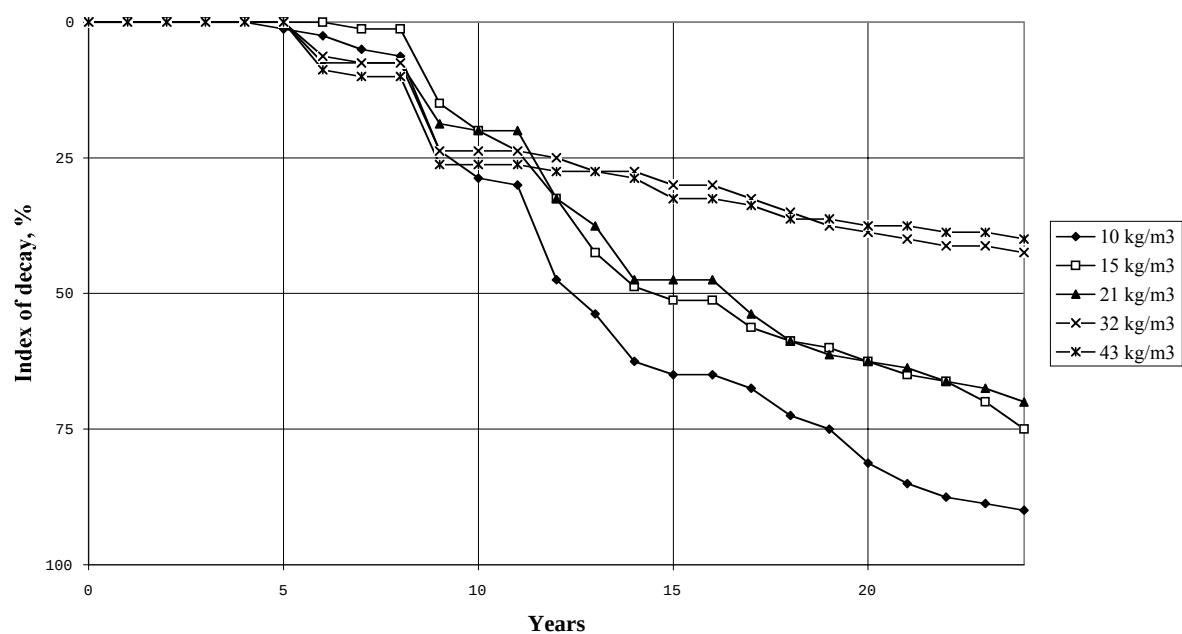
Vaasa/Viikki. Eur redwood.**Sørkedalen. Eur redwood.**

Figure 83b. Field trial 1973. Rate of decay for untreated stakes.

Simlångsdalen. Eur redwood. Basilit KM



Tåstrup. Eur redwood. Basilit KM

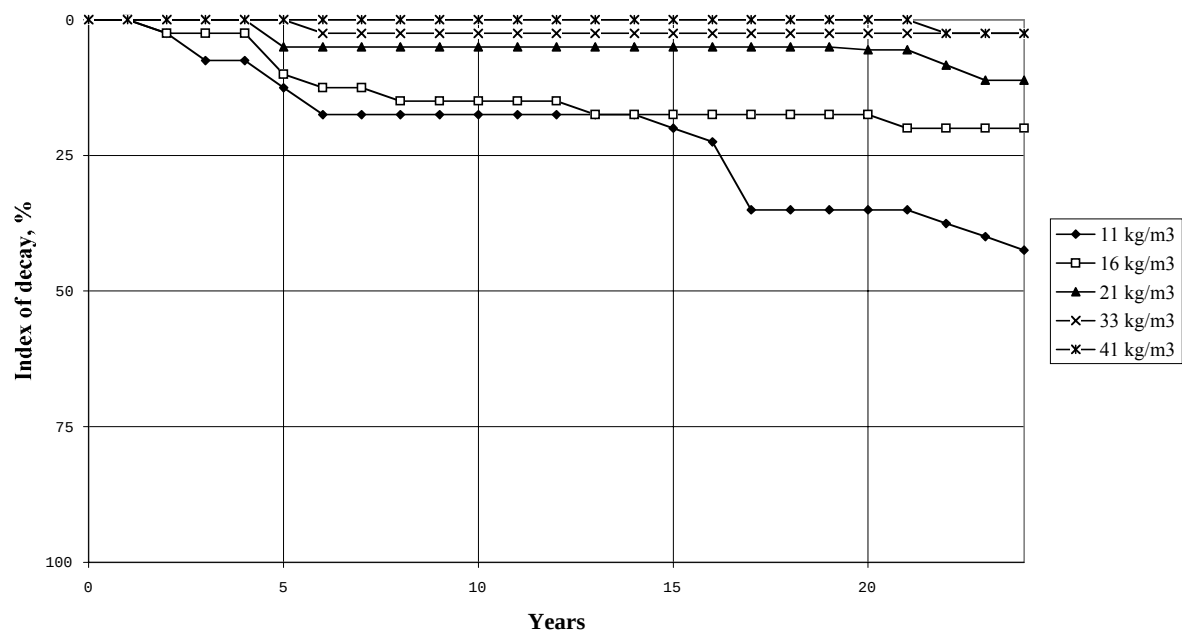
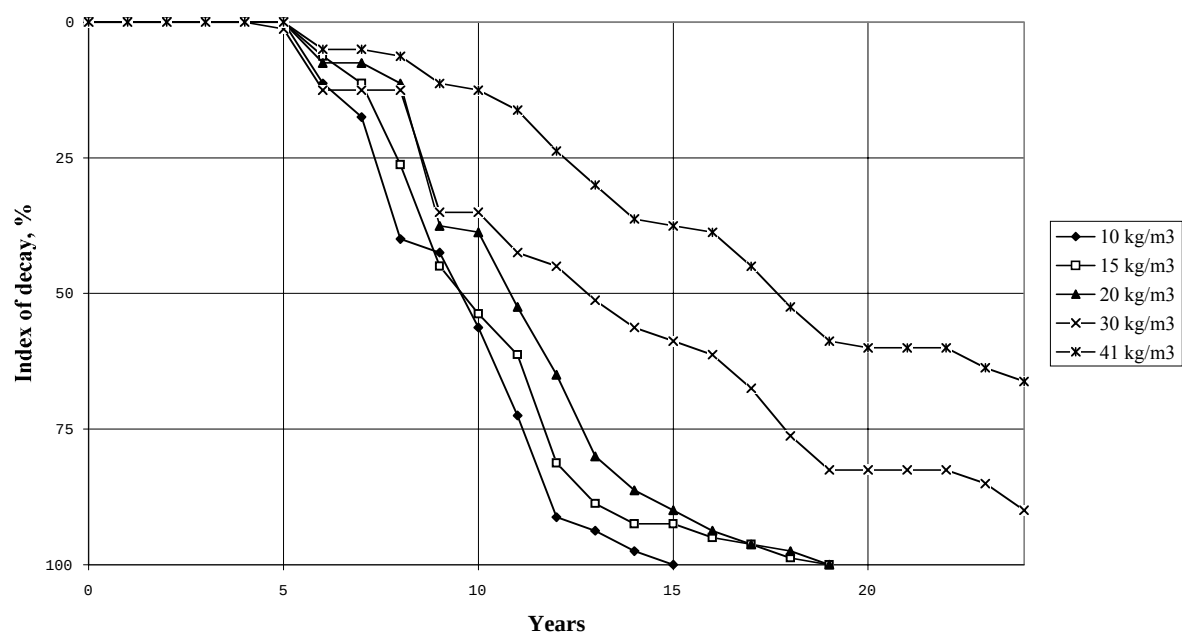


Figure 84. Field trial 1975. Rate of decay for stakes treated with Basilit KM.

Simlångsdalen. Eur redwood. Gufa 521



Tåstrup. Eur redwood. Gufa 521

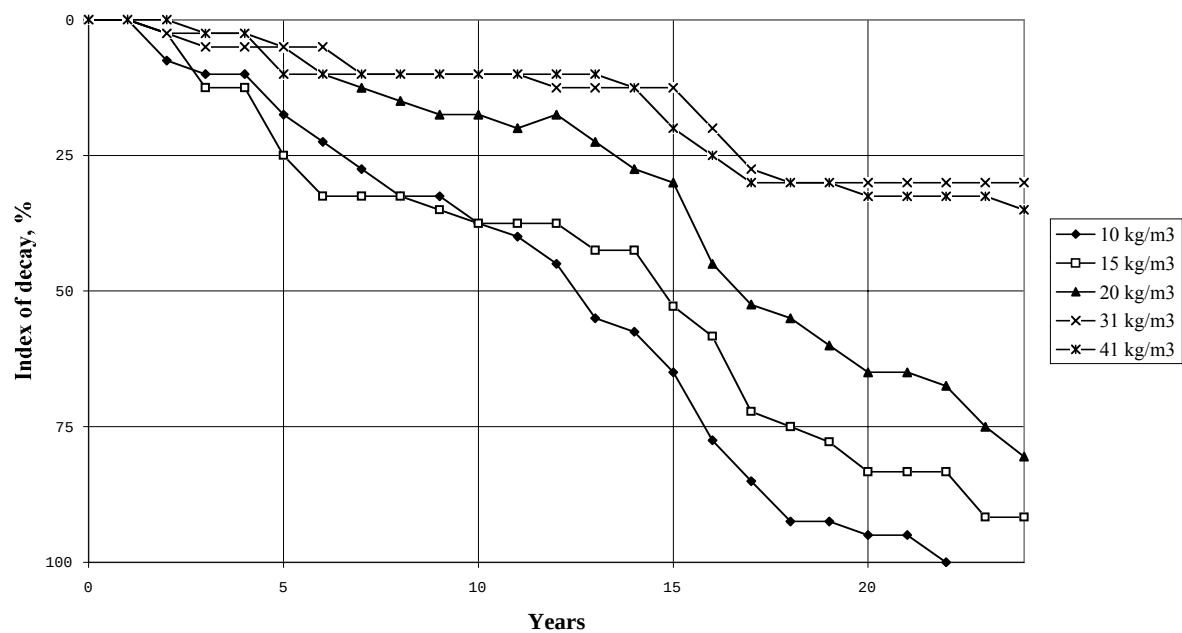
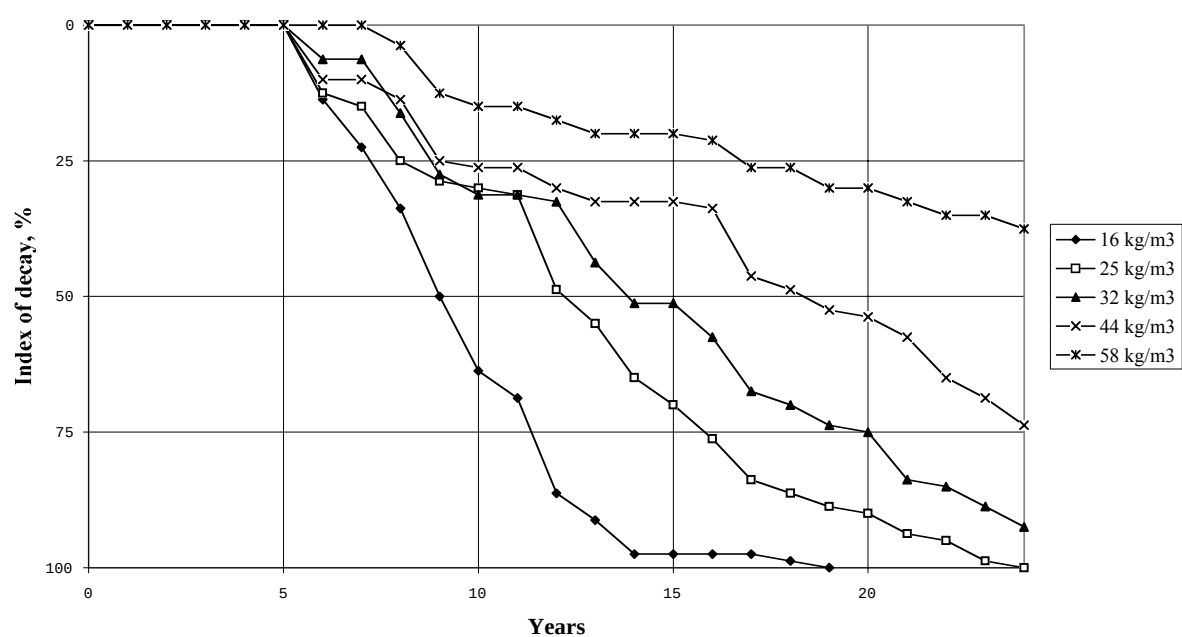


Figure 85. Field trial 1975. Rate of decay for stakes treated with Gufa 521.

Simlångsdalen. Eur redwood. Kemira K-75



Tåstrup. Eur redwood. Kemira K-75

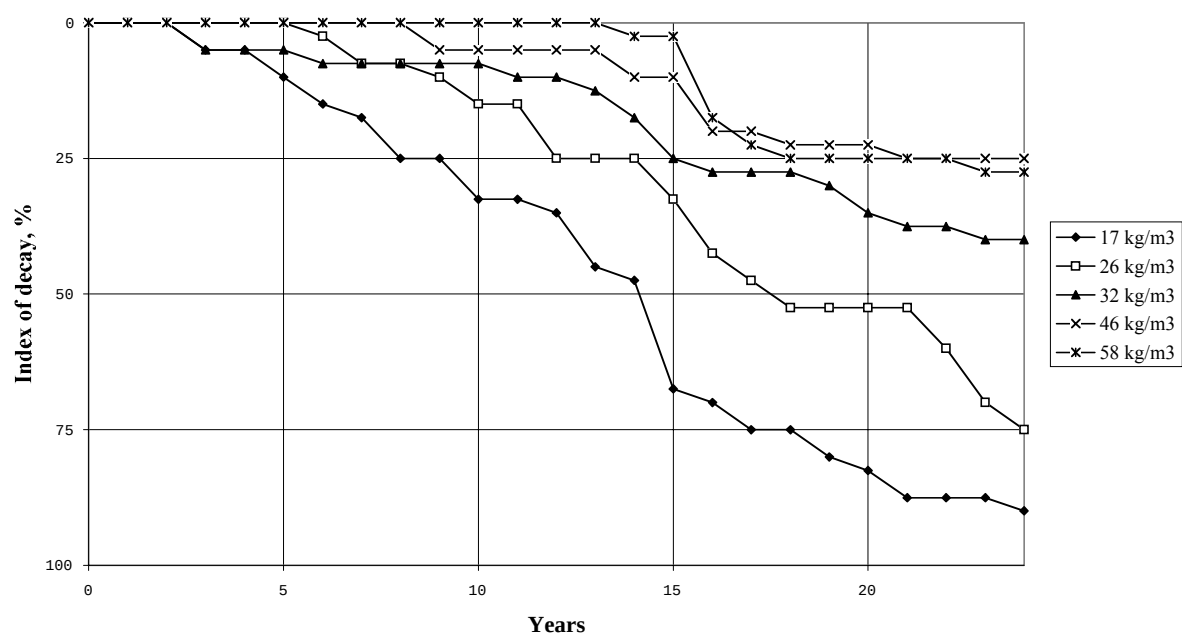
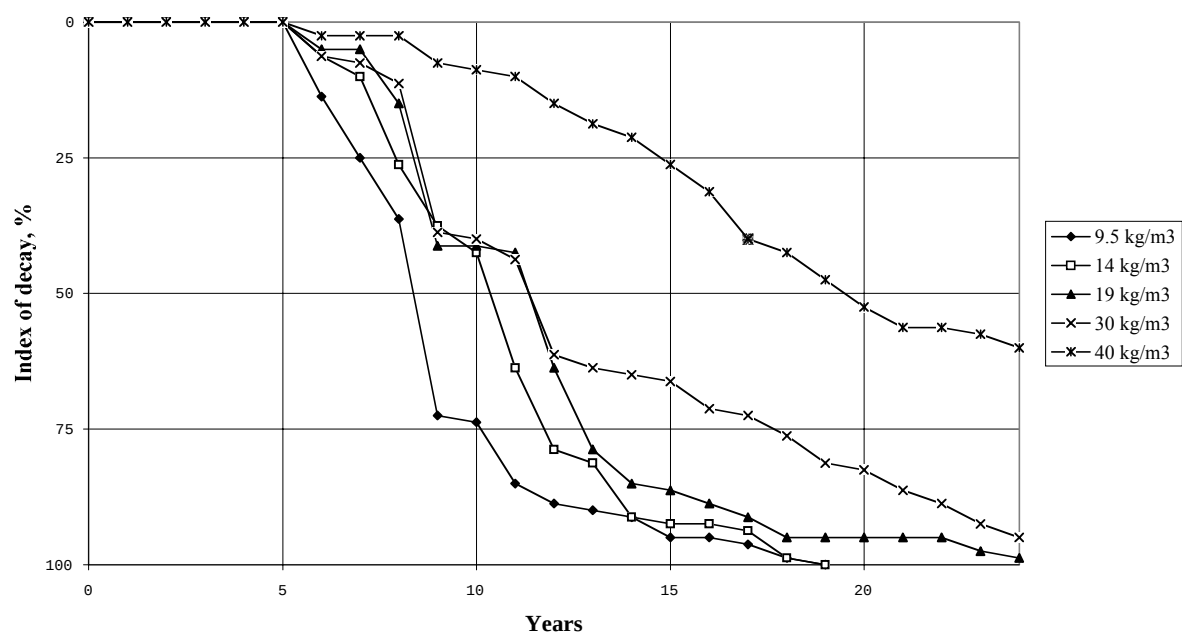


Figure 86. Field trial 1975. Rate of decay for stakes treated with Kemira K-75.

Simlångsdalen. Eur redwood. Kemira KB-75



Tåstrup. Eur redwood. Kemira KB-75

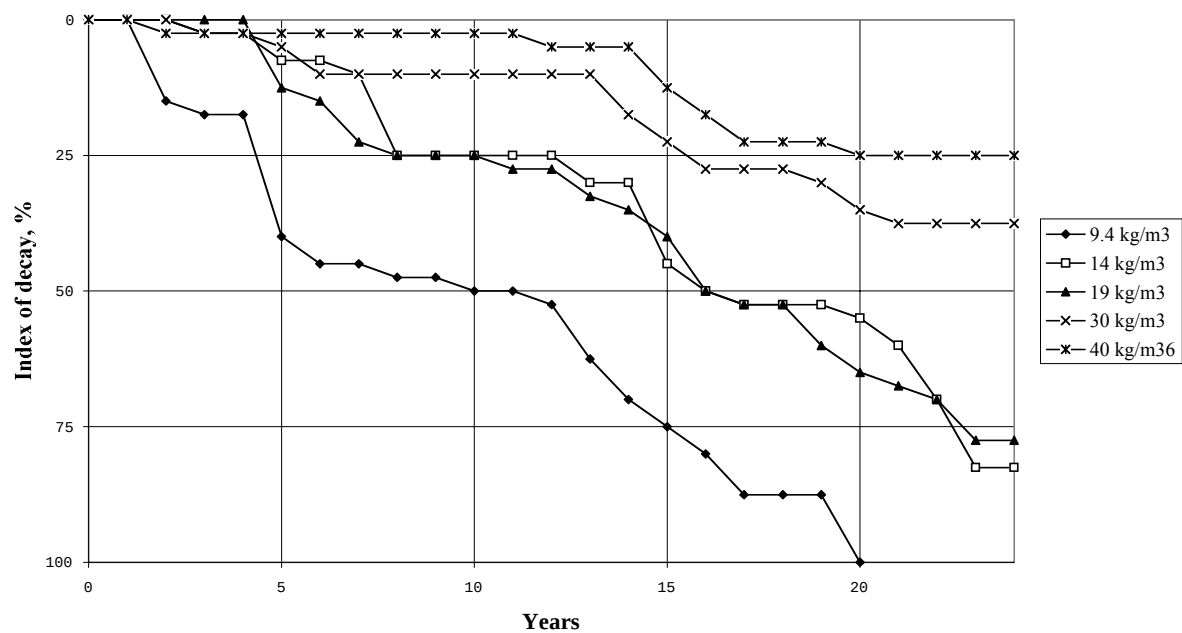
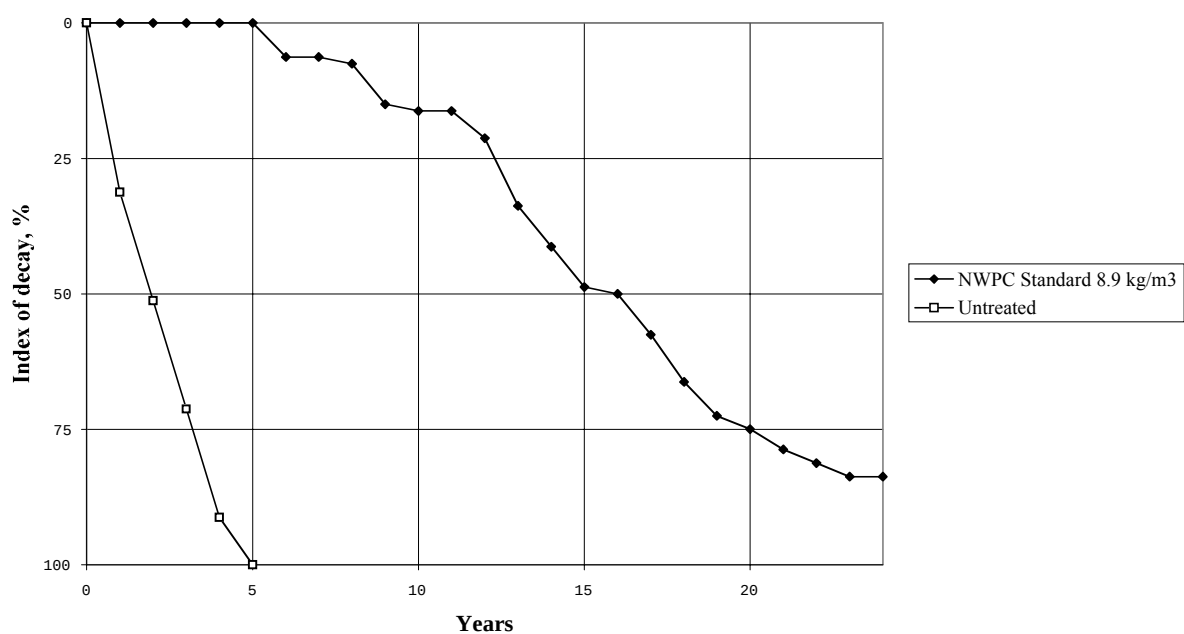


Figure 87. Field trial 1975. Rate of decay for stakes treated with Kemira KB-75.

Simlångsdalen. Eur redwood.



Tåstrup. Eur redwood.

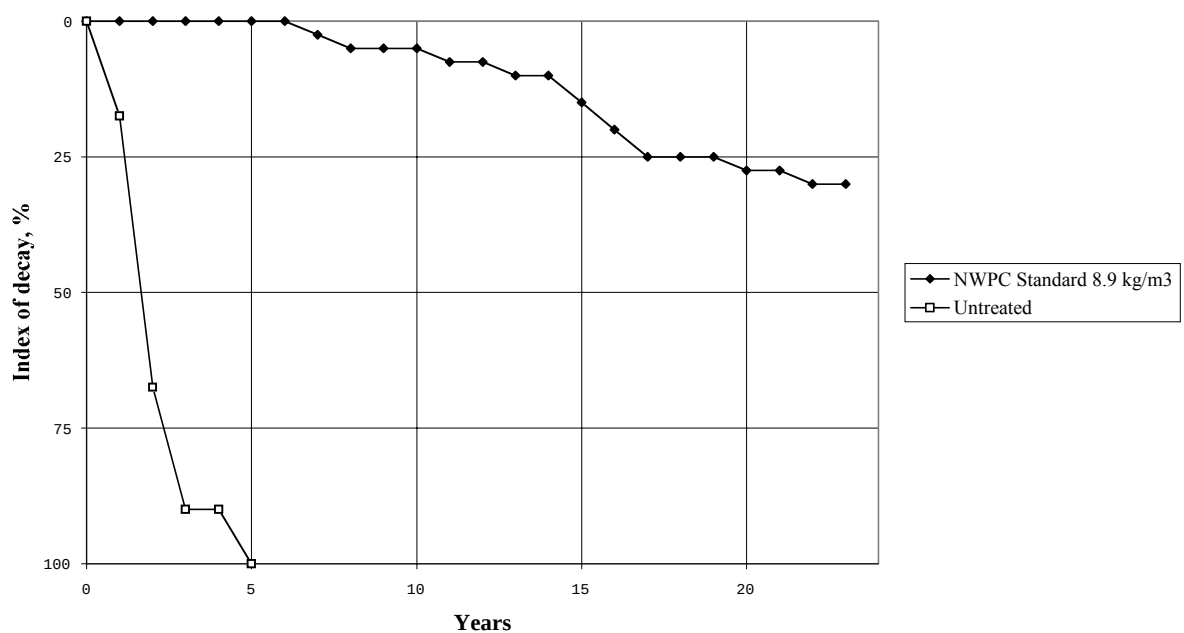
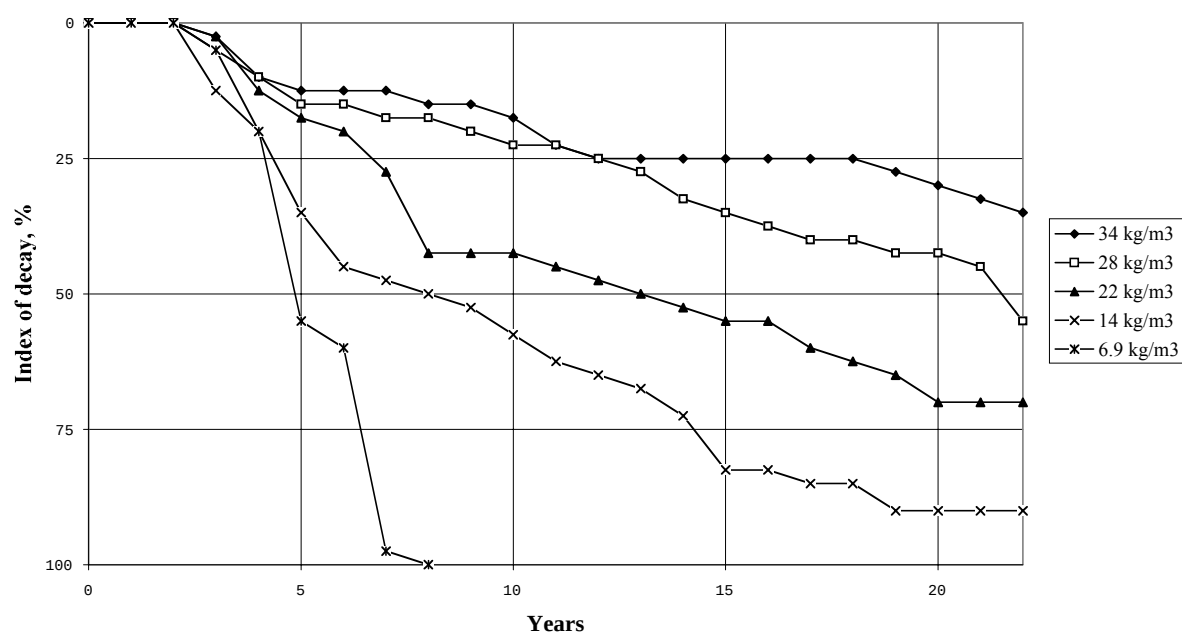


Figure 88. Field trial 1975. Rate of decay for stakes treated with NWPC Standard Preservative No. 1 and untreated stakes.

Simlångsdalen. Eur redwood. Basilit CCB



Vaasa/Viikki. Eur redwood. Basilit CCB

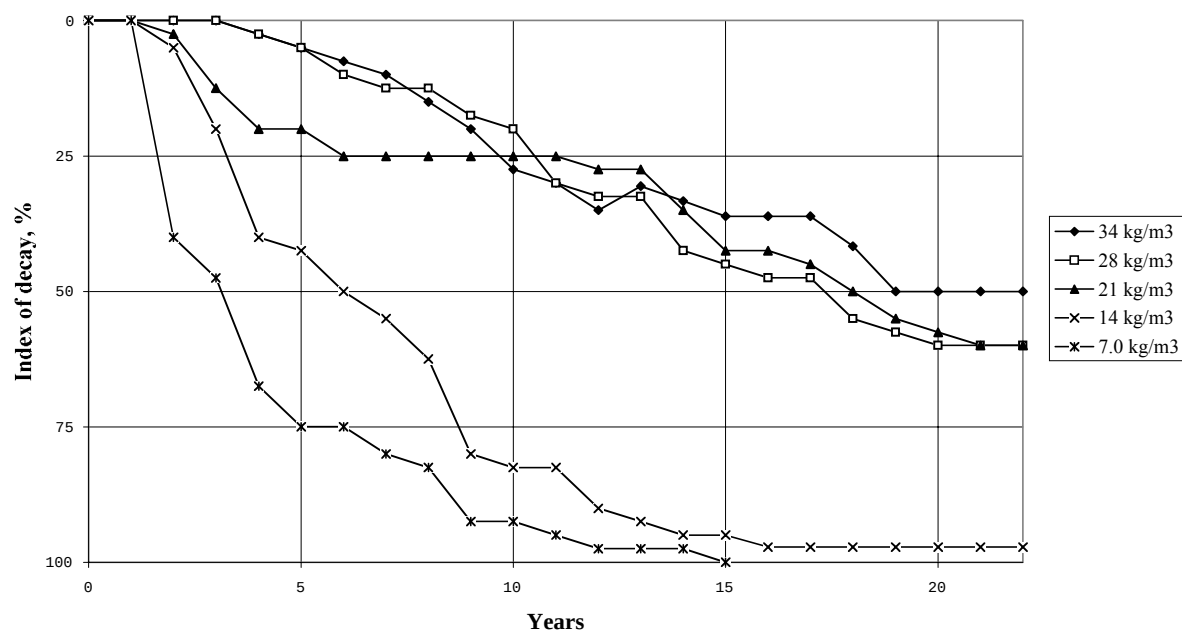


Figure 89a. Field trial 1977. Rate of decay for stakes treated with Basilit CCB.

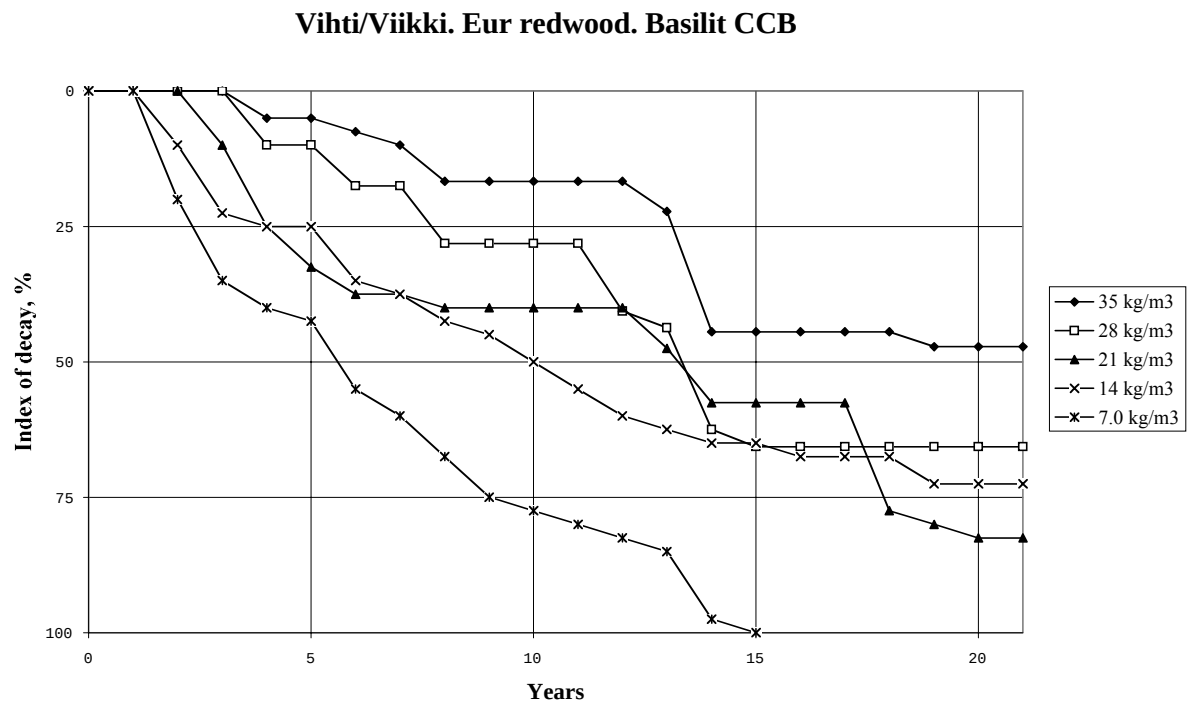
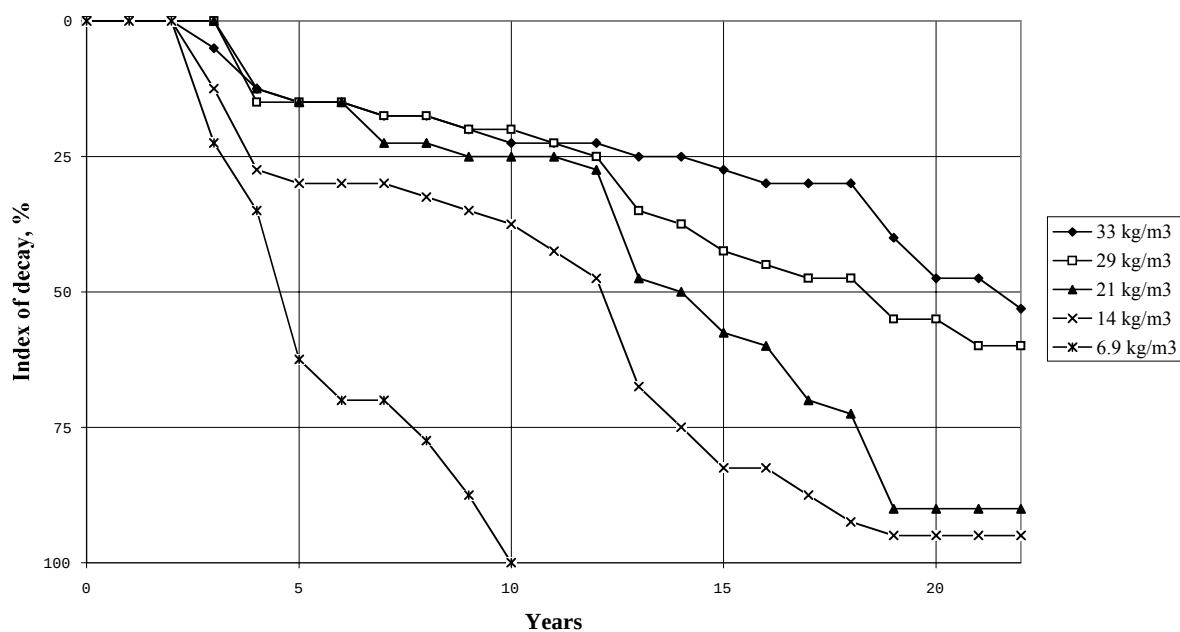


Figure 89b. Field trial 1977. Rate of decay for stakes treated with Basilit CCB.

Simlångsdalen. Eur redwood. Boliden P50



Vaasa/Viikki. Eur redwood. Boliden P50

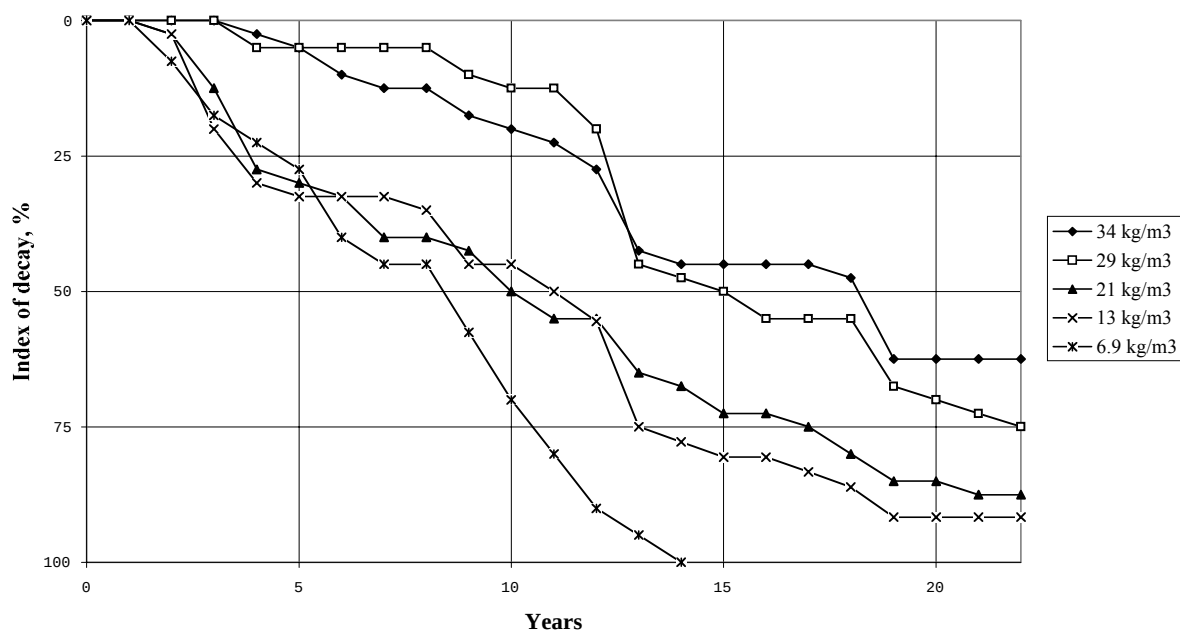


Figure 90a. Field trial 1977. Rate of decay for stakes treated with Boliden P 50.

Vaasa/Viikki. Eur redwood. Boliden P50

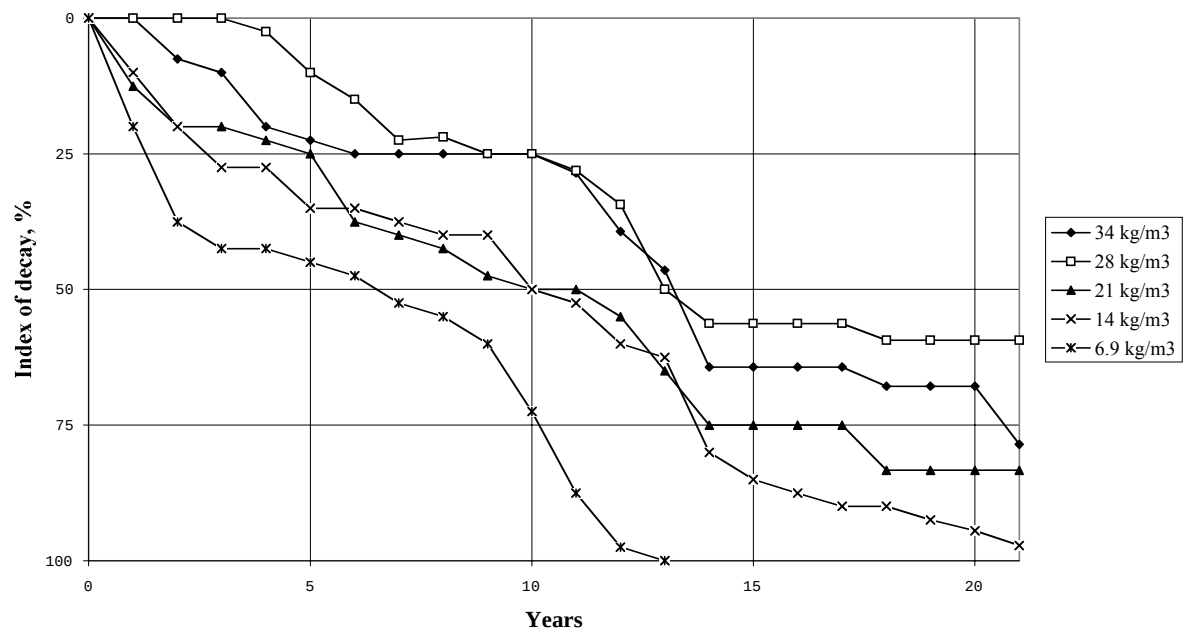
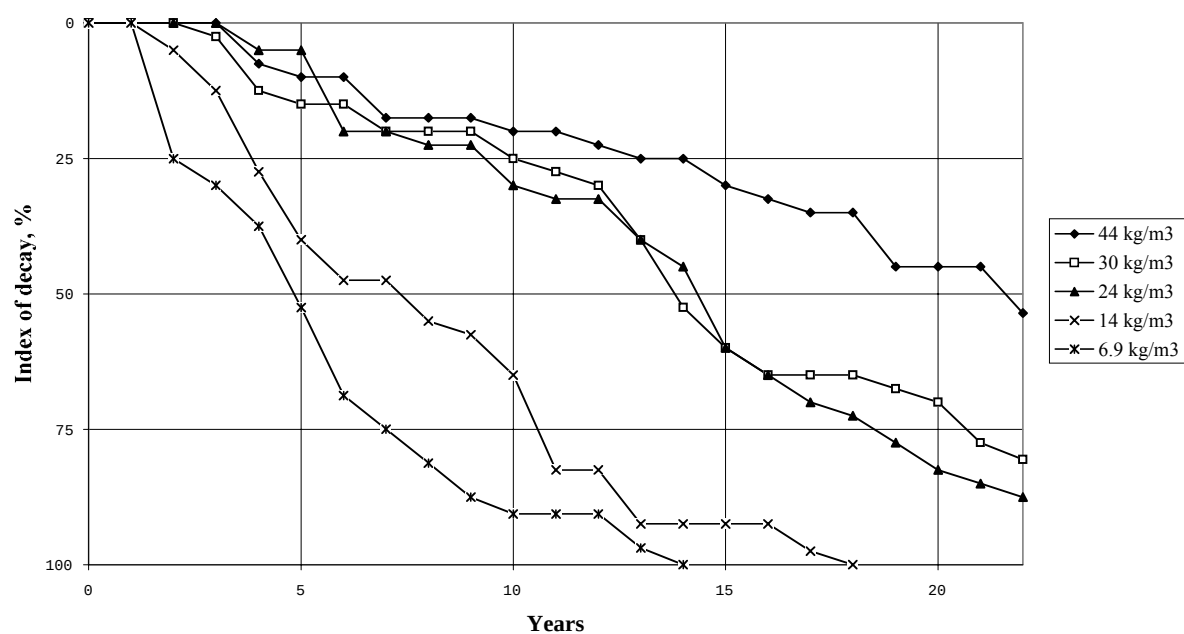


Figure 90b. Field trial 1977. Rate of decay for stakes treated with Boliden P 50.

Simlångsdalen. Eur redwood. Cuprinol Tryck



Vaasa/Viikki. Eur redwood. Cuprinol Tryck

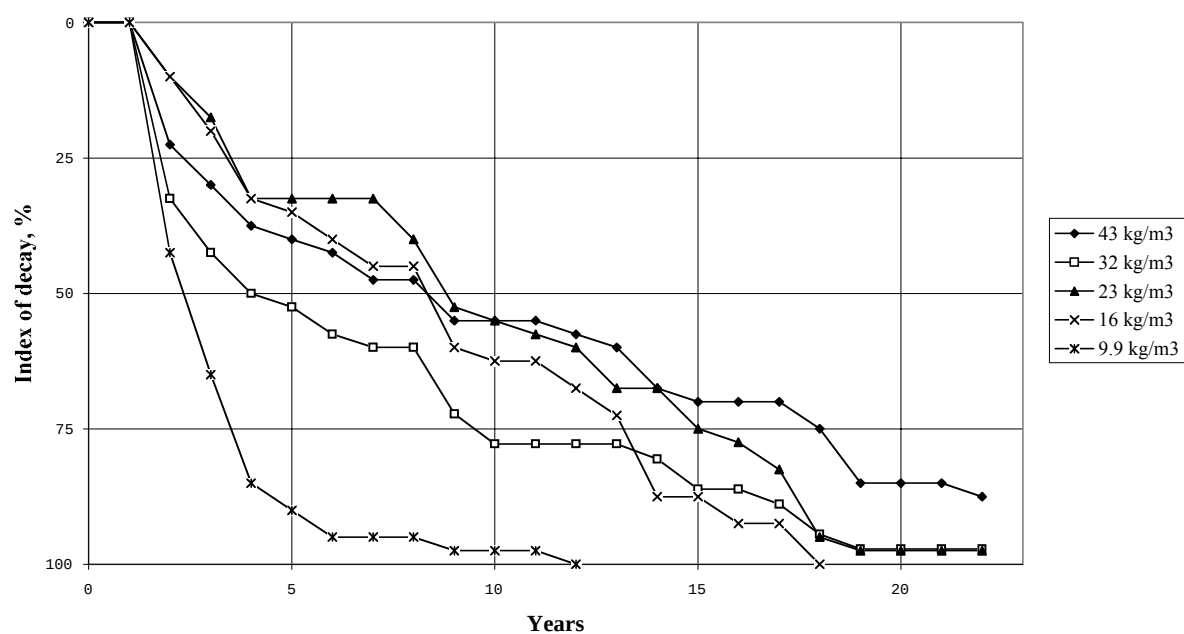


Figure 91a. Field trial 1977. Rate of decay for stakes treated with Cuprinol Tryck.

Vihti/Viikki. Eur redwood. Cuprinol Tryck

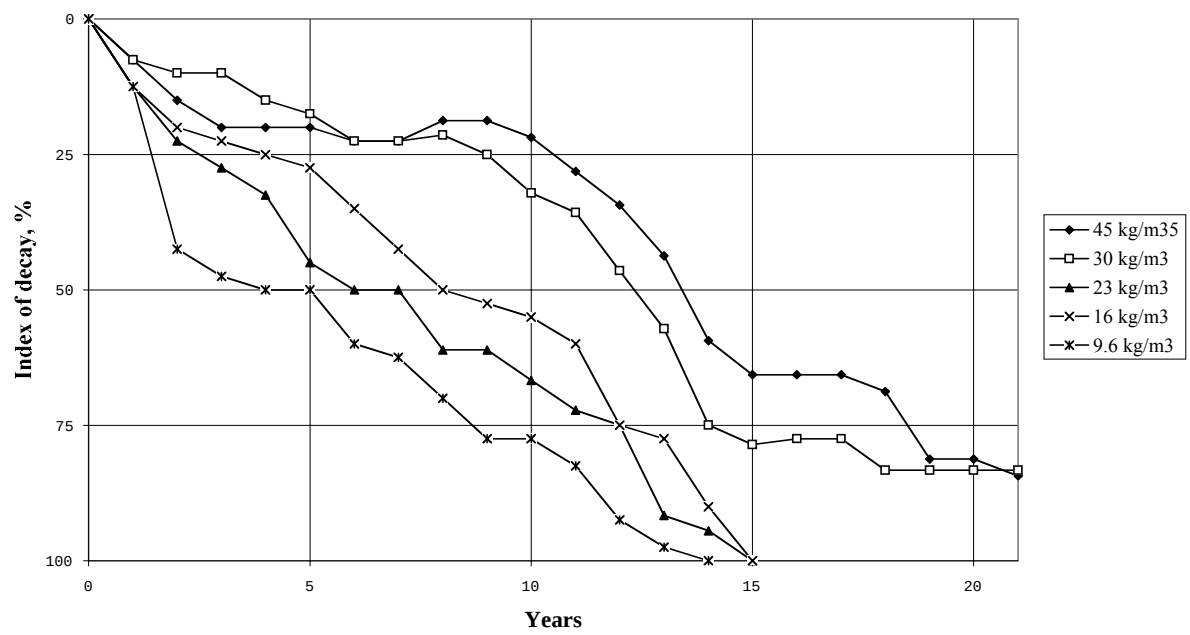
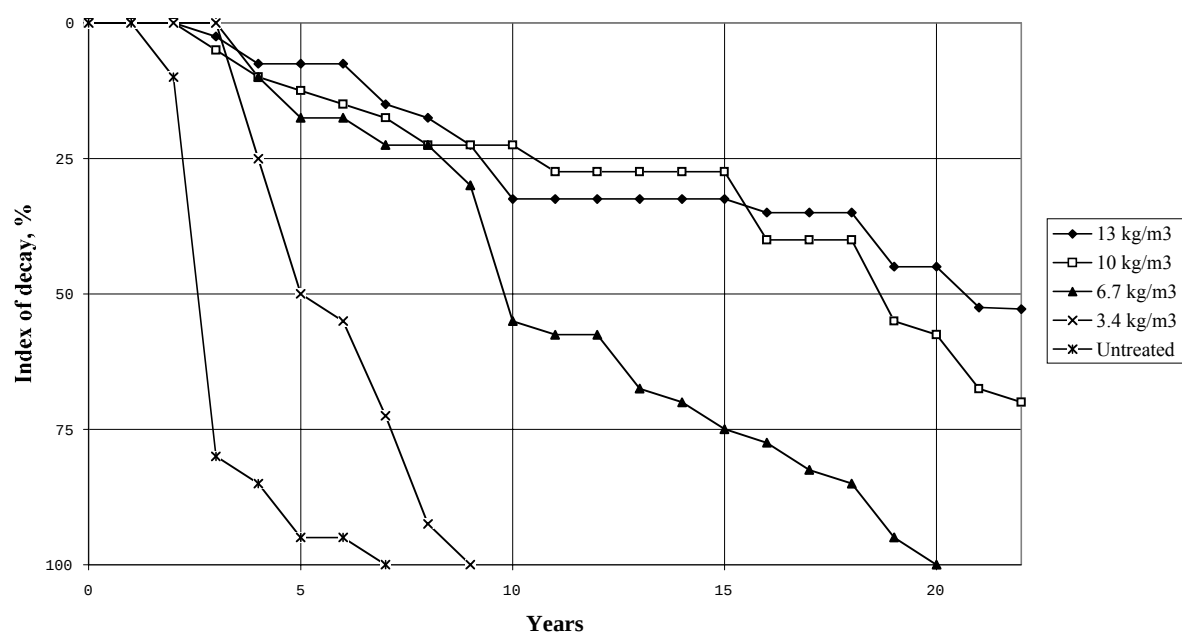


Figure 91b. Field trial 1977. Rate of decay for stakes treated with Cuprinol Tryck.

Simlångsdalen. Eur redwood. NWPC Standard



Vaasa/Viikki. Eur redwood. NWPC Standard

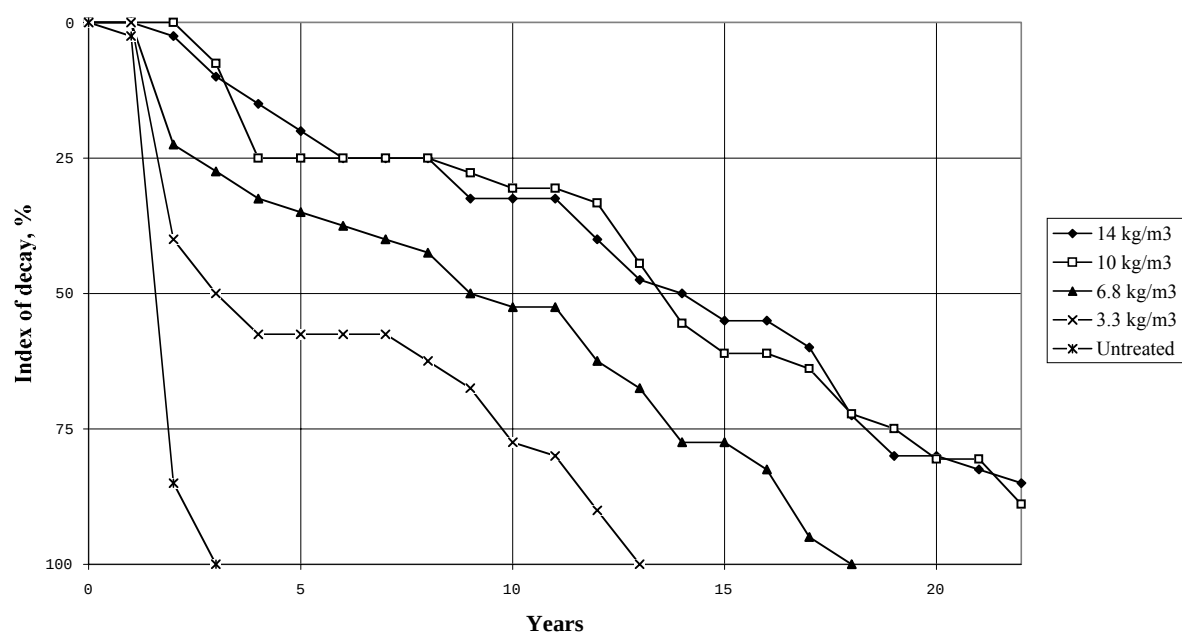


Figure 92a. Field trial 1977. Rate of decay for stakes treated with NWPC Standard Preservative No. 1 and untreated stakes.

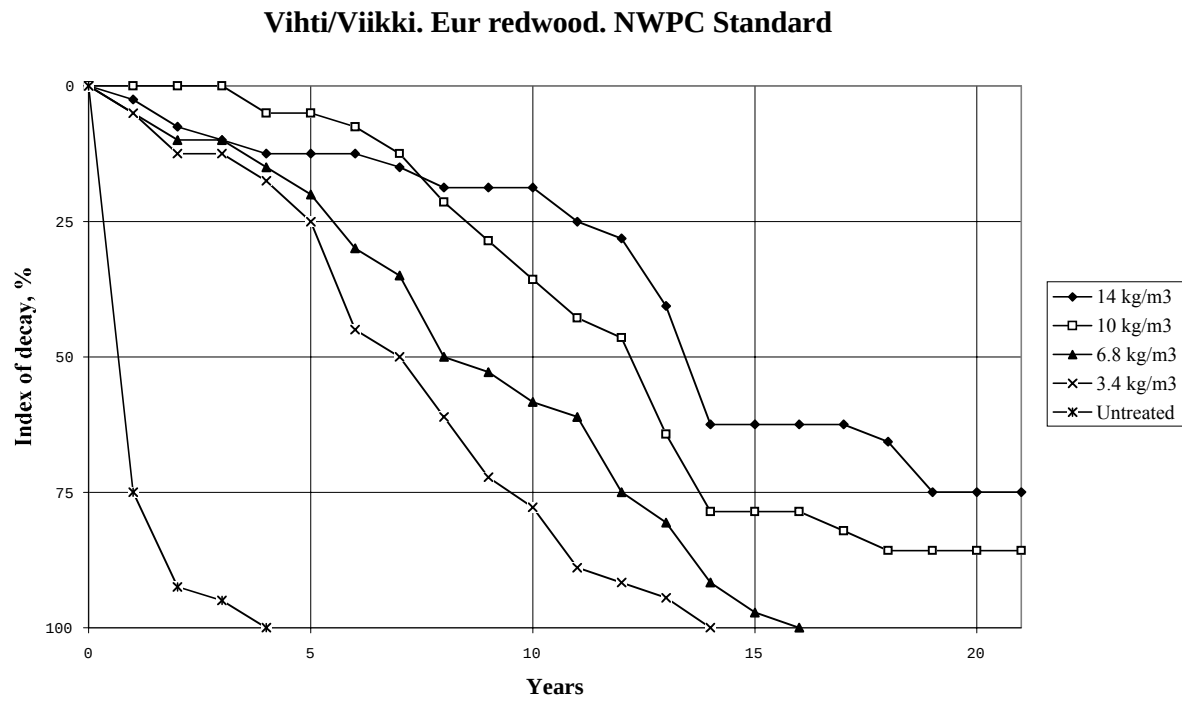
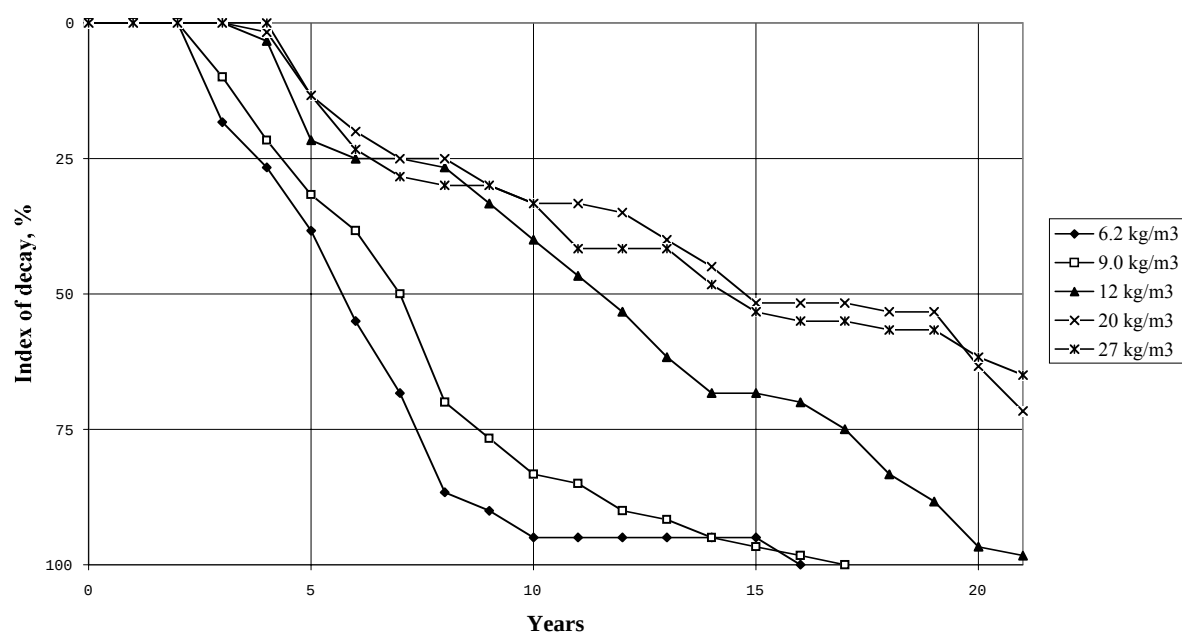


Figure 92b. Field trial 1977. Rate of decay for stakes treated with NWPC Standard Preservative No. 1 and untreated stakes.

Simlångsdalen. Eur redwood. Hylosan PT



Sørkedalen. Eur redwood. Hylosan PT

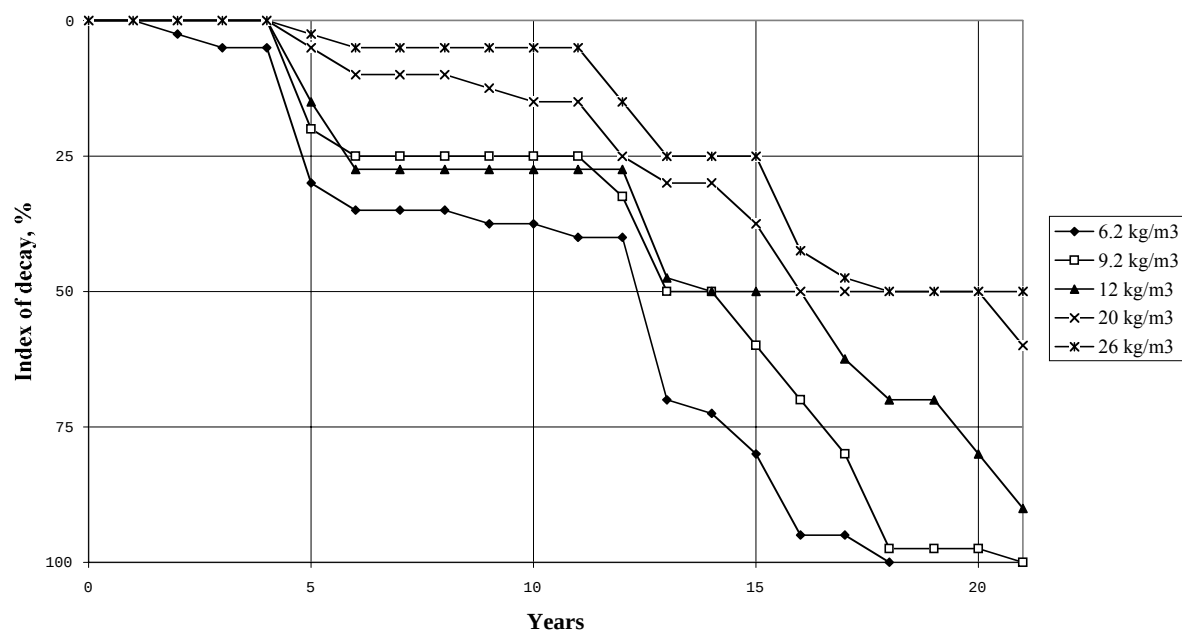
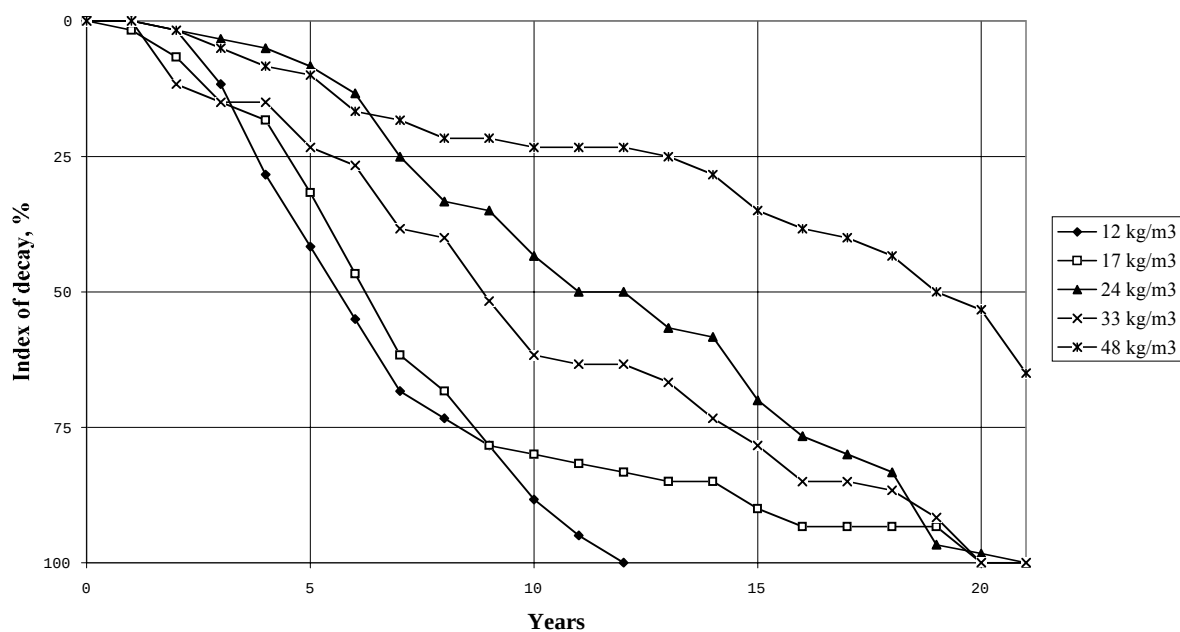


Figure 93. Field trial 1978. Rate of decay for stakes treated with Hylosan PT.

Simlångsdalen. Eur redwood. Cuprinol Tryck



Sørkedalen. Eur redwood. Cuprinol Tryck

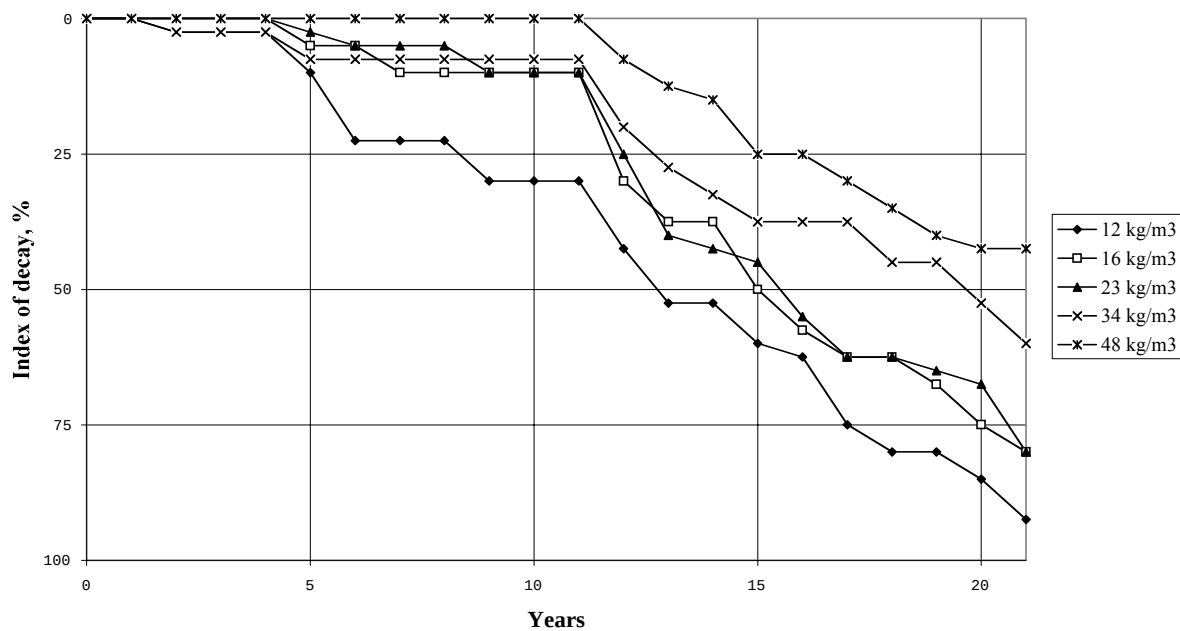
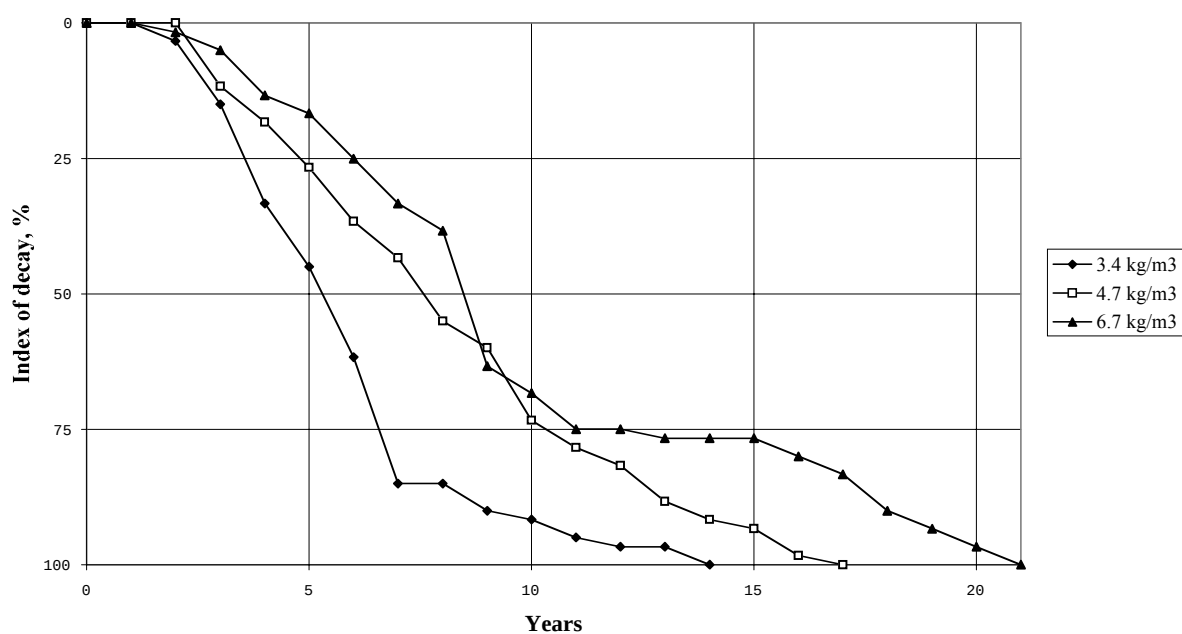


Figure 94. Field trial 1978. Rate of decay for stakes treated with Cuprinol Tryck.

Simlångsdalen. Eur redwood. Test product A



Sørkedalen. Eur redwood. Test product A

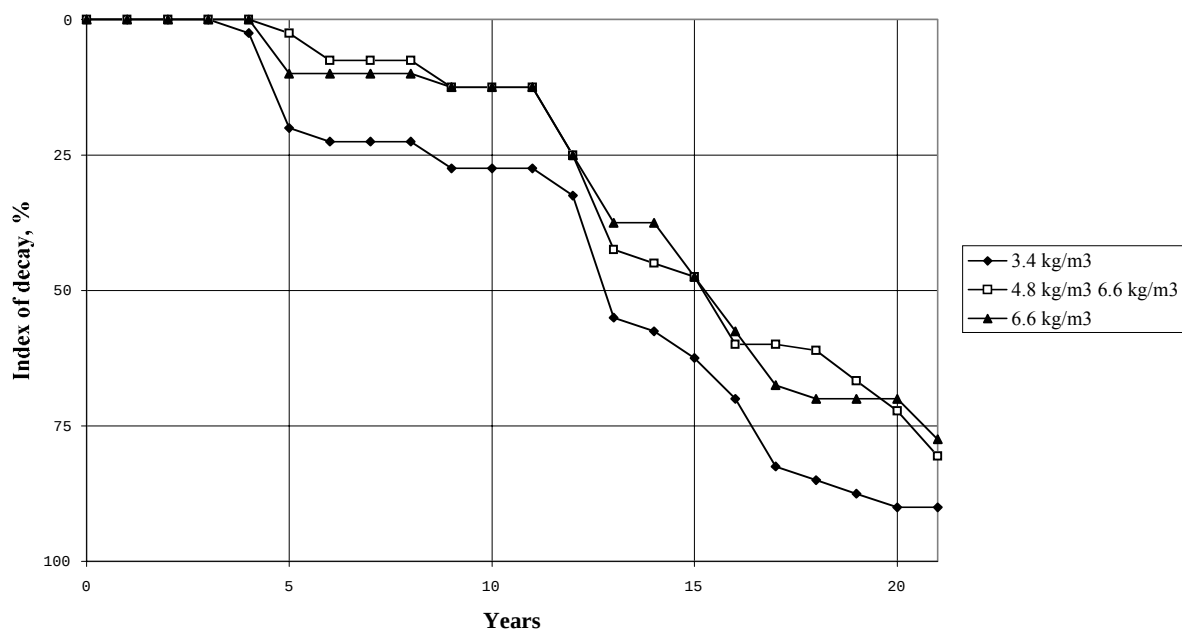
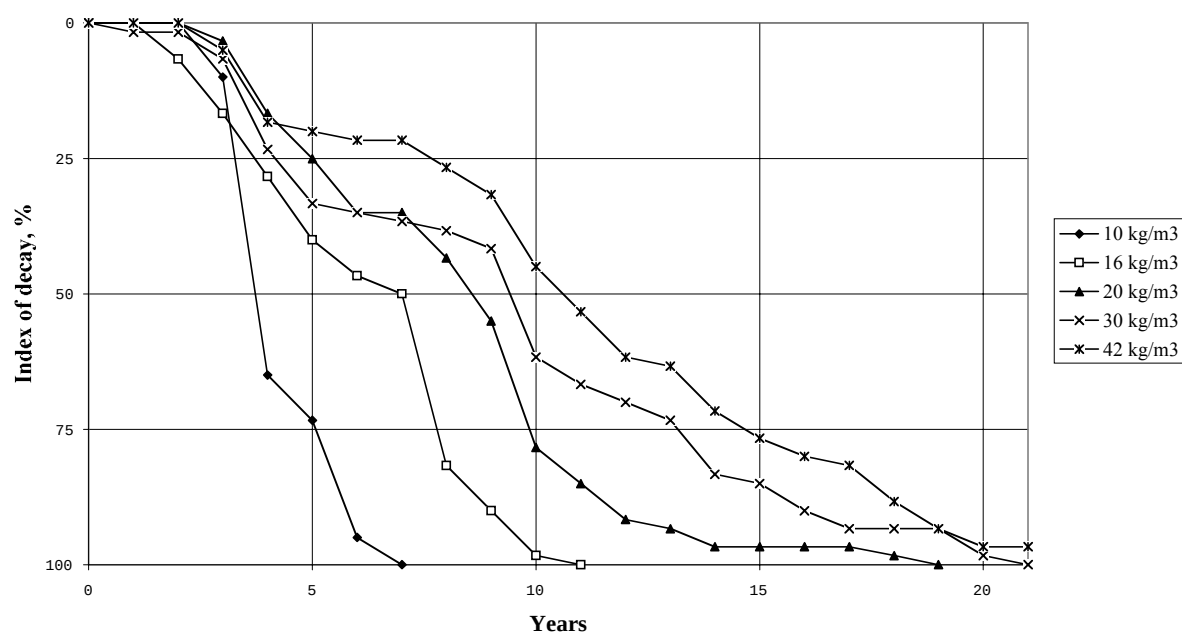


Figure 95. Field trial 1978. Rate of decay for stakes treated with Test product A.

Simlångsdalen. Eur redwood. Test product B



Sørkedalen. Eur redwood. Test product B

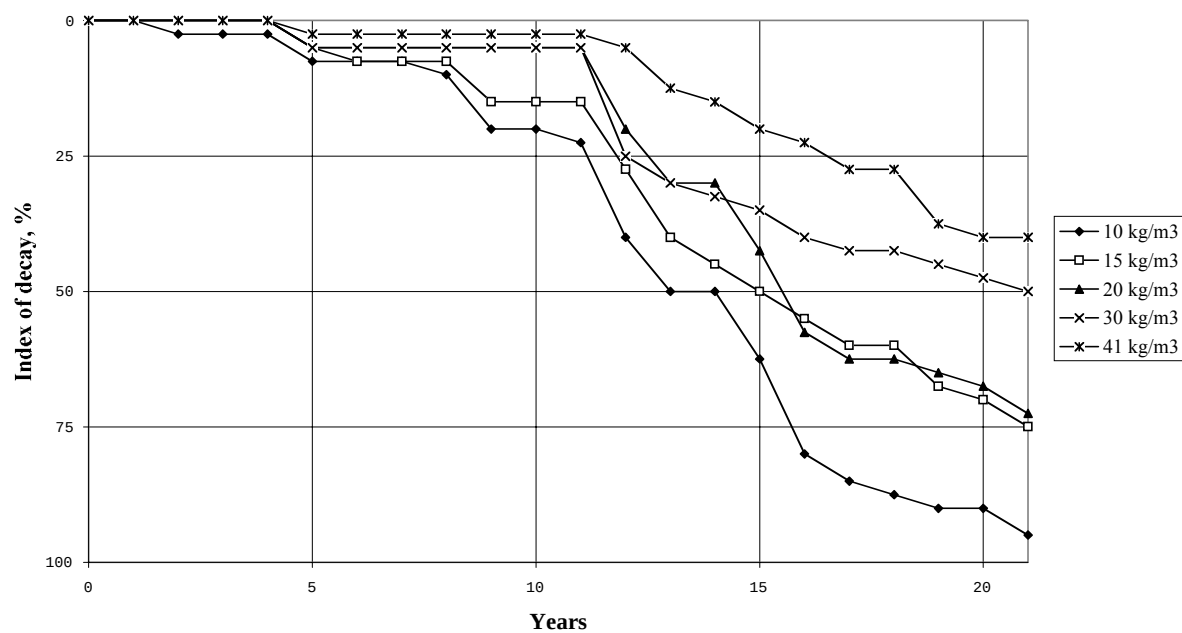


Figure 96. Field trial 1978. Rate of decay for stakes treated with Test product B.

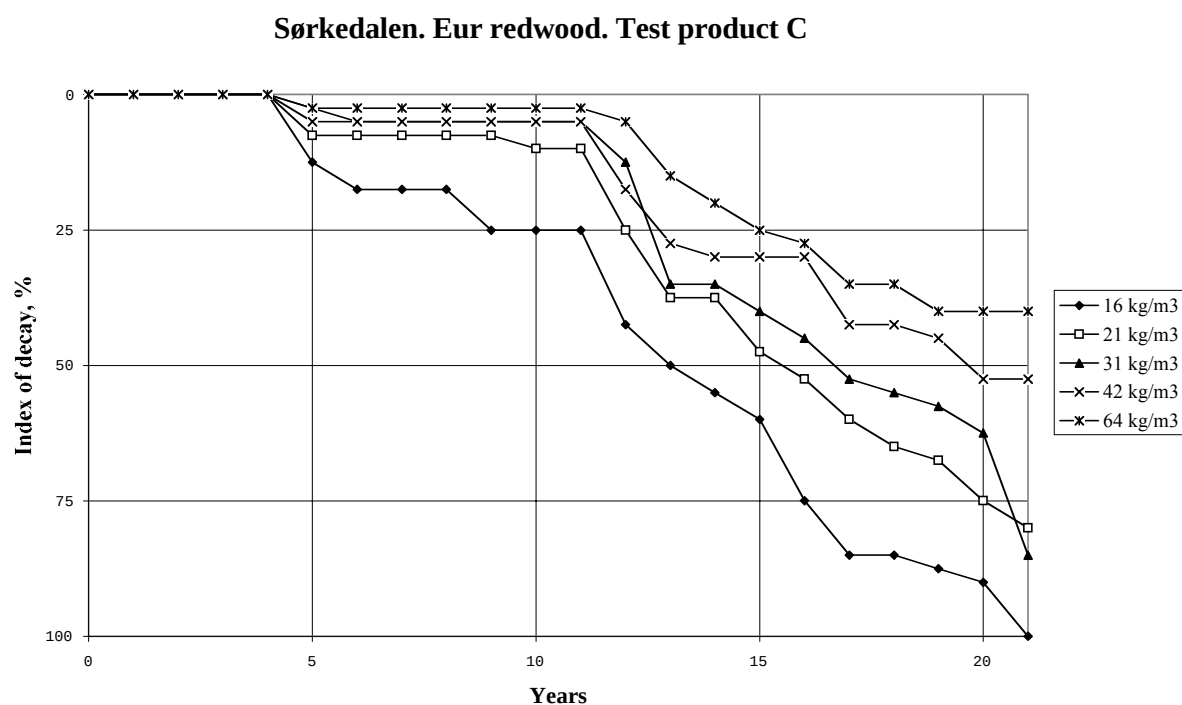
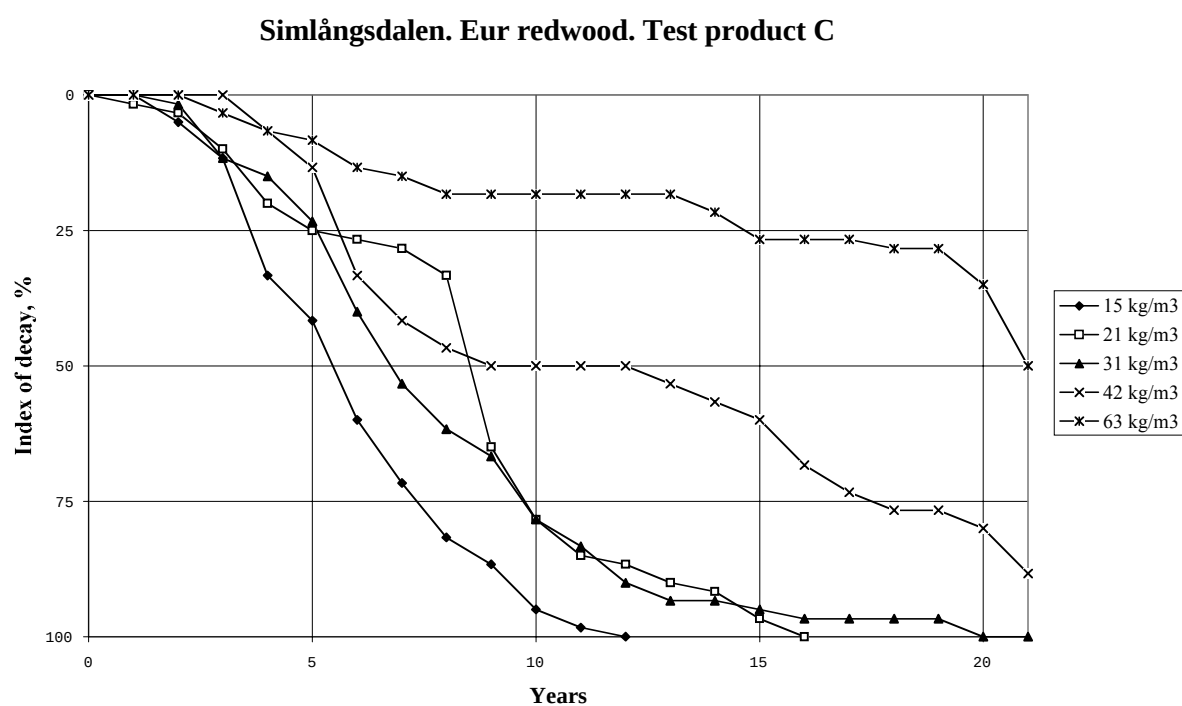
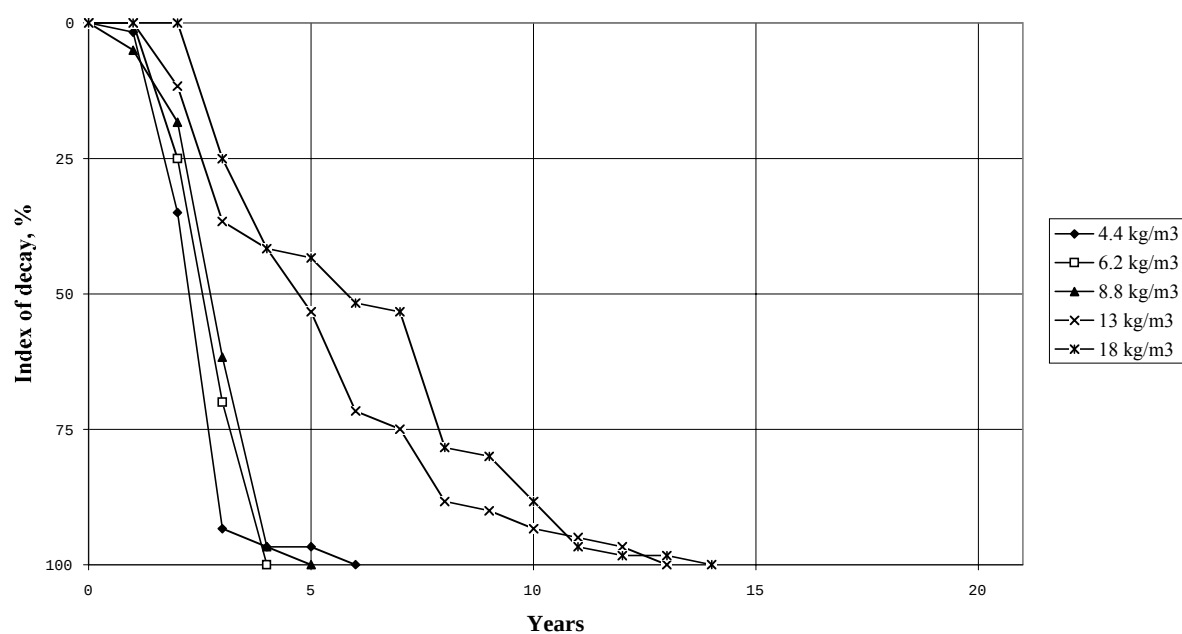


Figure 97. Field trial 1978. Rate of decay for stakes treated with Test product C.

Simlångsdalen. Eur redwood. Celcure Q



Sørkedalen. Eur redwood. Celcure Q

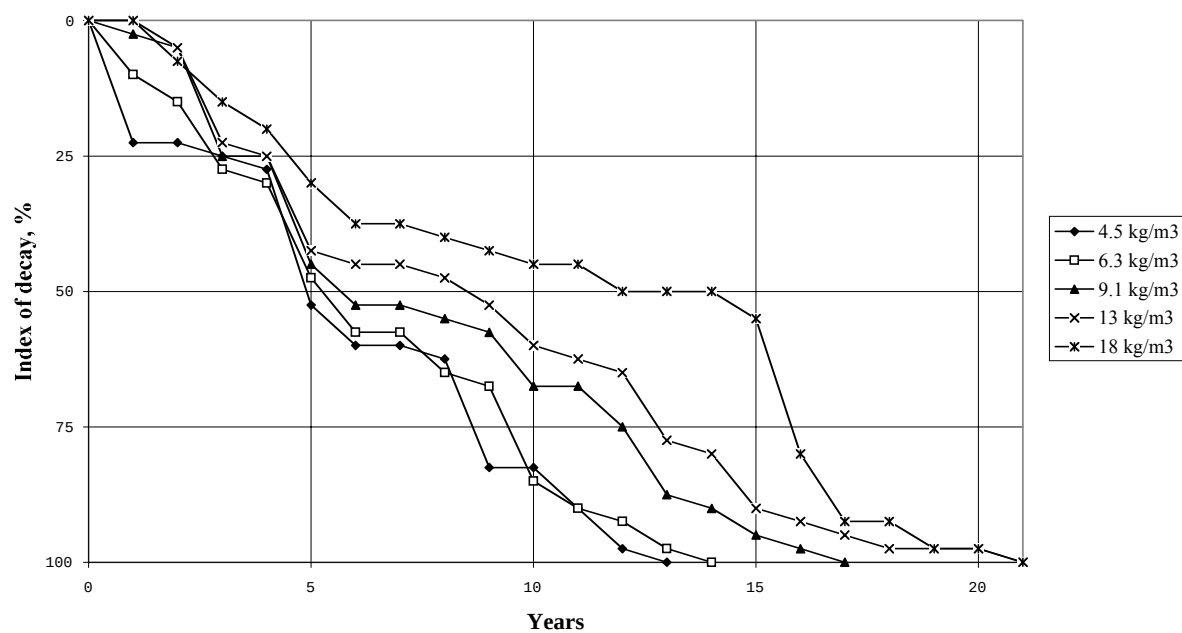
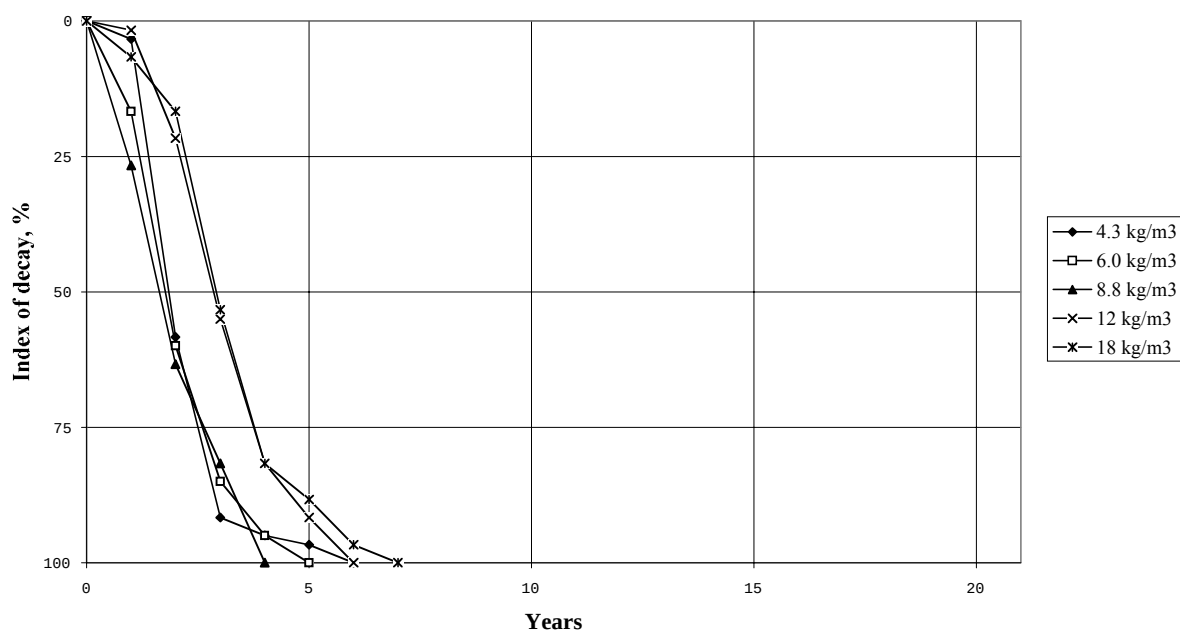


Figure 98. Field trial 1978. Rate of decay for stakes treated with Celcure Q.

Simlångsdalen. Eur redwood. Celcure T



Sørkedalen. Eur redwood. Celcure T

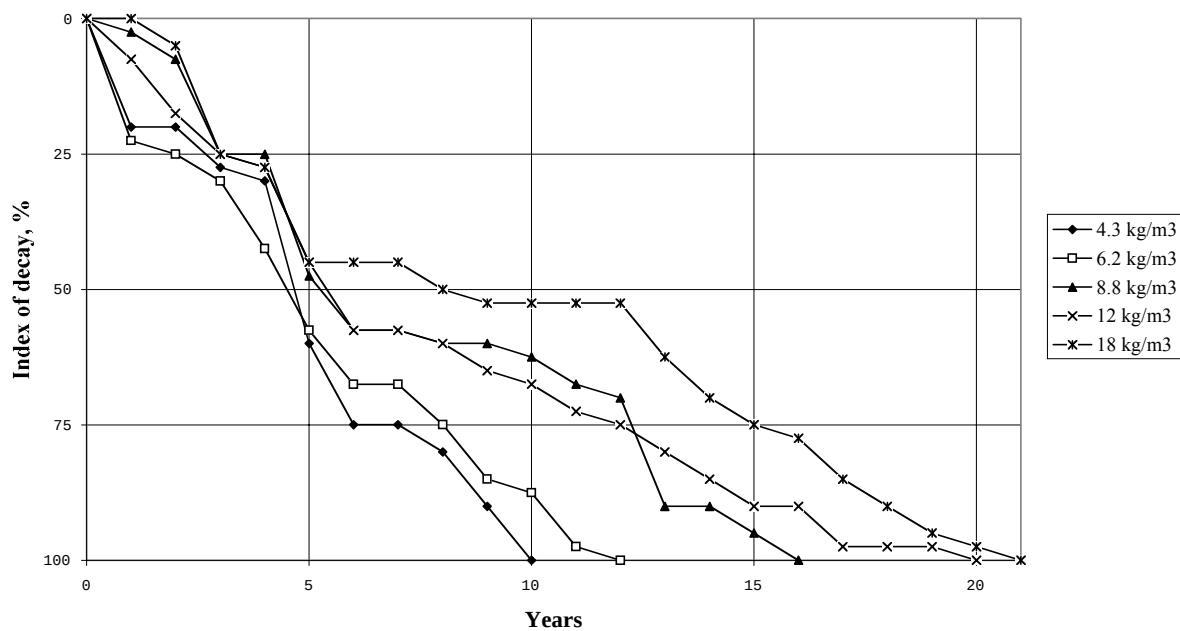
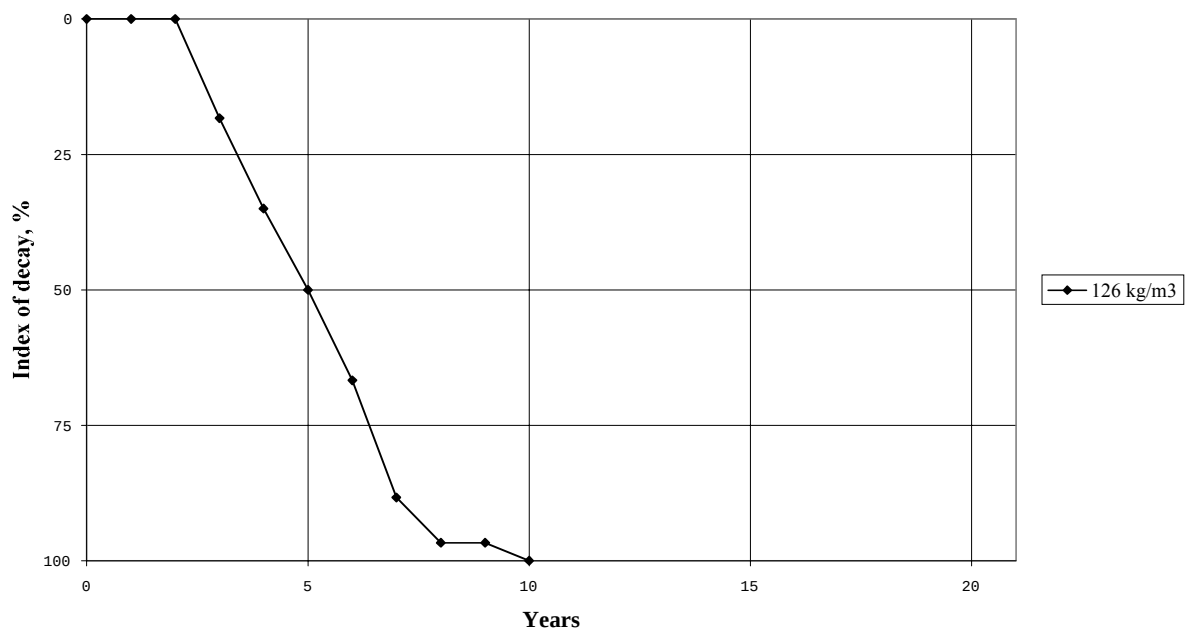


Figure 99. Field trial 1978. Rate of decay for stakes treated with Celcure T.

Simlångsdalen. Eur redwood. Creosote



Sørkedalen. Eur redwood. Creosote

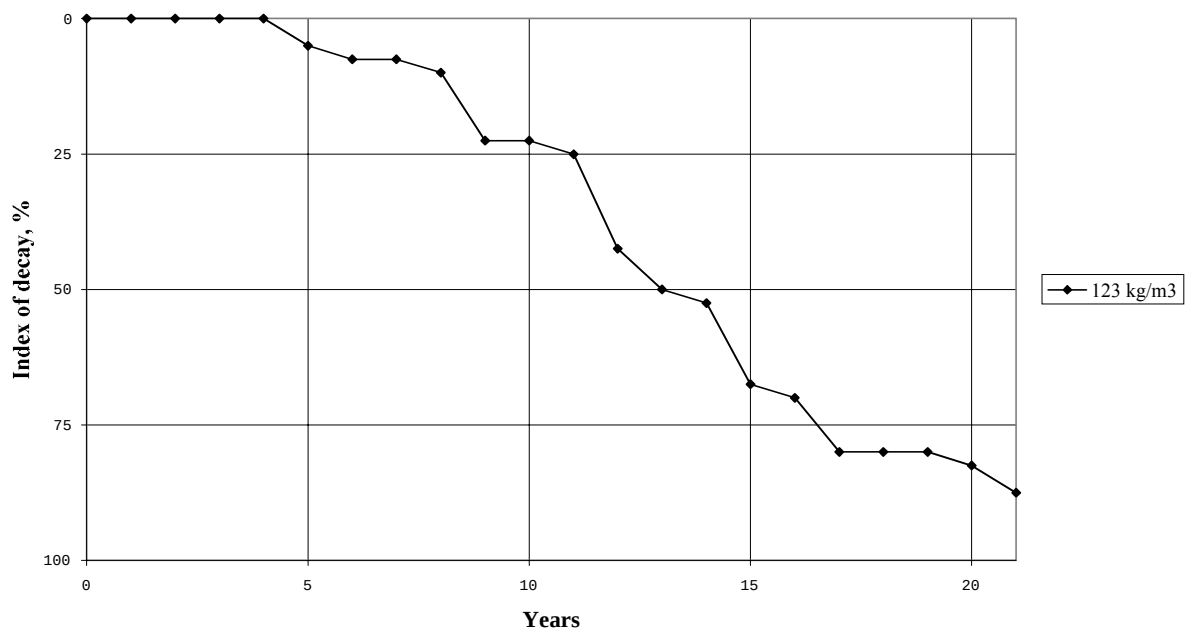
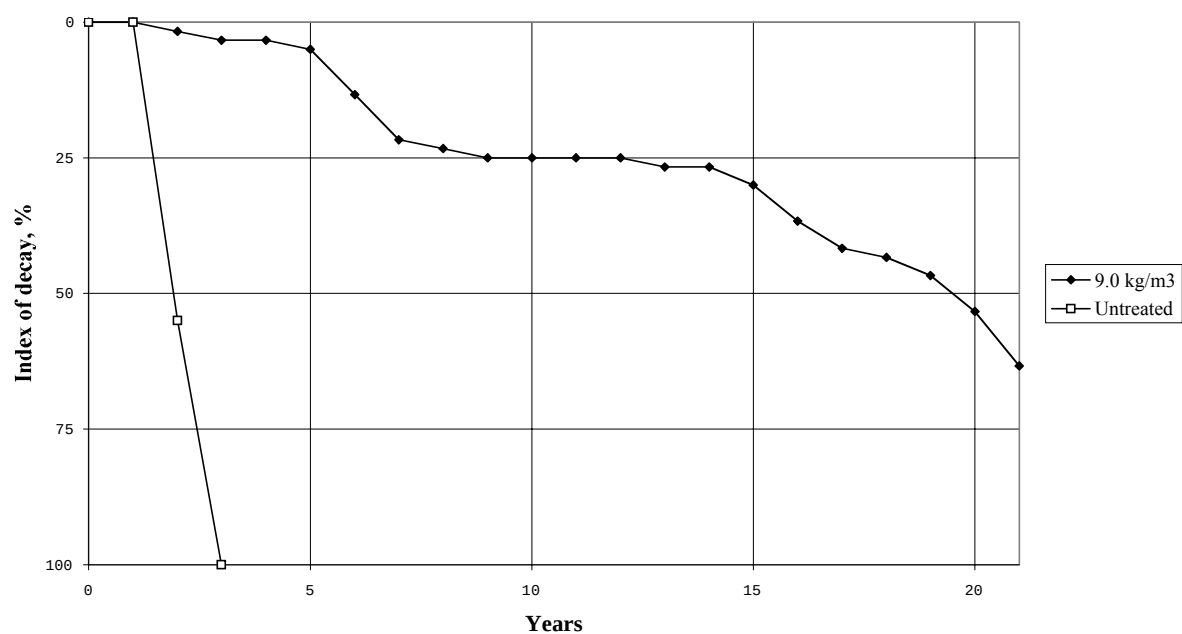


Figure 100. Field trial 1978. Rate of decay for stakes treated with creosote.

Simlångsdalen. Eur redwood. NWPC Standard



Sørkedalen. Eur redwood. NWPC Standard

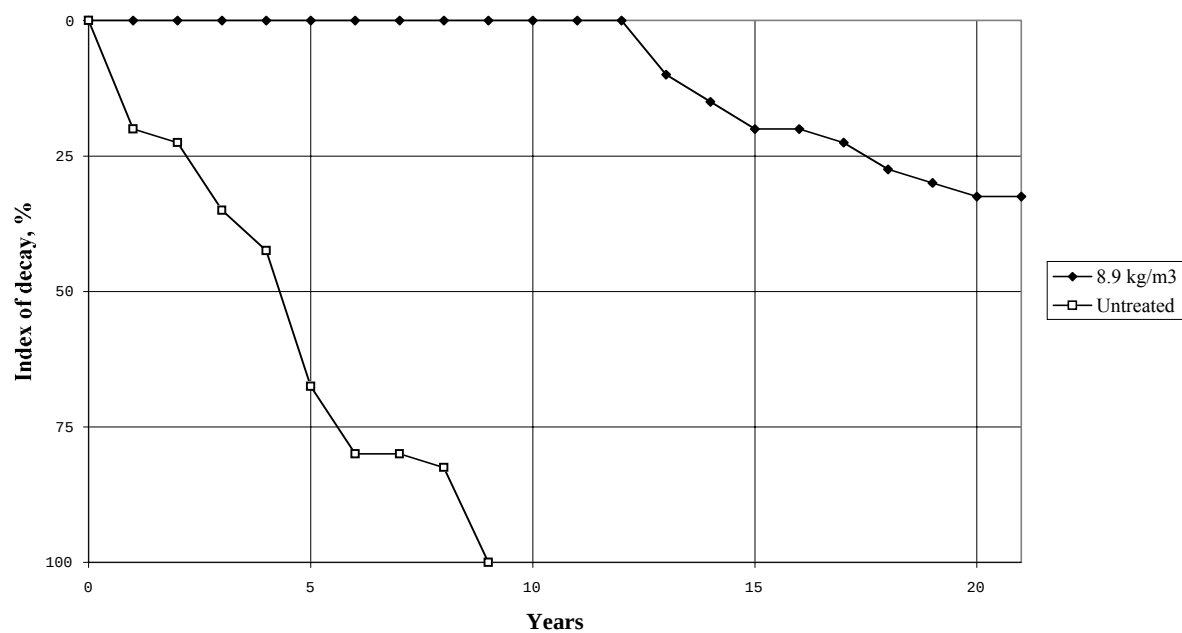


Figure 101. Field trial 1978. Rate of decay for stakes treated with NWPC Standard Preservative No. 1 and untreated stakes.

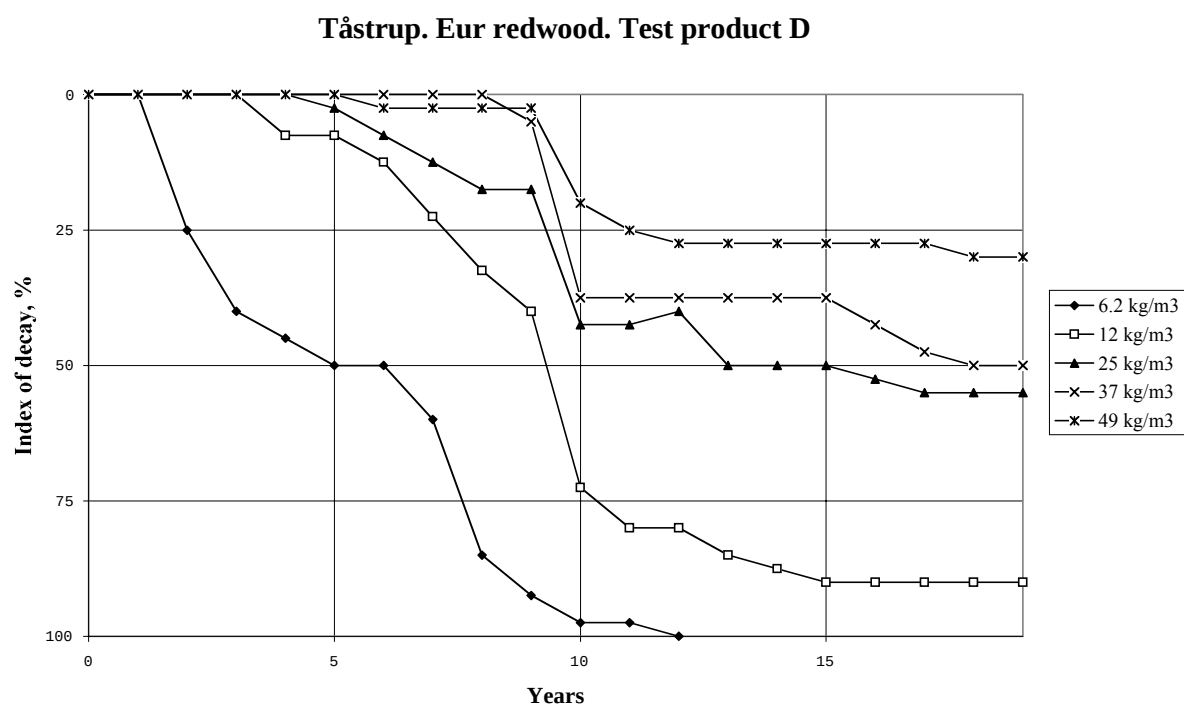
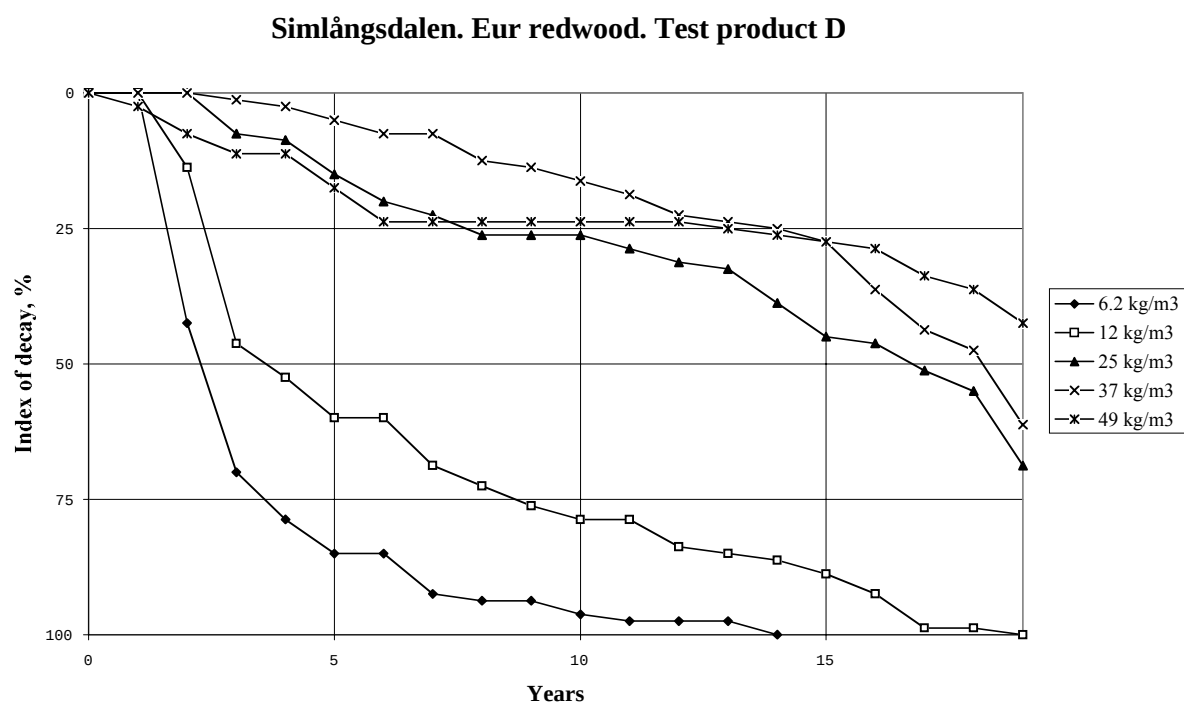
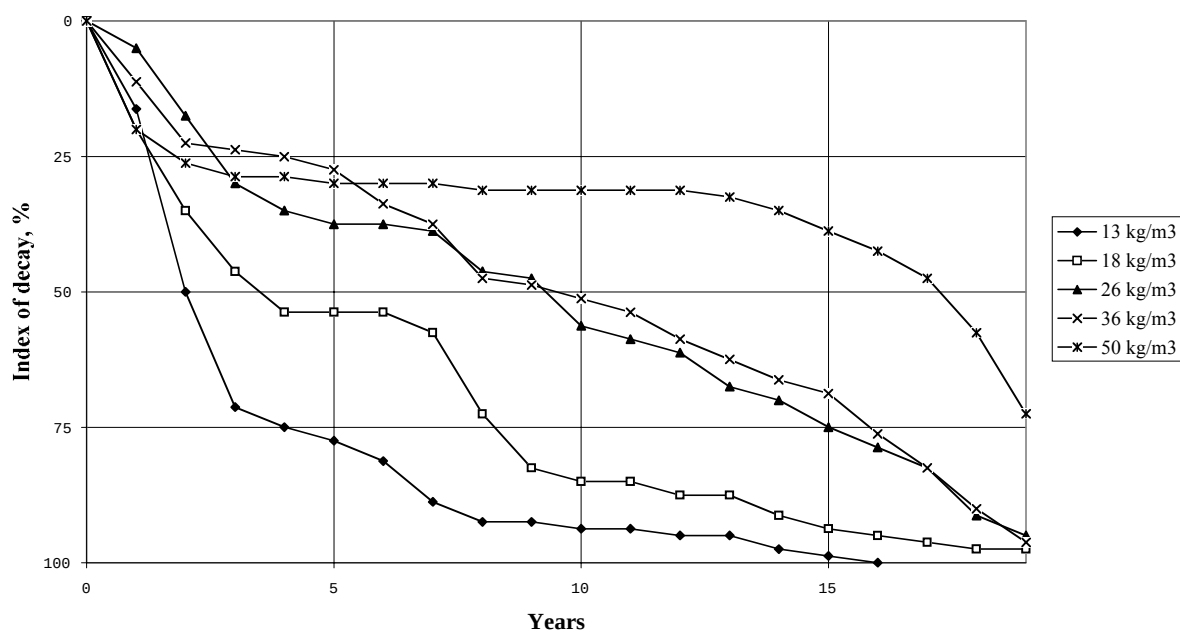


Figure 102. Field trial 1980:1. Rate of decay for stakes treated with Test product D.

Simlångsdalen. Eur redwood. Test product E



Tåstrup. Eur redwood. Test product E

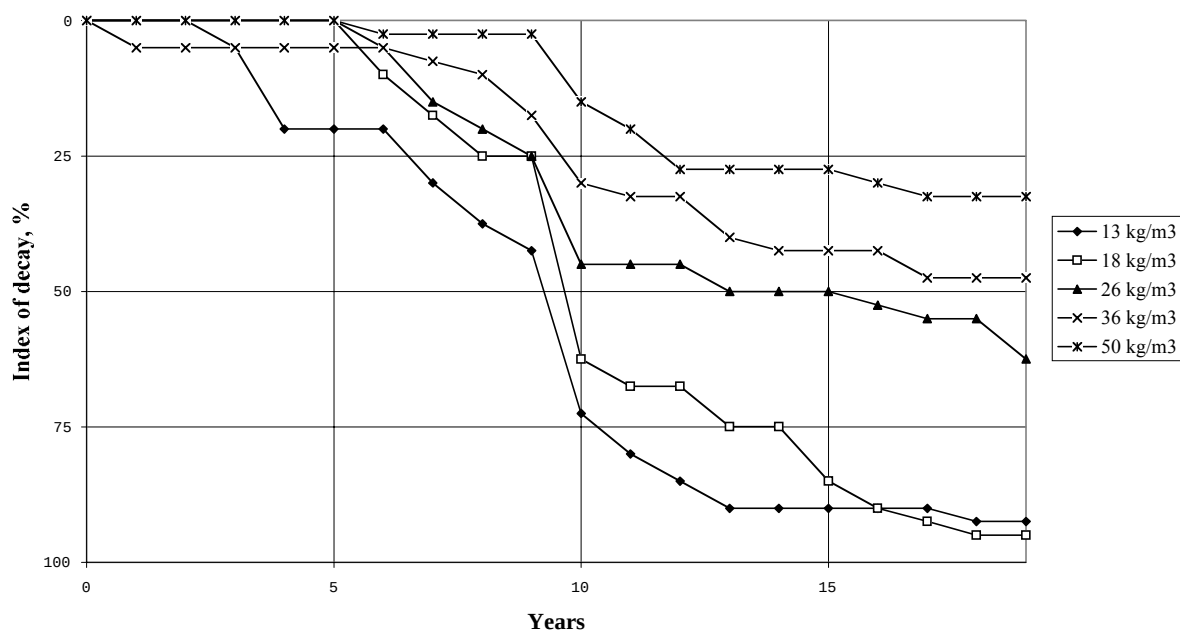
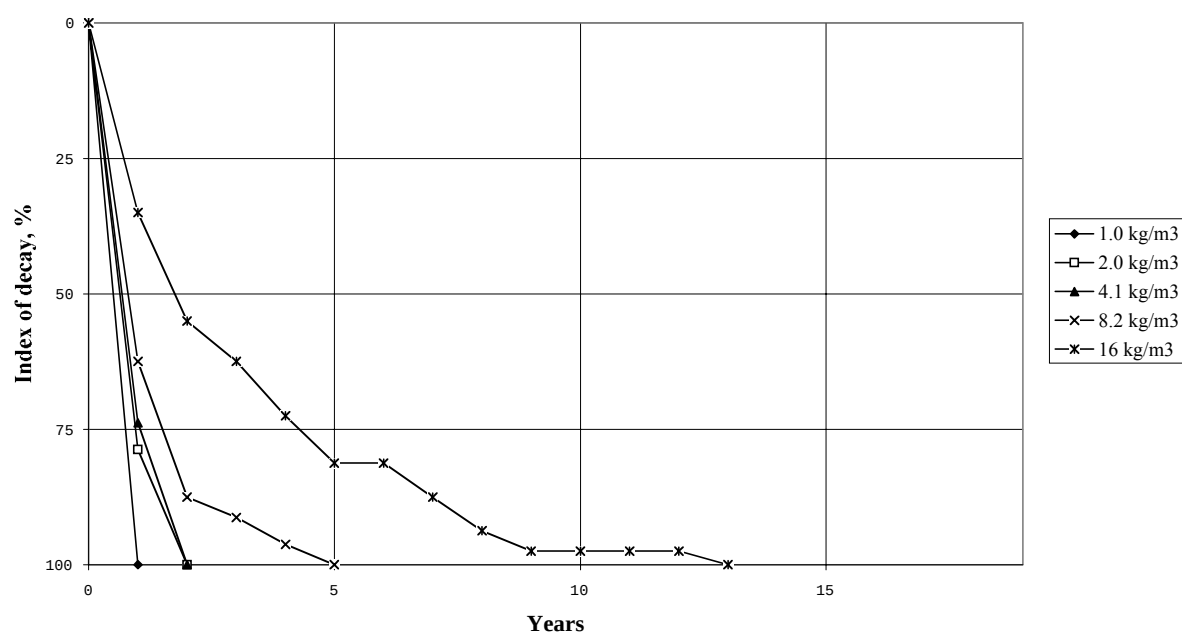


Figure 103. Field trial 1980:1. Rate of decay for stakes treated with Test product E.

Simlångsdalen. Eur redwood. Synprolam 35 DMA in water



Tåstrup. Eur redwood. Synprolam 35 DMA in water

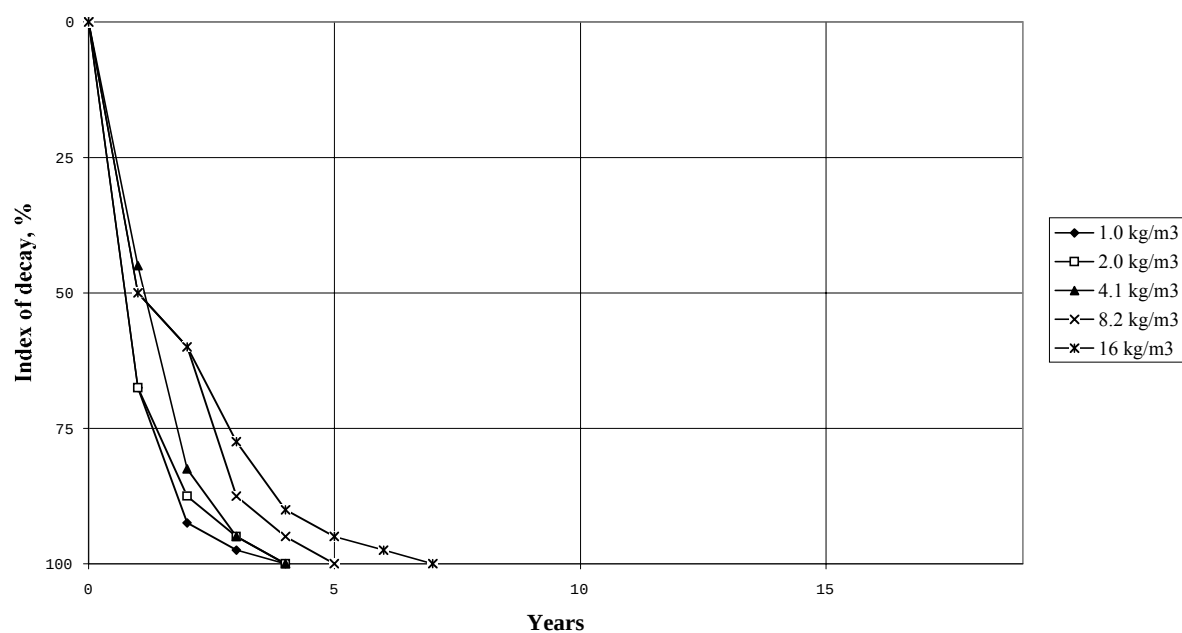
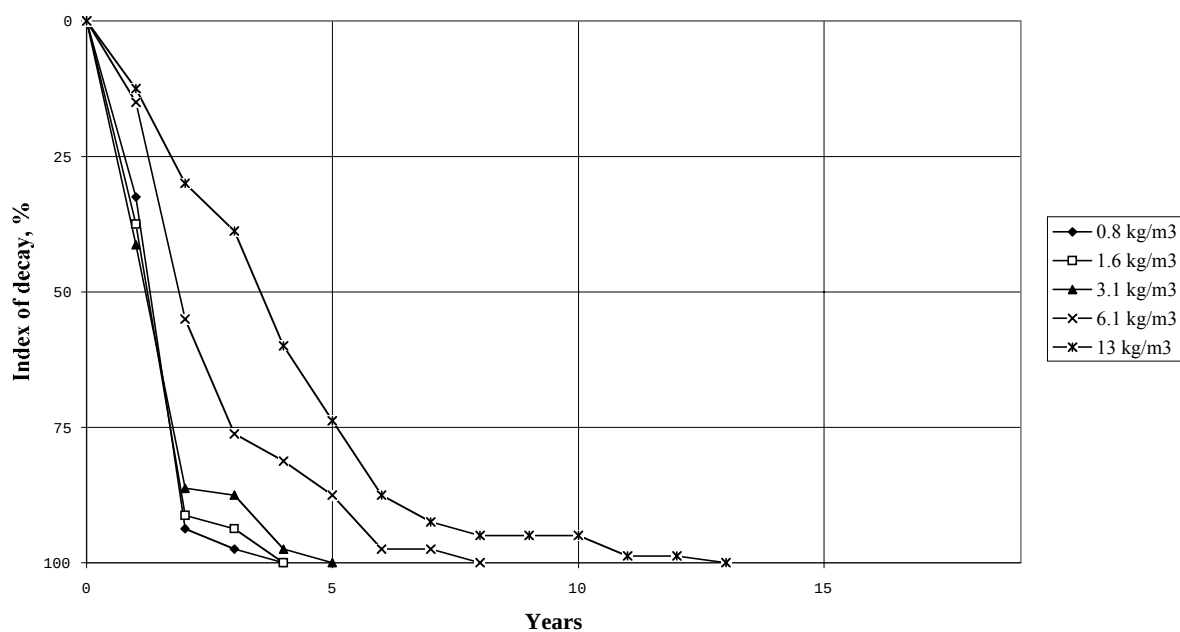


Figure 104. Field trial 1980:1. Rate of decay for stakes treated with Synprolam 35 DMA in water.

Simlångsdalen. Eur redwood. Synprolam 35 DMA in white spirit



Tåstrup. Eur redwood. Synprolam 35 DMA in white spirit

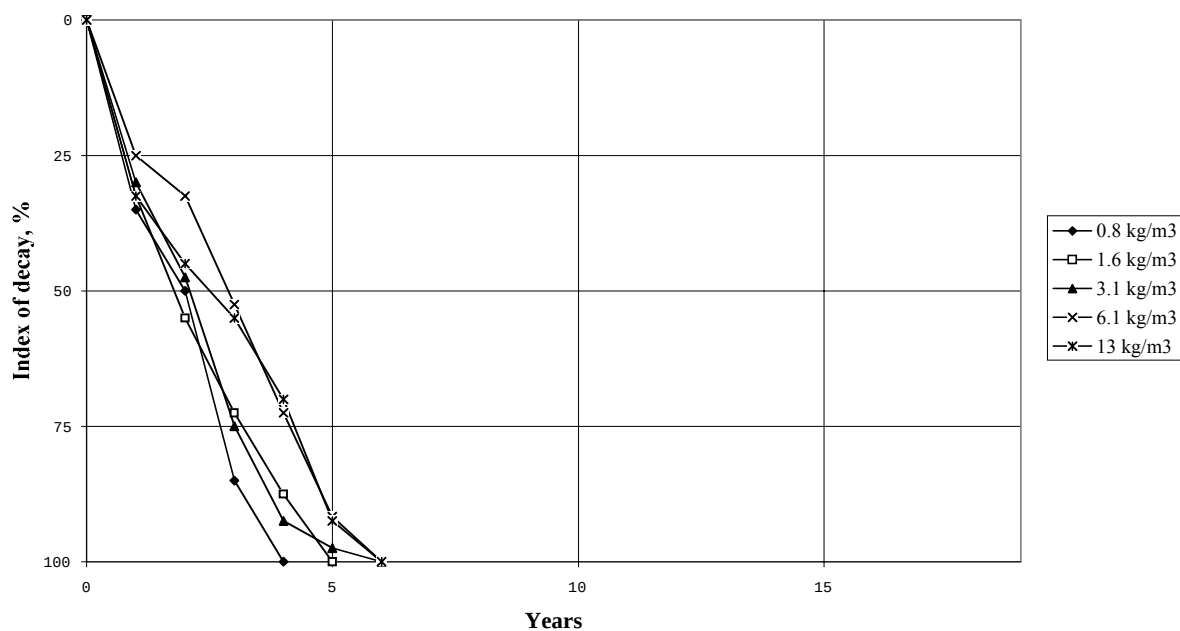
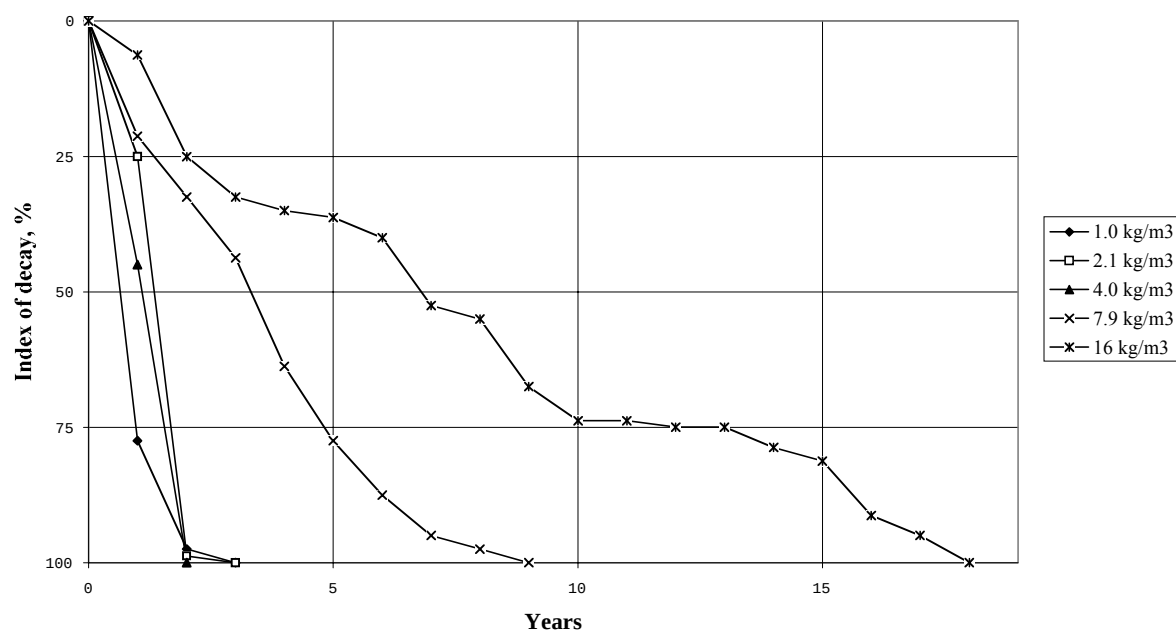


Figure 105. Field trial 1980:1. Rate of decay for stakes treated with Synprolam 35 DMA in white spirit.

Simlångsdalen. Eur redwood. Synprolam 35 DMBQC in water



Tåstrup. Eur redwood. Synprolam 35 DMBQC in water

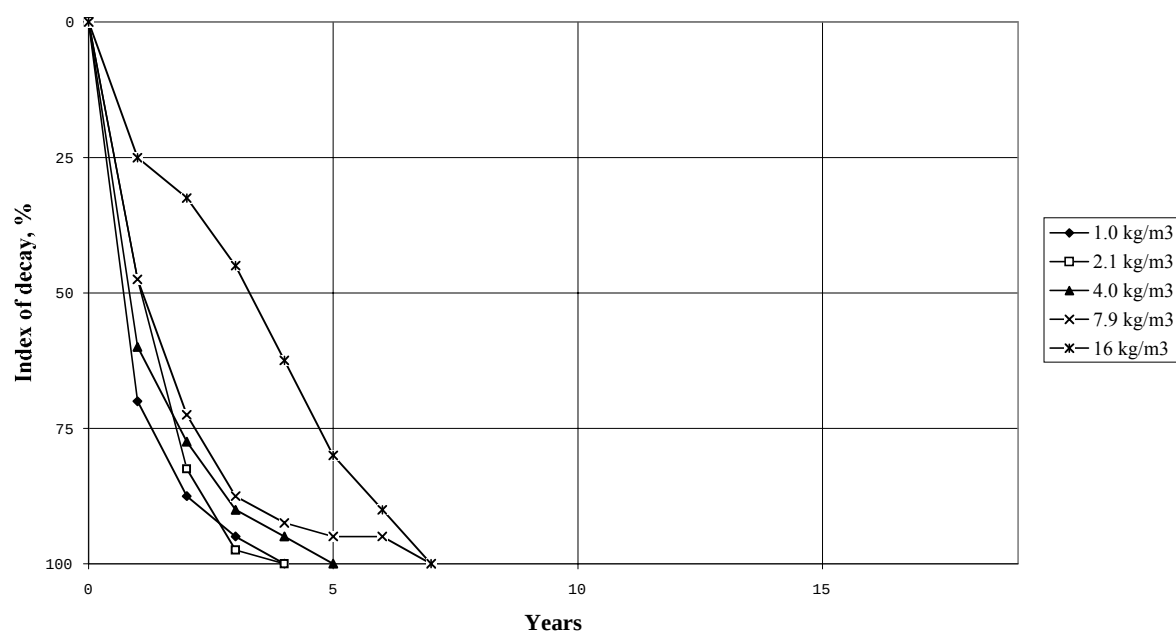


Figure 106. Field trial 1980:1. Rate of decay for stakes treated with Synprolam 35 DMBQC in water.

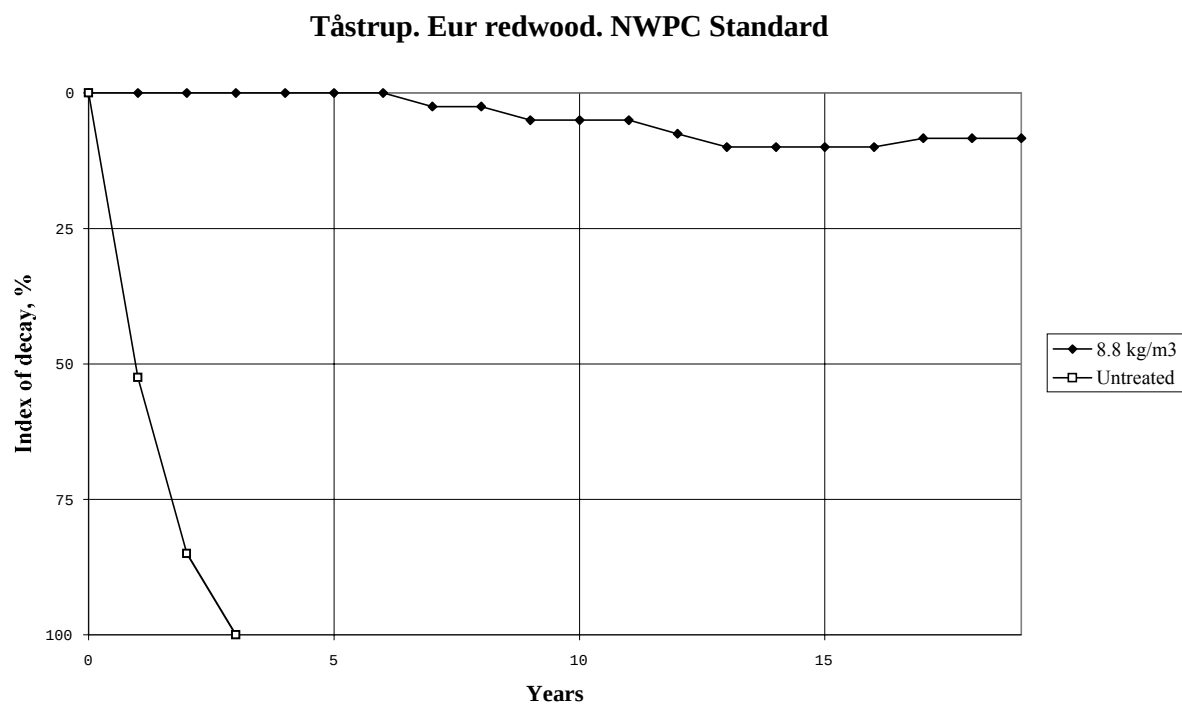
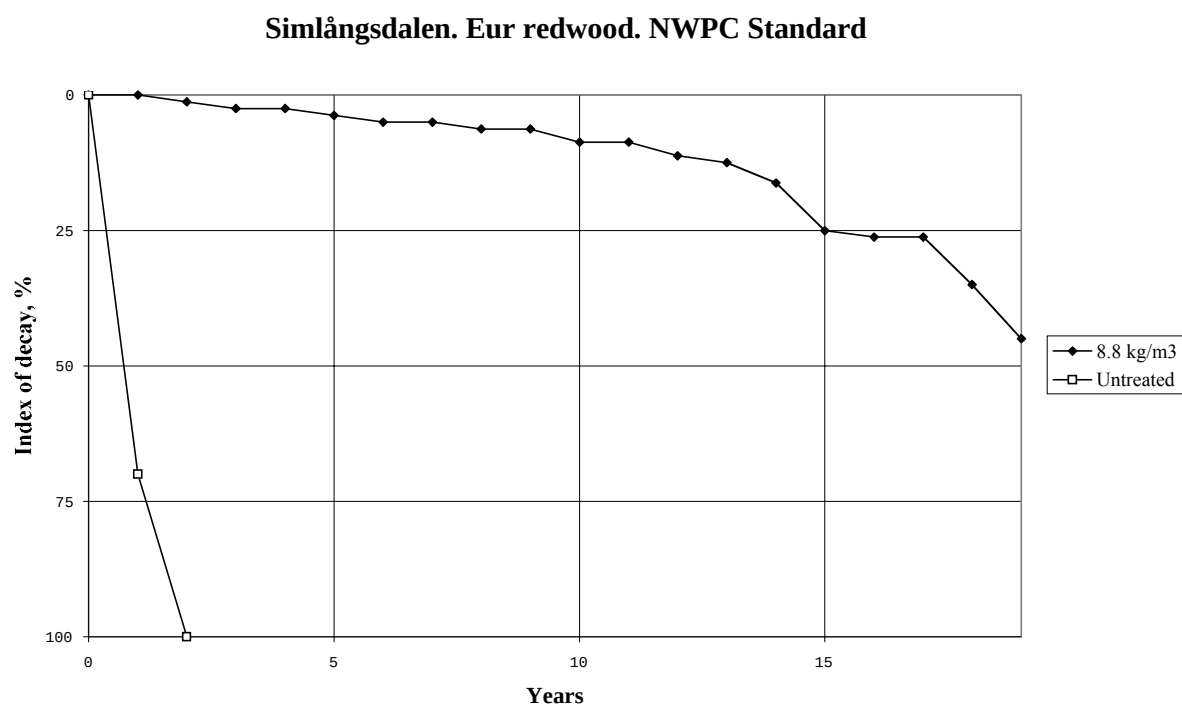
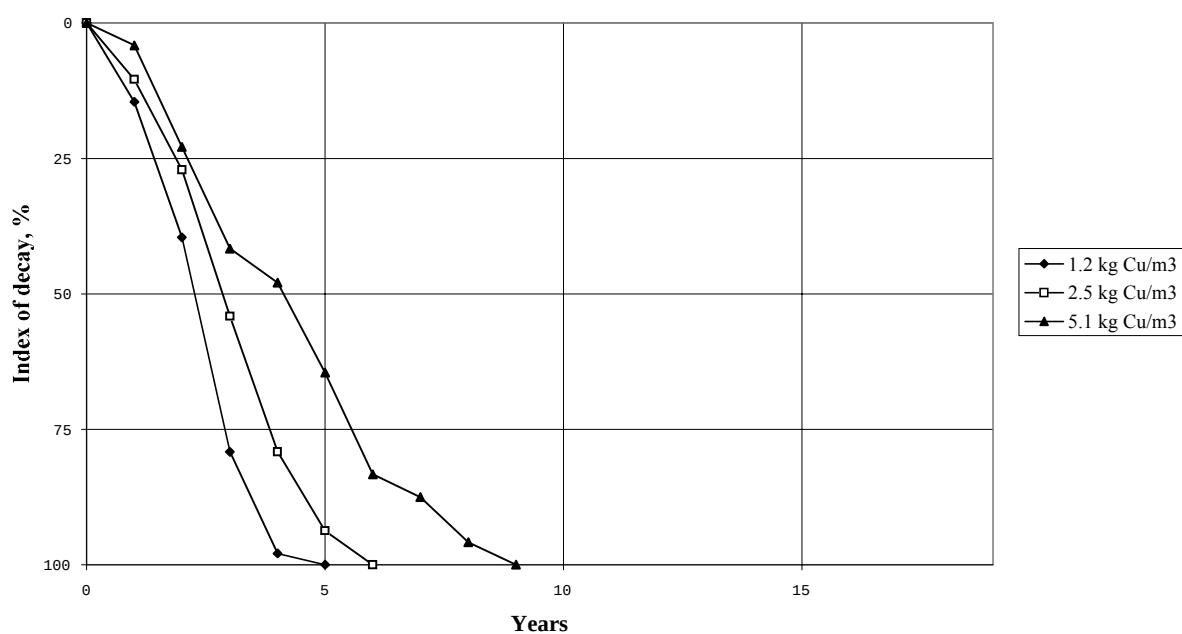


Figure 107. Field trial 1980:1. Rate of decay for stakes treated with NWPC Standard Preservative No. 1 and untreated stakes.

Simlångsdalen. Eur beech. Amline special



Sørkedalen. Eur beech. Amline special

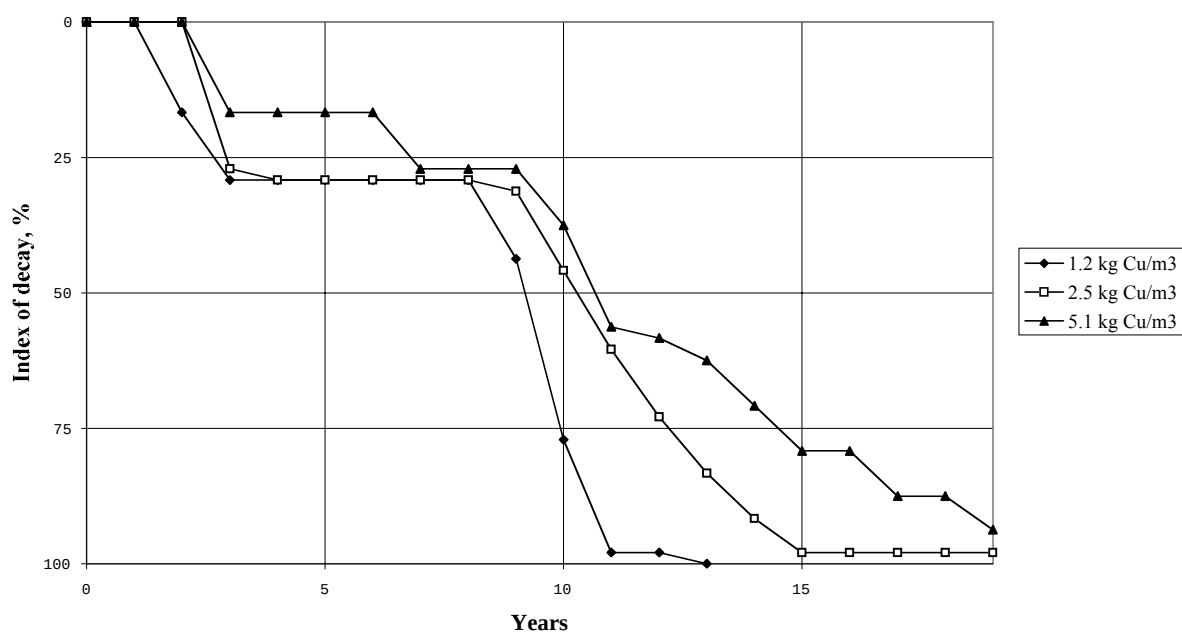
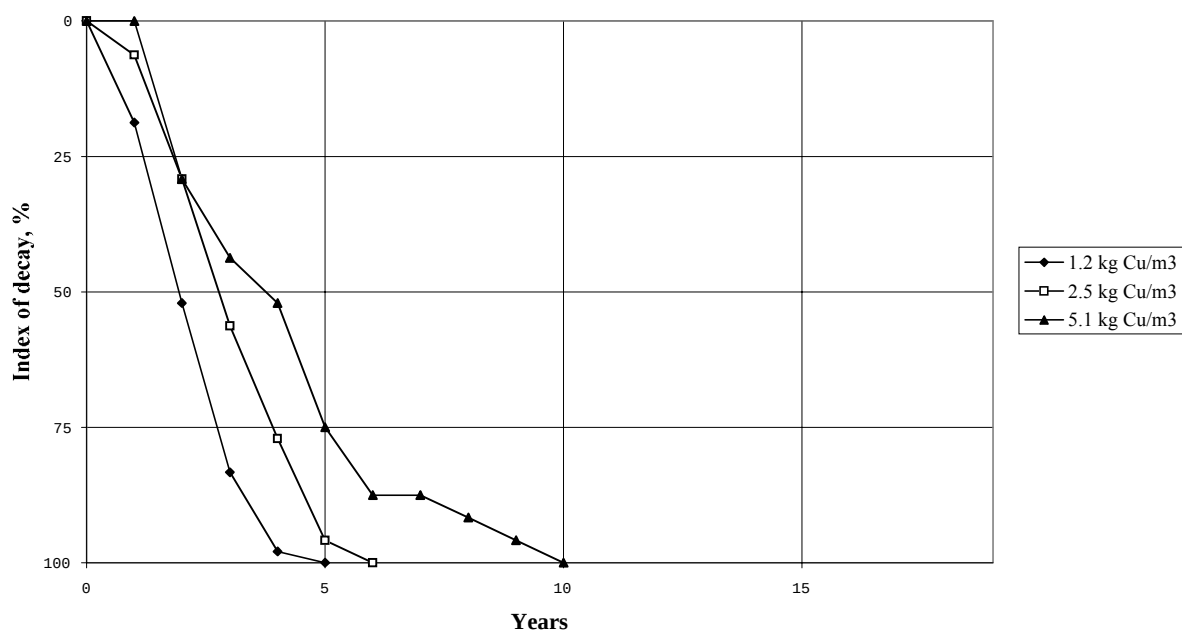


Figure 108. Field trial 1980:2. Rate of decay for stakes of European beech treated with Amline special. The stakes were dried immediately after treatment.

Simlångsdalen. Eur beech. Amline special



Sørkedalen. Eur beech. Amline special

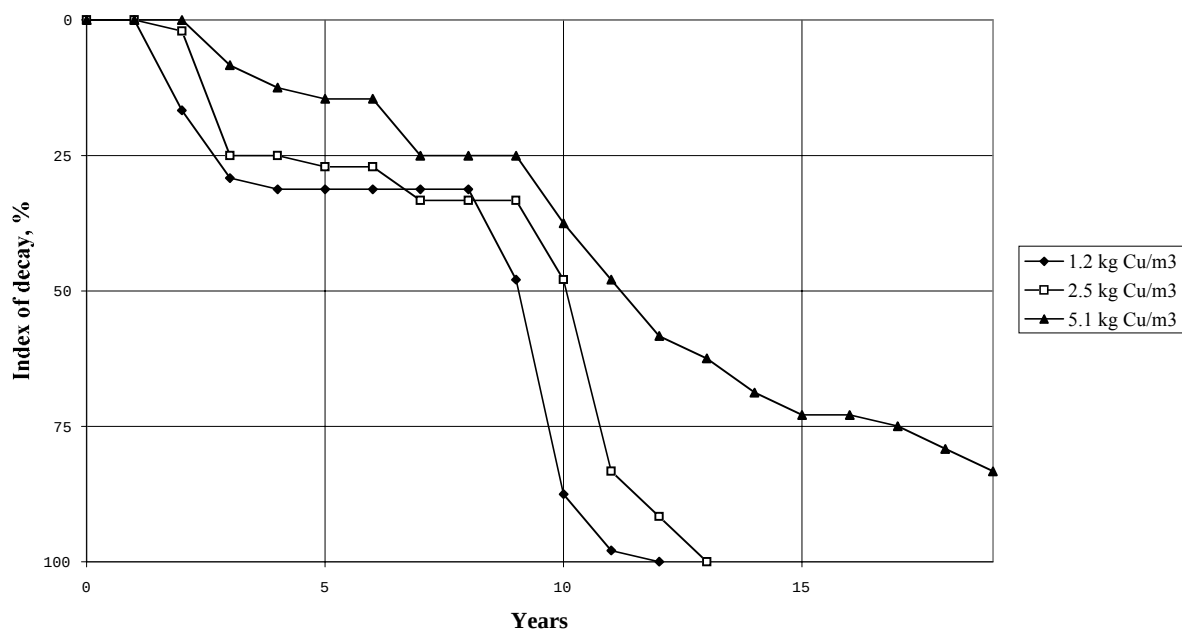


Figure 109. Field trial 1980:2. Rate of decay for stakes of European beech treated with Amline special. The stakes were stored in plastic bags for 2 weeks immediately after treatment.

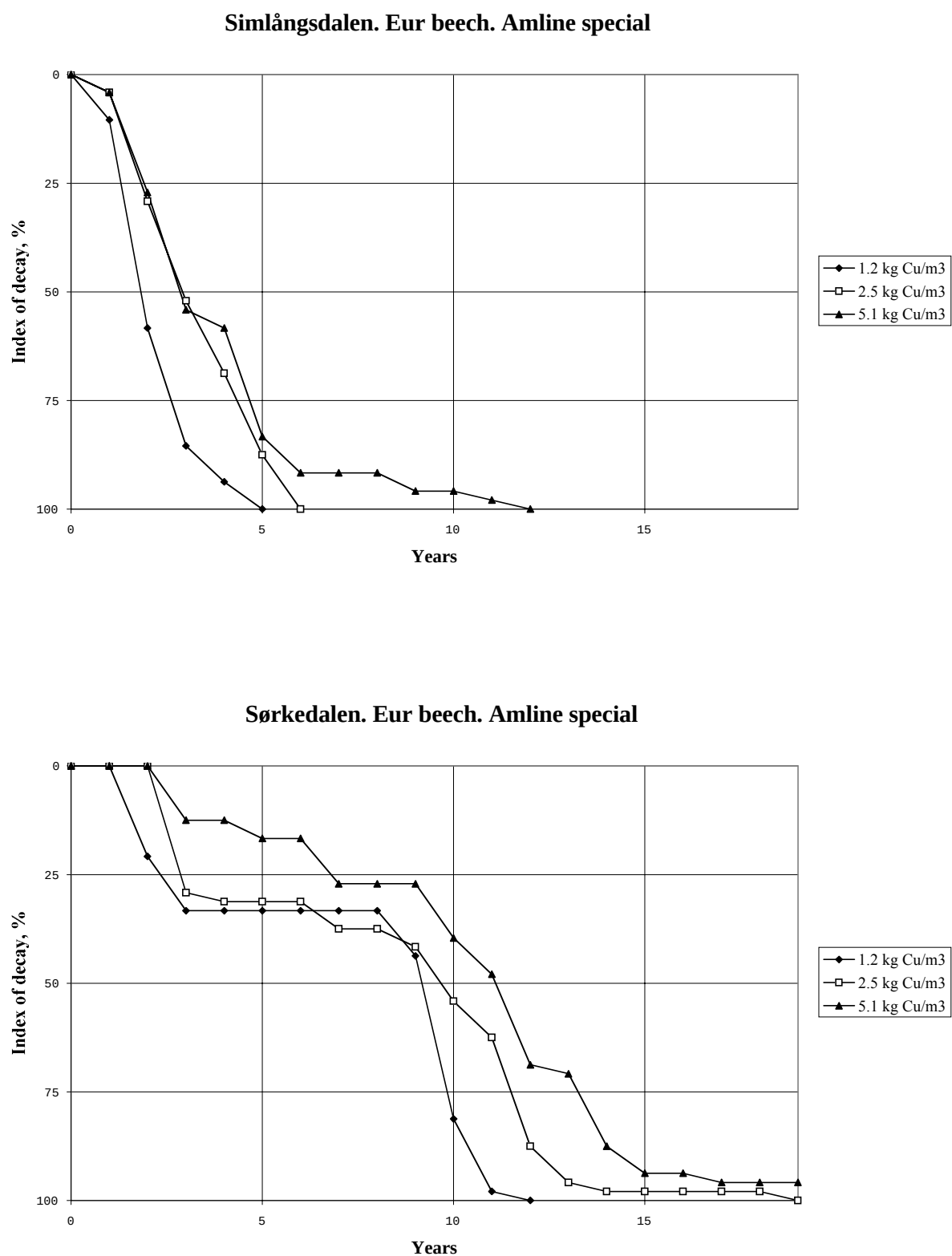


Figure 110. Field trial 1980:2. Rate of decay for stakes of European beech treated with Amline special. The stakes were stored in plastic bags for 4 weeks immediately after treatment.

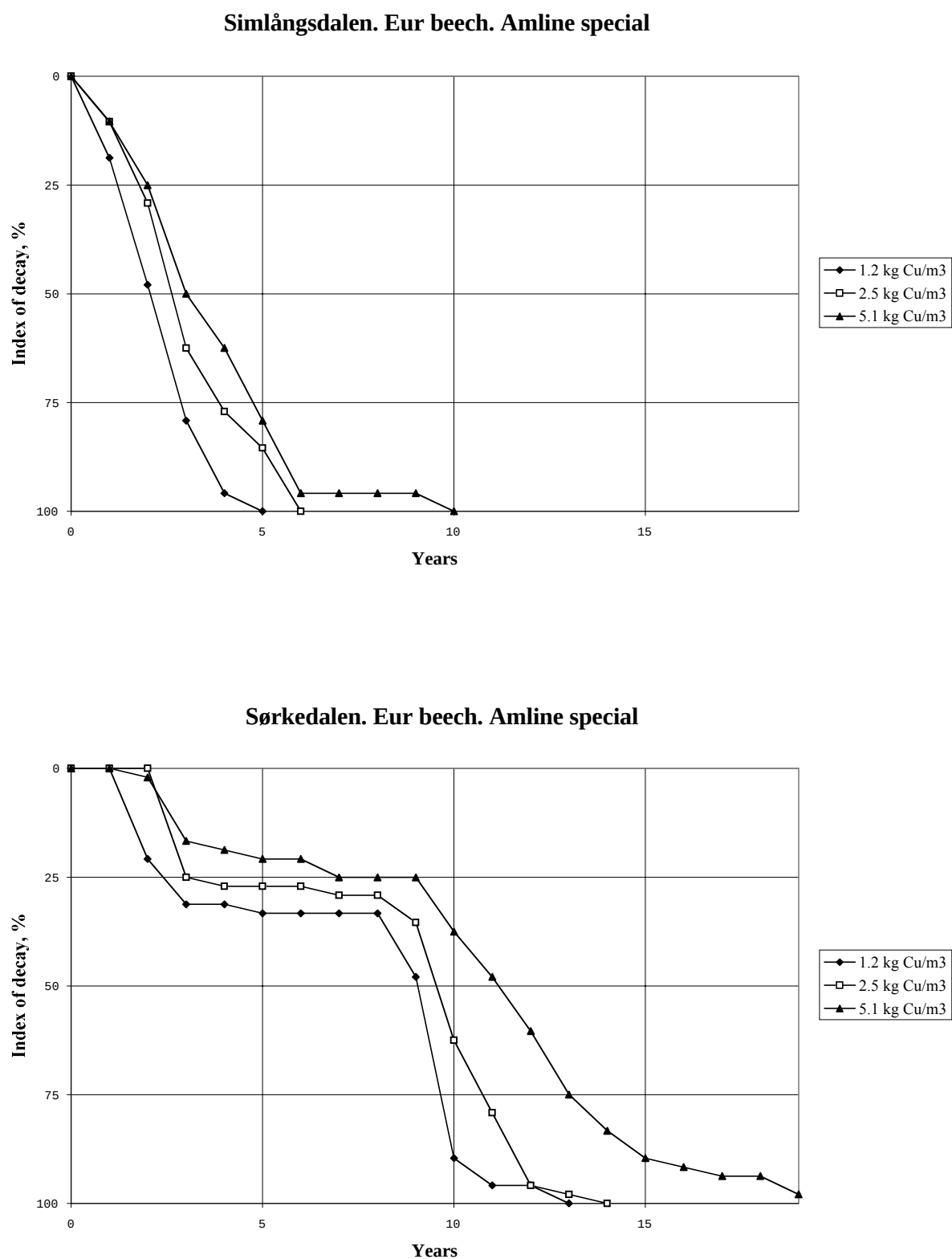
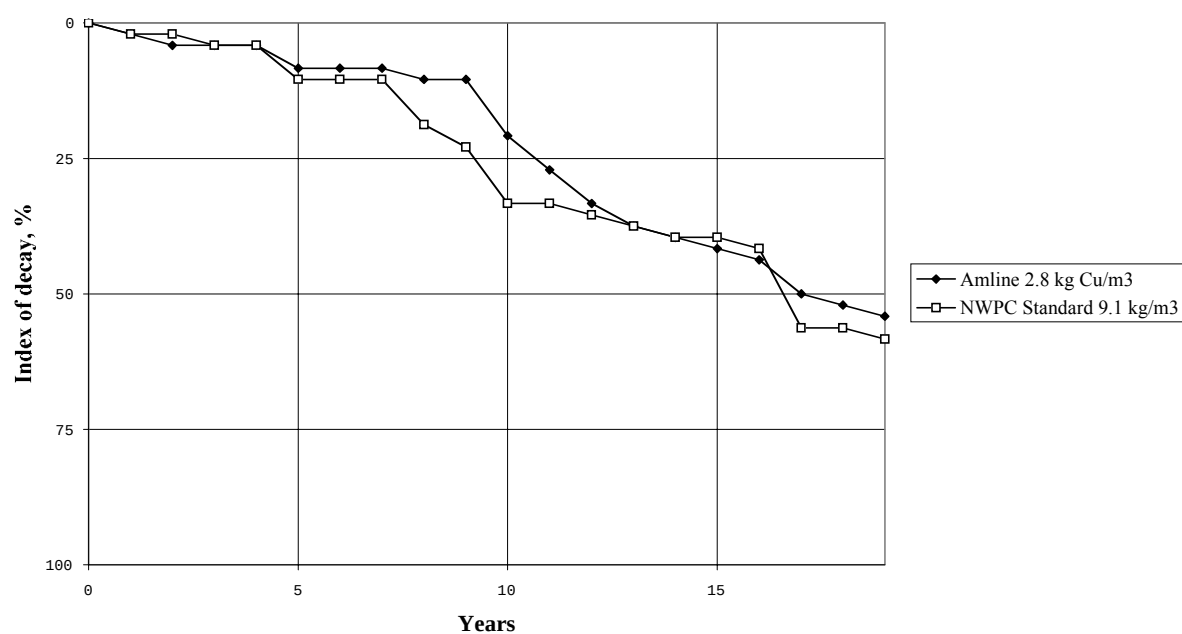


Figure 111. Field trial 1980:2. Rate of decay for stakes of European beech treated with Amline special. The stakes were stored in plastic bags for 8 weeks immediately after treatment.

Simlångsdalen. Eur redwood. Amline special/NWPC Standard



Sørkedalen. Eur redwood. Amline special/NWPC Standard

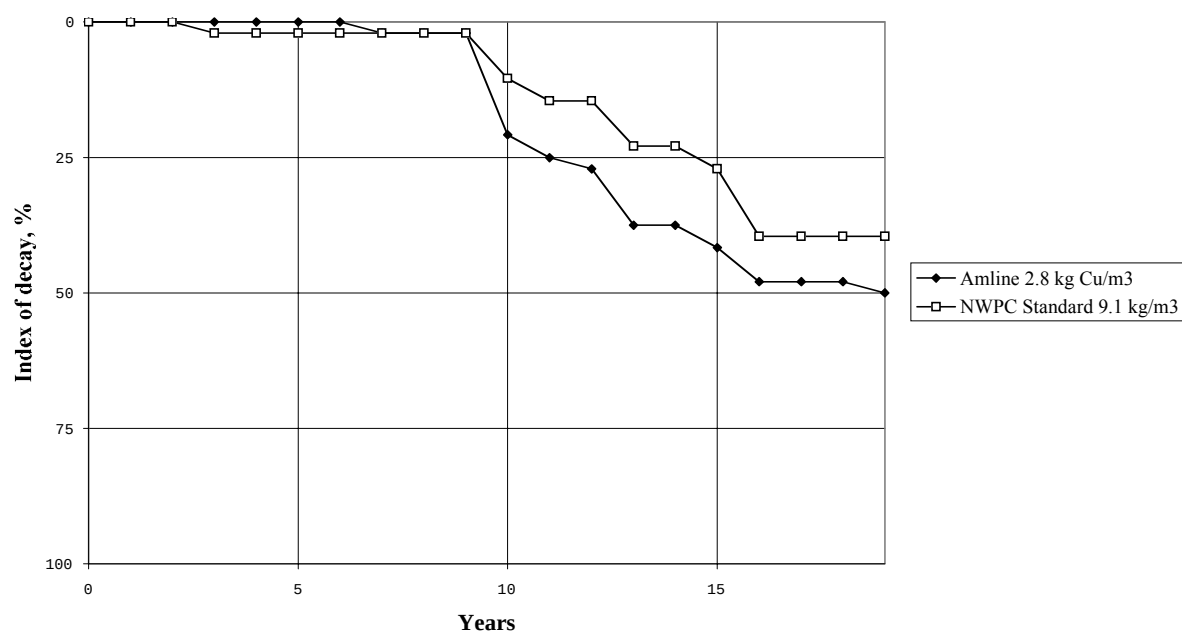
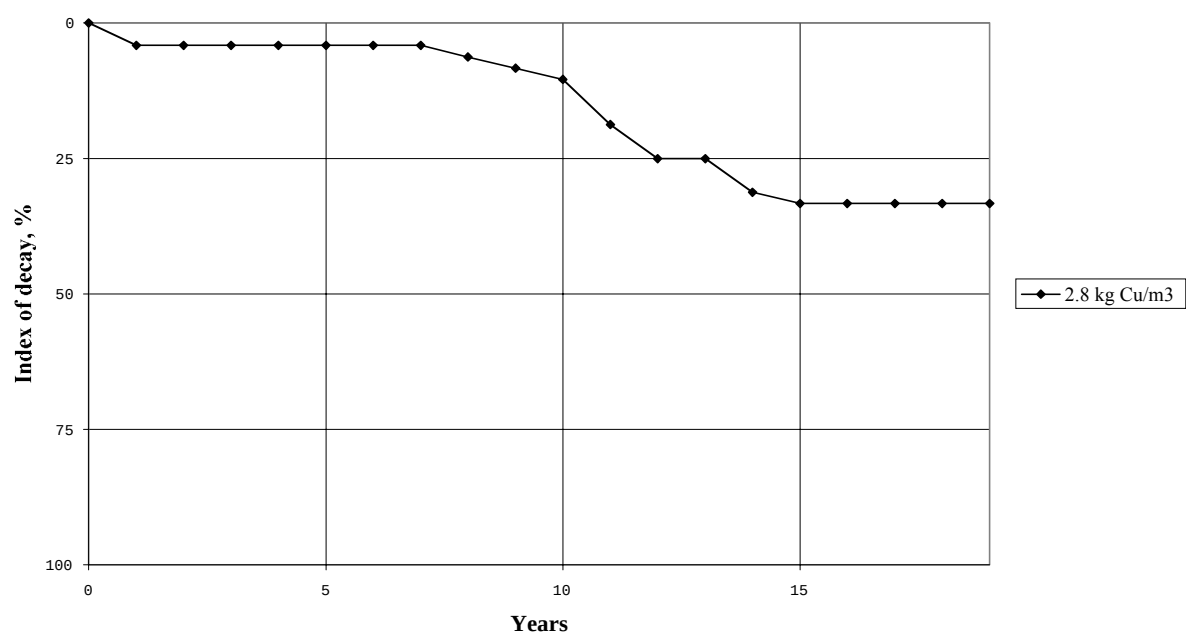


Figure 112. Field trial 1980:2. Rate of decay for stakes of European redwood treated with Amline special and NWPC Standard Preservative No.1. The stakes were dried immediately after treatment.

Simlångsdalen. Eur redwood. Amline special



Sørkedalen. Eur redwood. Amline special

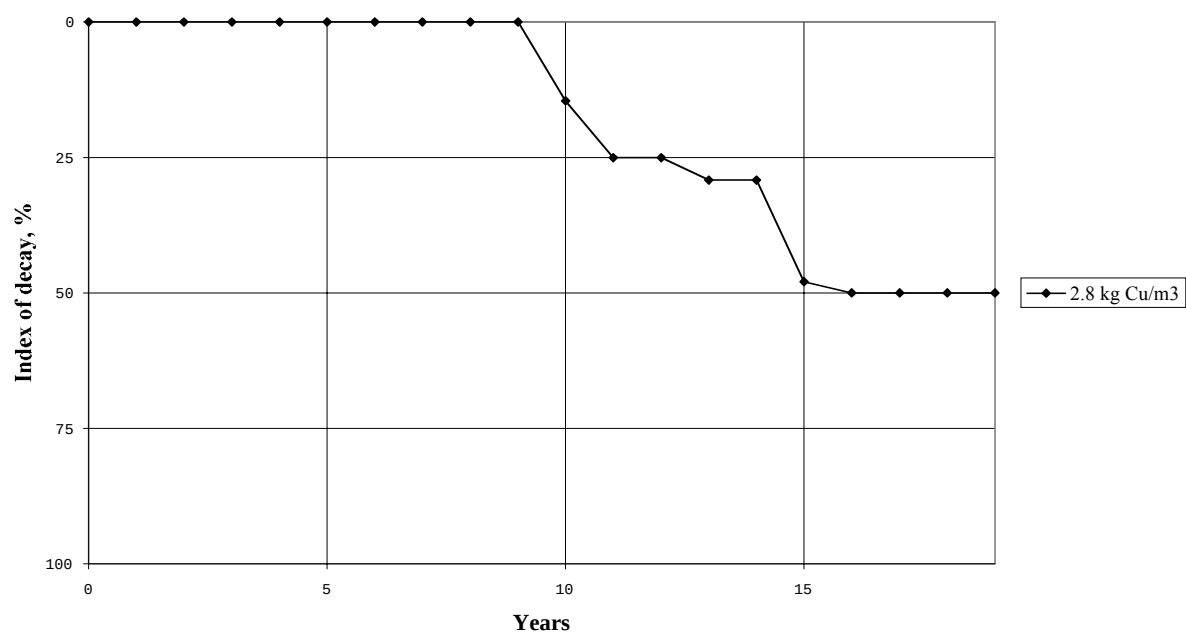
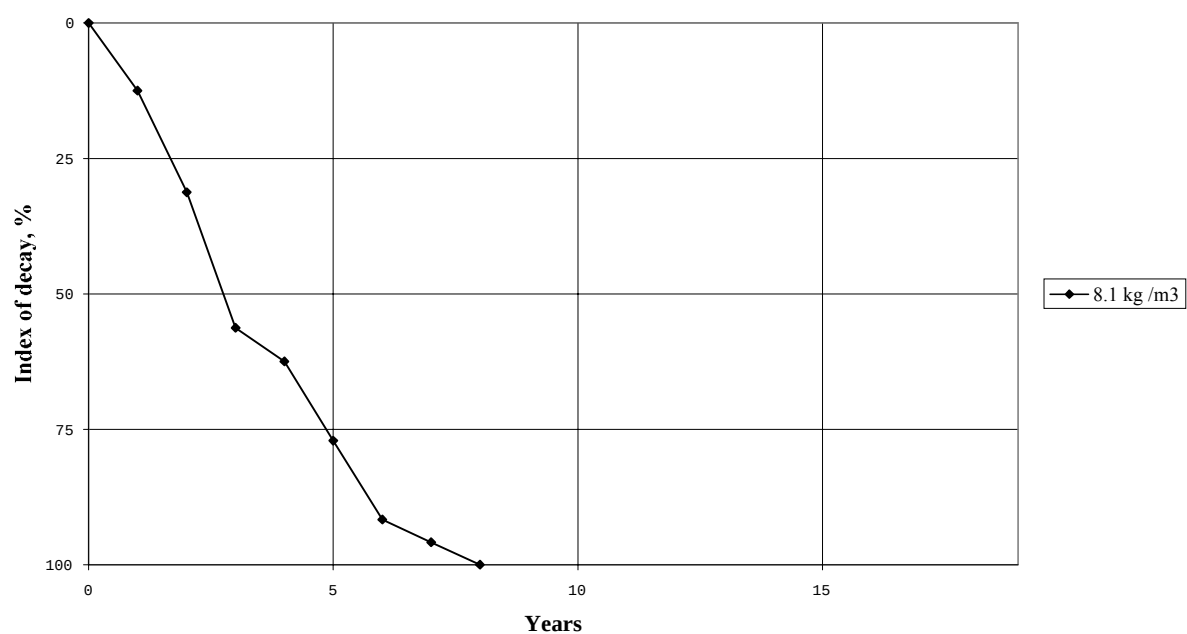


Figure 113. Field trial 1980:2. Rate of decay for stakes of European redwood treated with Amline special. The stakes were stored in plastic bags for 8 weeks immediately after treatment.

Simlångsdalen. Eur beech. NWPC Standard



Sørkedalen. Eur beech. NWPC Standard

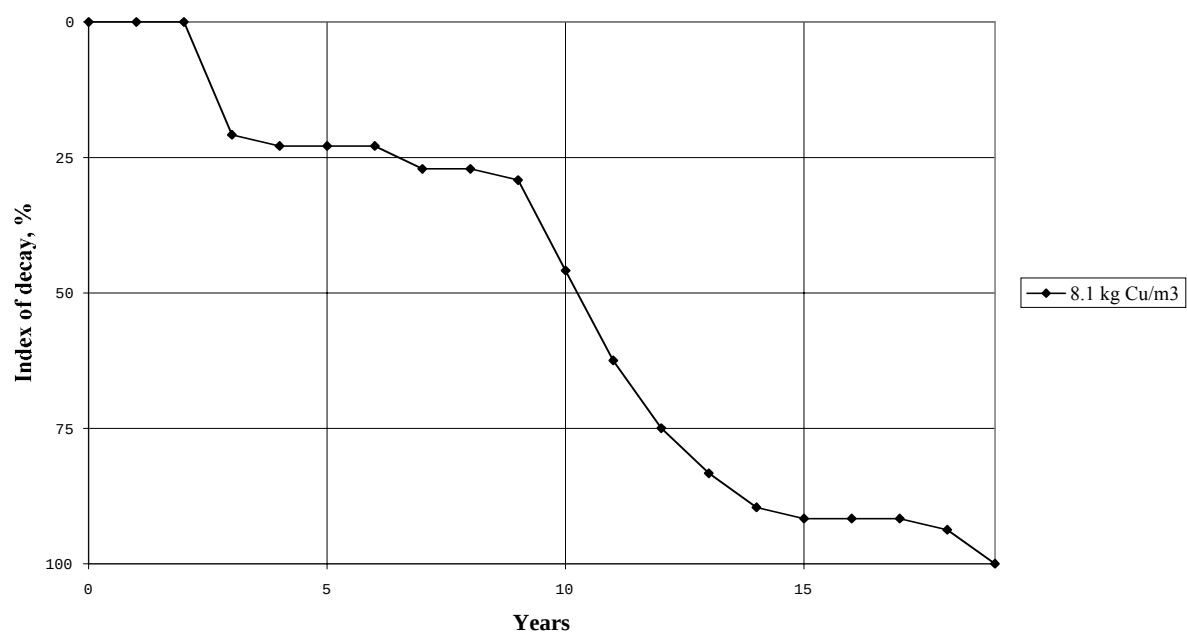
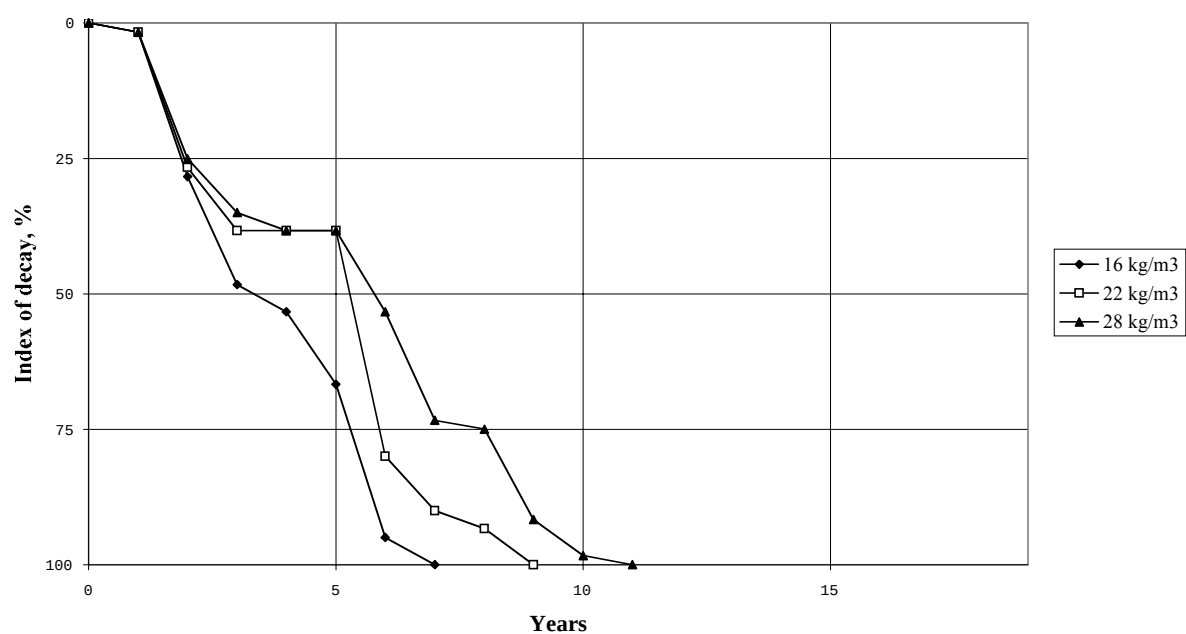


Figure 114. Field trial 1980:2. Rate of decay for stakes of European beech treated with NWPC Standard Preservative No. 1. The stakes were dried immediately after treatment.

Simlångsdalen. Eur redwood. Celcure Q



Sørkedalen. Eur redwood. Celcure Q

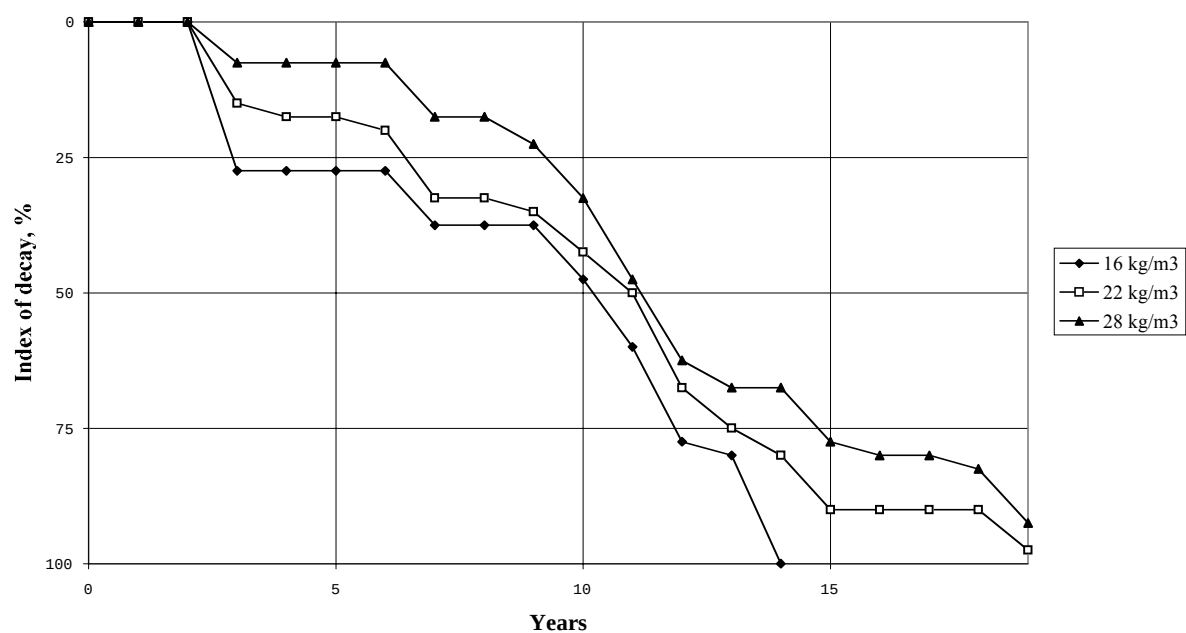
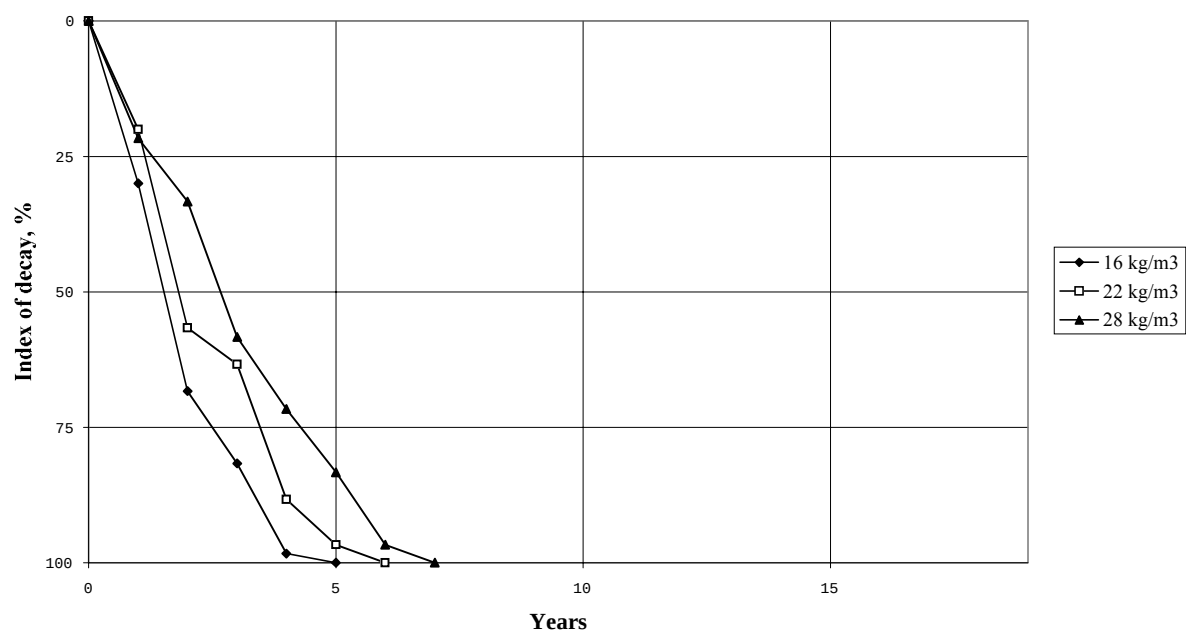


Figure 115. Field trial 1980:3. Rate of decay for stakes treated with Celcure Q.

Simlångsdalen. Eur redwood. Celcure T



Sørkedalen. Eur redwood. Celcure T

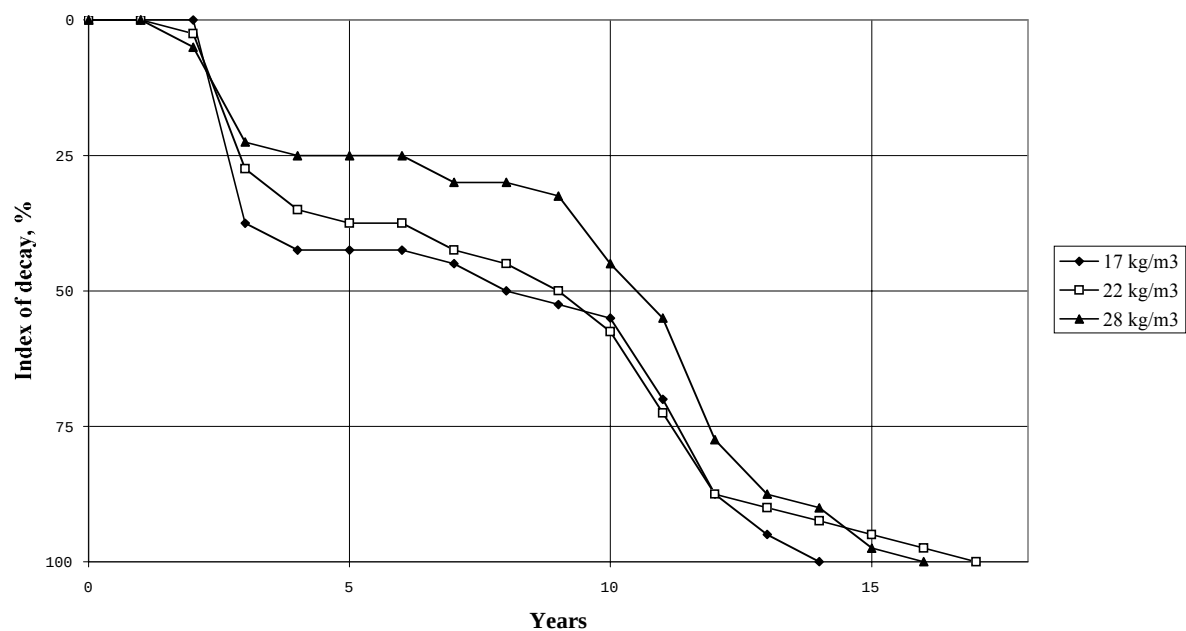
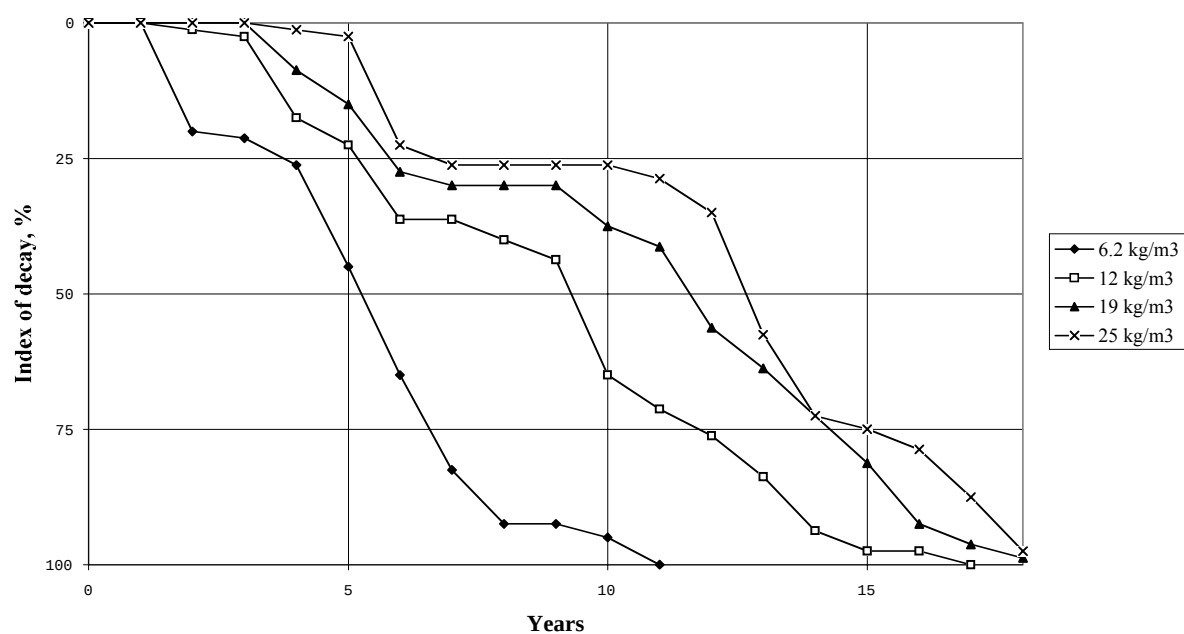


Figure 116. Field trial 1980:3. Rate of decay for stakes treated with Celcure T.

Simlångsdalen. Eur beech. HW 81



Tåstrup. Eur beech. HW 81

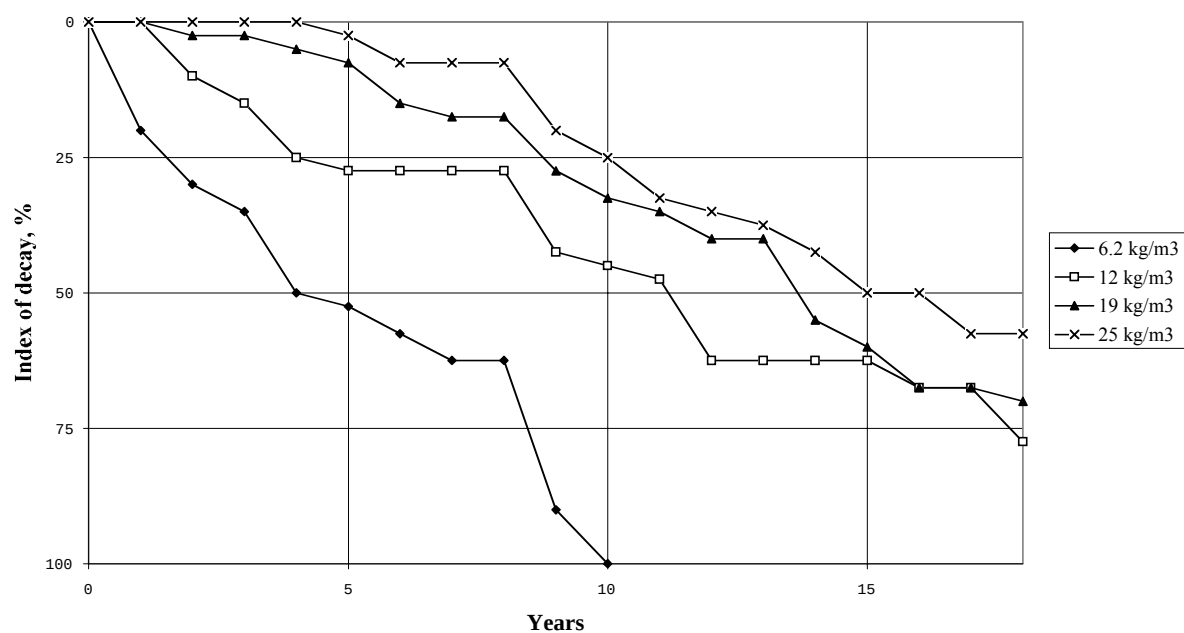
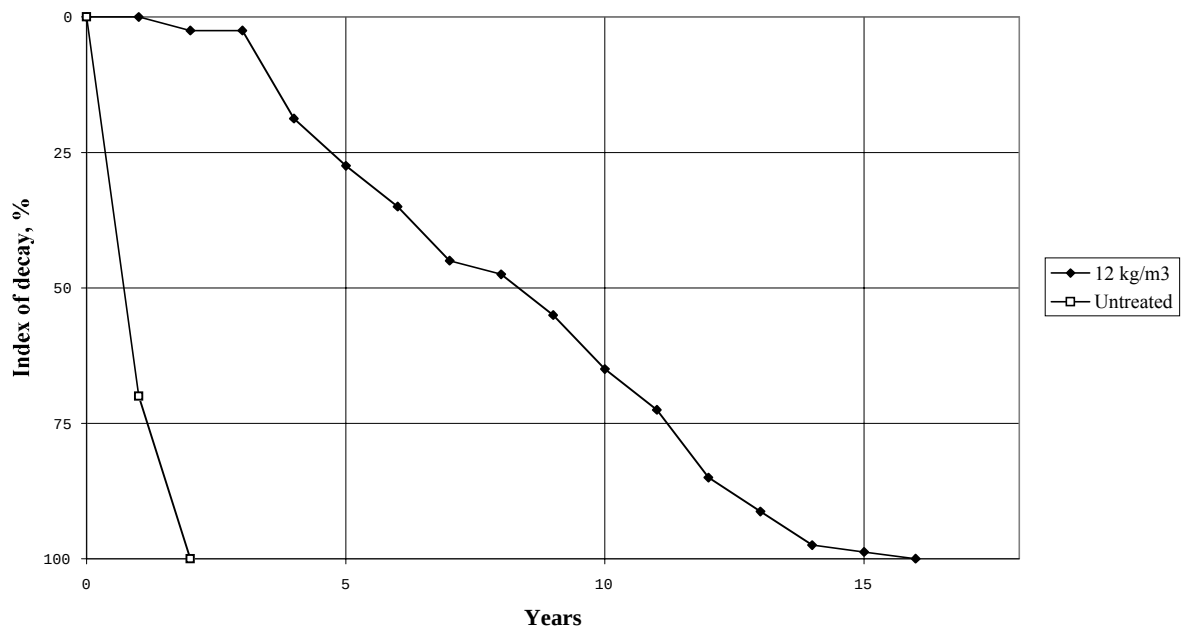


Figure 117. Field trial 1981. Rate of decay for stakes of European beech treated with HW 81. The stakes were stored in plastic bags for 6 weeks immediately after treatment.

Simlångsdalen. Eur beech. HW 81



Tåstrup. Eur beech. HW 81

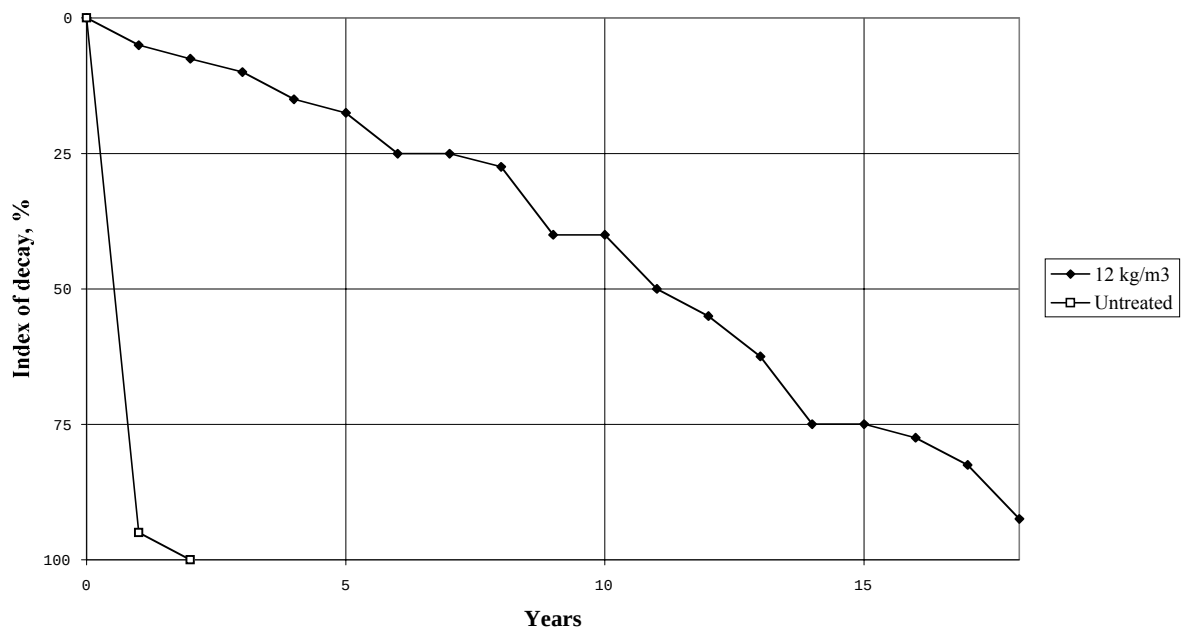


Figure 118. Field trial 1981. Rate of decay for stakes of European beech treated with HW 81. The stakes were dried immediately after treatment. Untreated stakes of European beech.

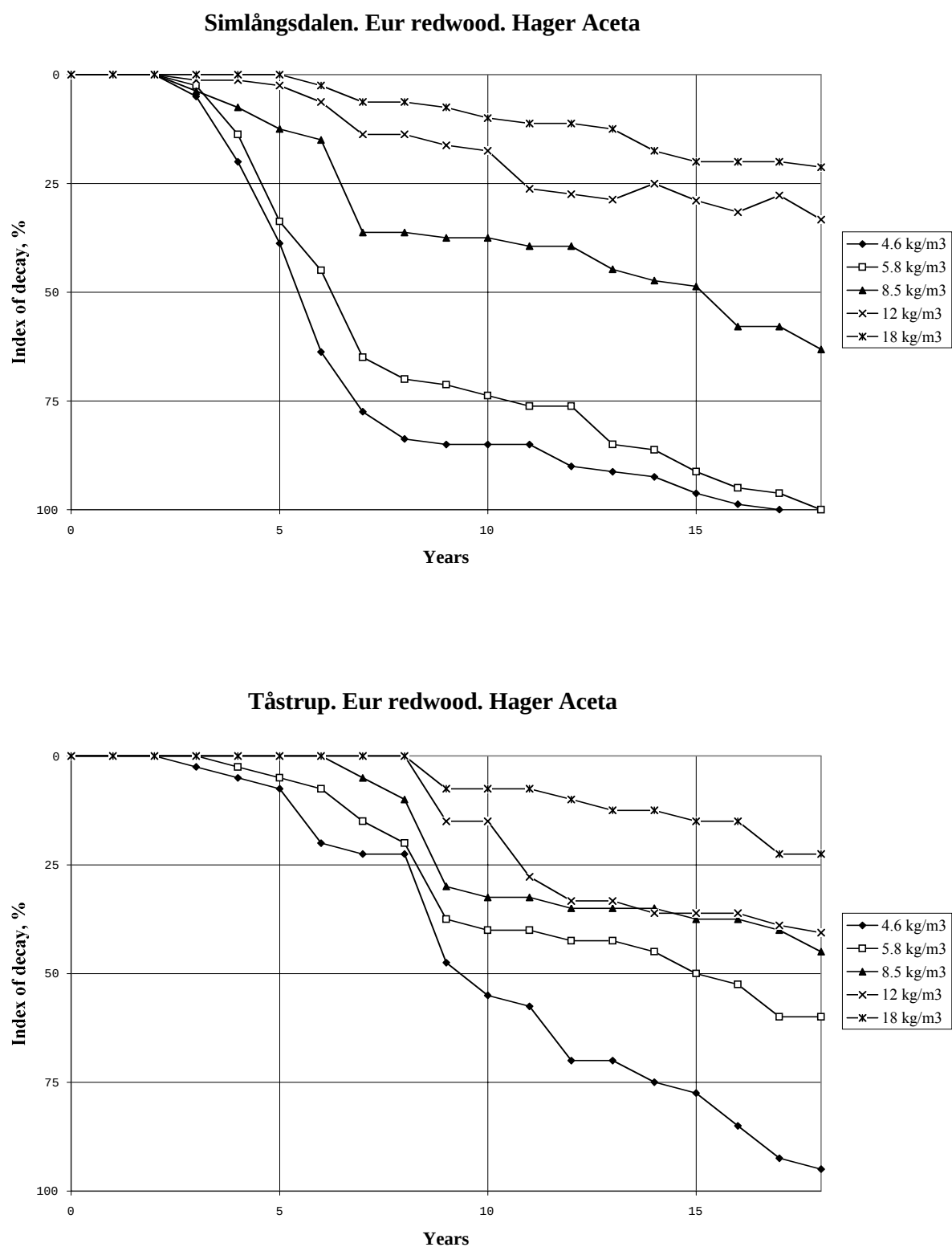
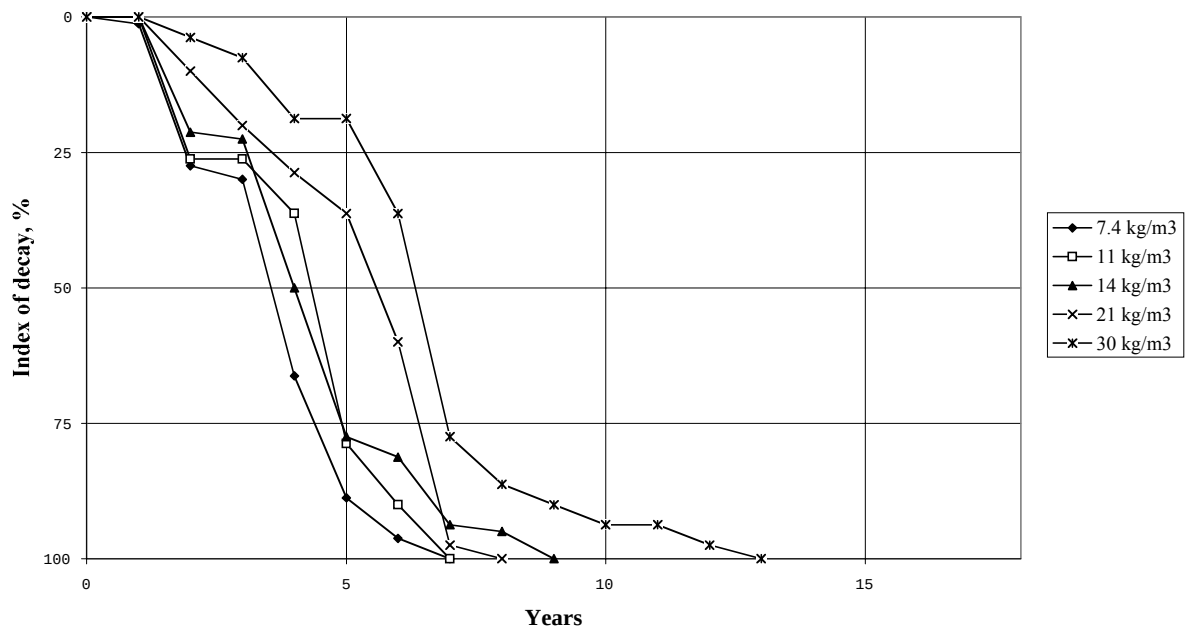


Figure 119. Field trial 1981. Rate of decay for stakes treated with Hager Aceta.

Simlångsdalen. Eur redwood. HZ 81



Tåstrup. Eur redwood. HZ 81

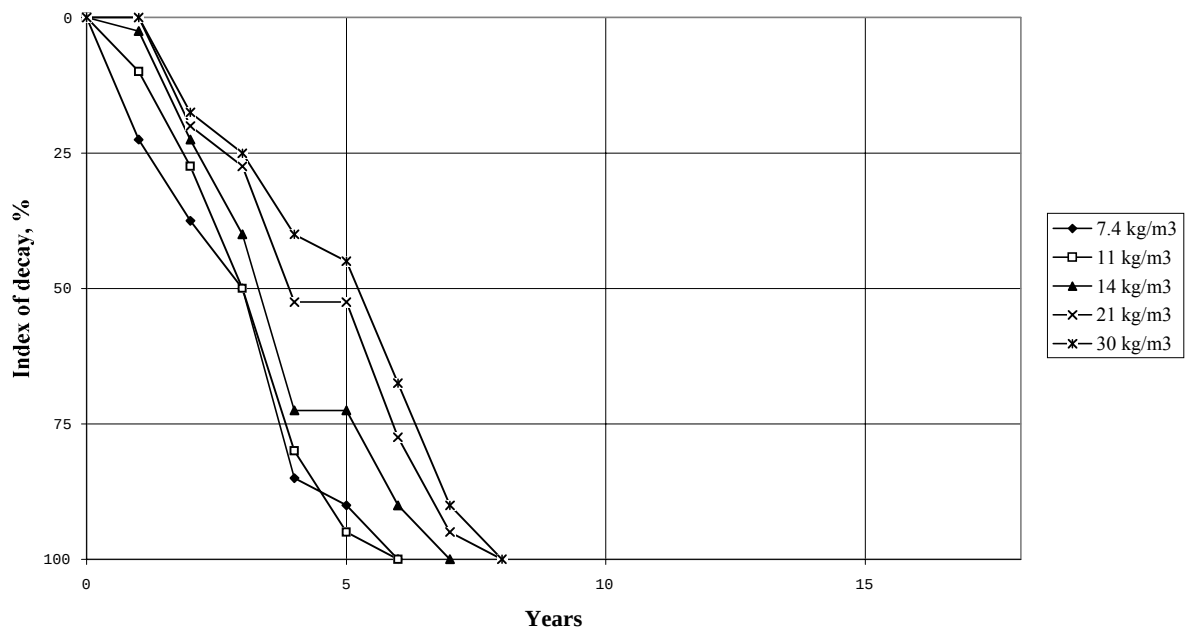
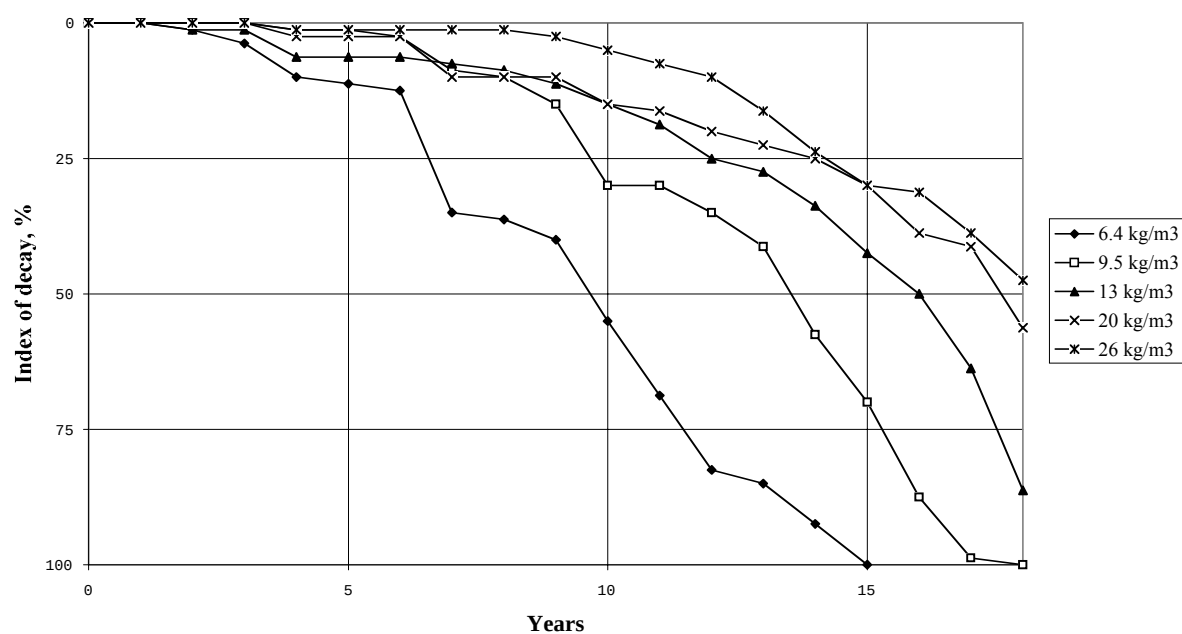


Figure 120. Field trial 1981. Rate of decay for stakes treated with HZ 81.

Simlångsdalen. Eur redwood. Hylosan PT 1/81



Tåstrup. Eur redwood. Hylosan PT 1/81

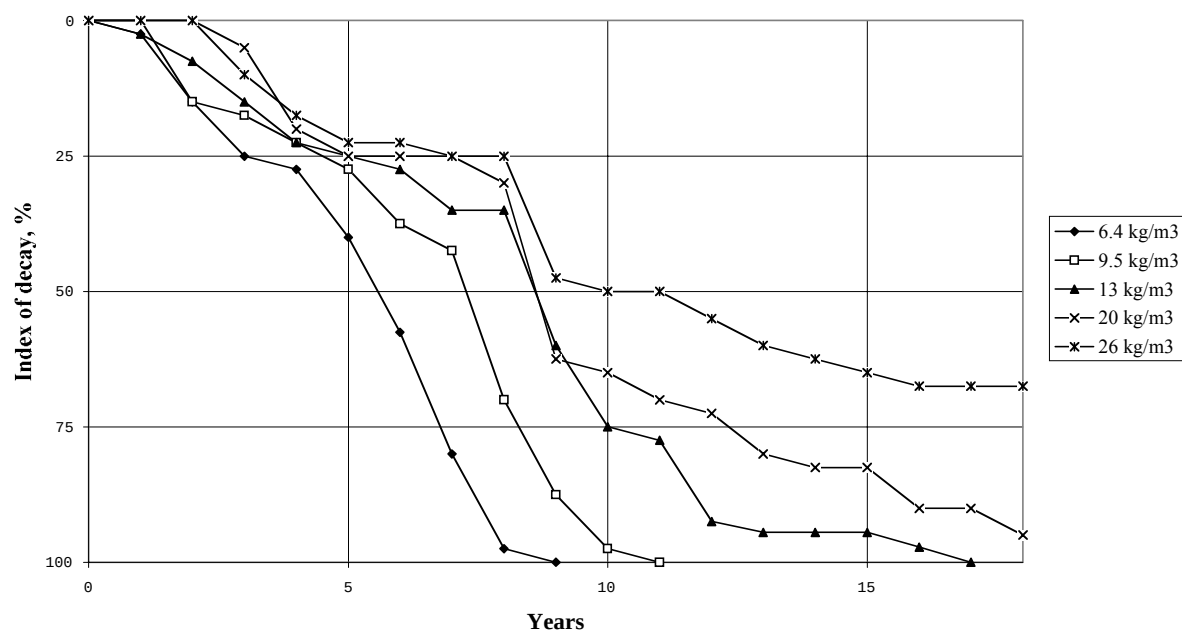
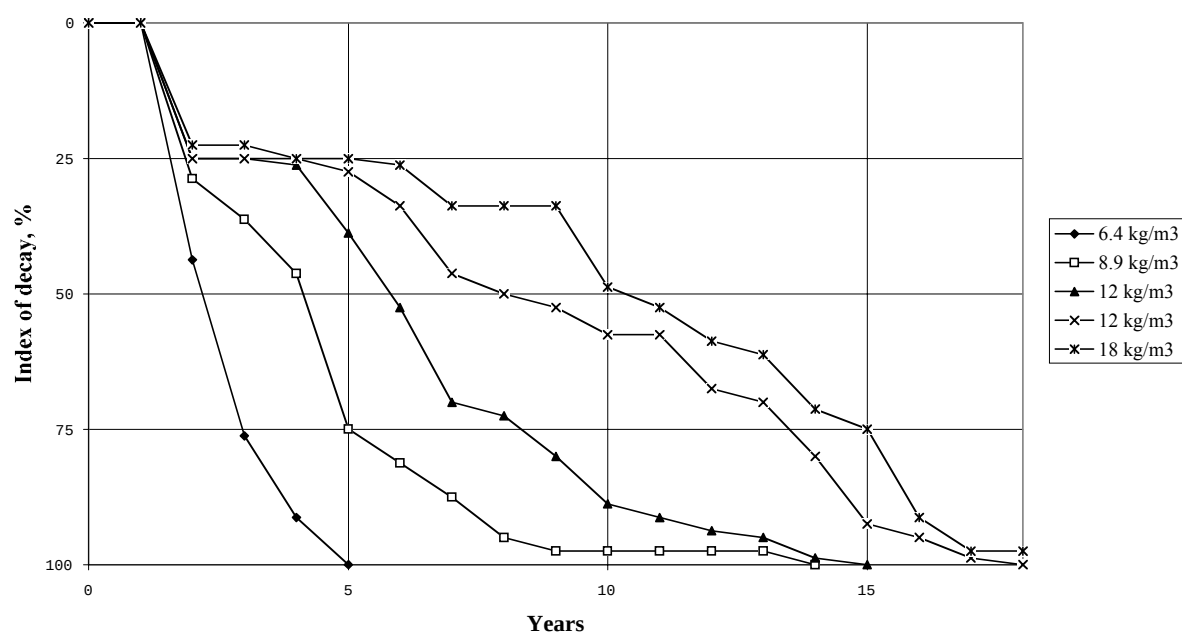


Figure 121. Field trial 1981. Rate of decay for stakes treated with Hylosan PT 1/81.

Simlångsdalen. Eur redwood. ES 240



Tåstrup. Eur redwood. ES 240

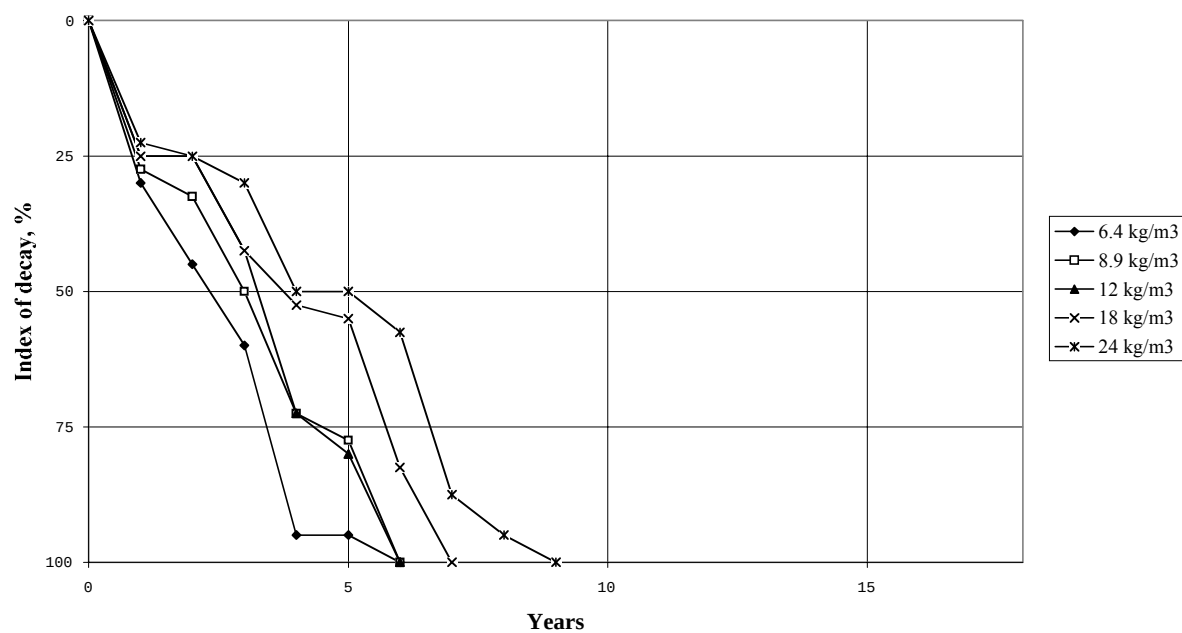
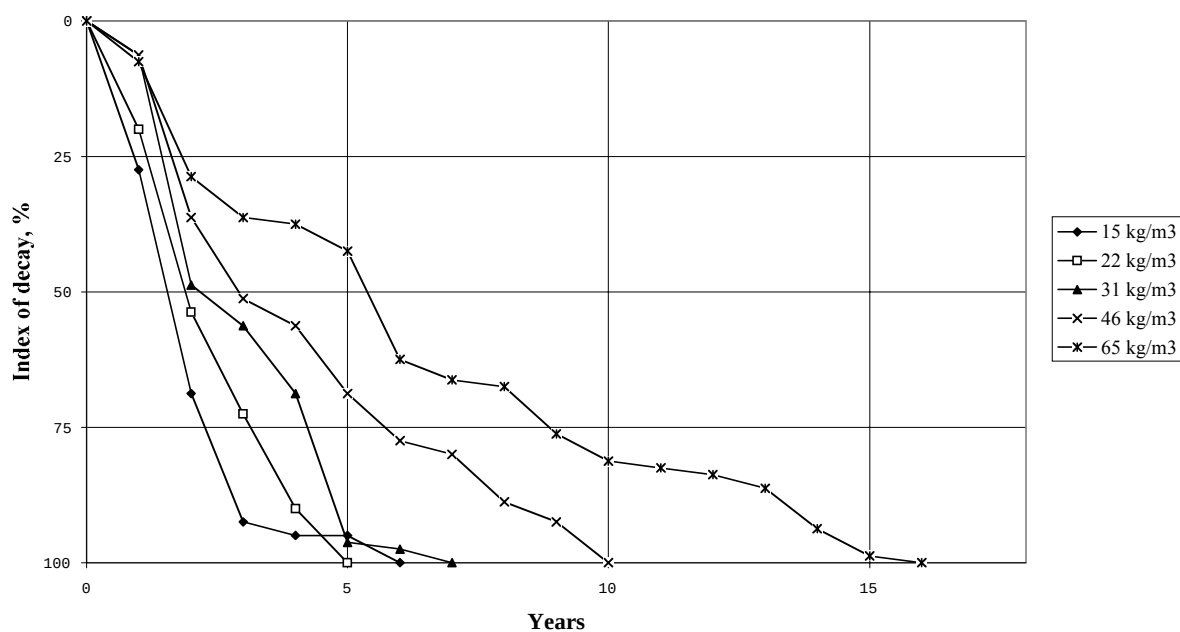


Figure 122. Field trial 1981. Rate of decay for stakes treated with ES 240.

Simlångsdalen. Eur redwood. Arquard AC



Tåstrup. Eur redwood. Arquard AC

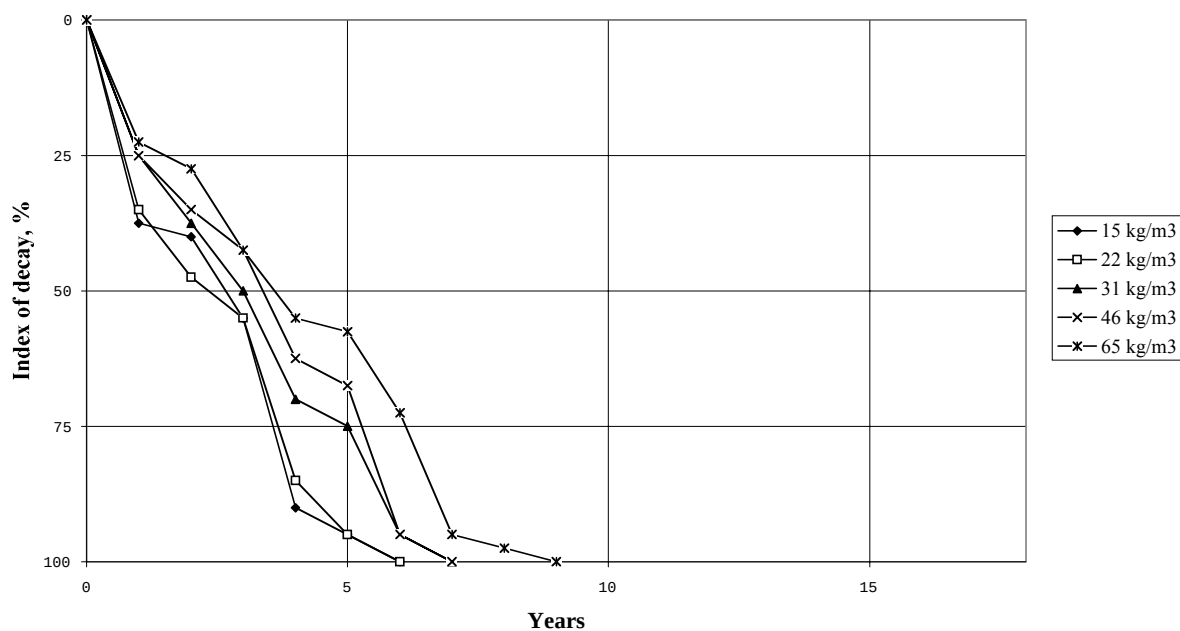
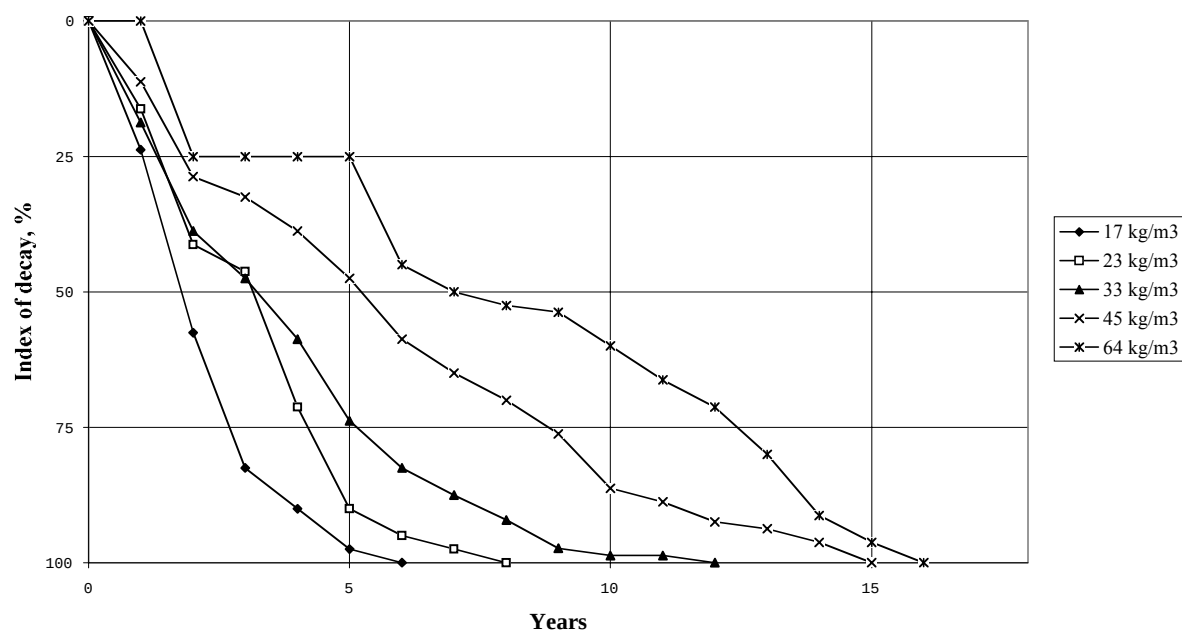


Figure 123. Field trial 1981. Rate of decay for stakes treated with Arquard AC.

Simlångsdalen. Eur redwood. Arquard IC



Tåstrup. Eur redwood. Arquard IC

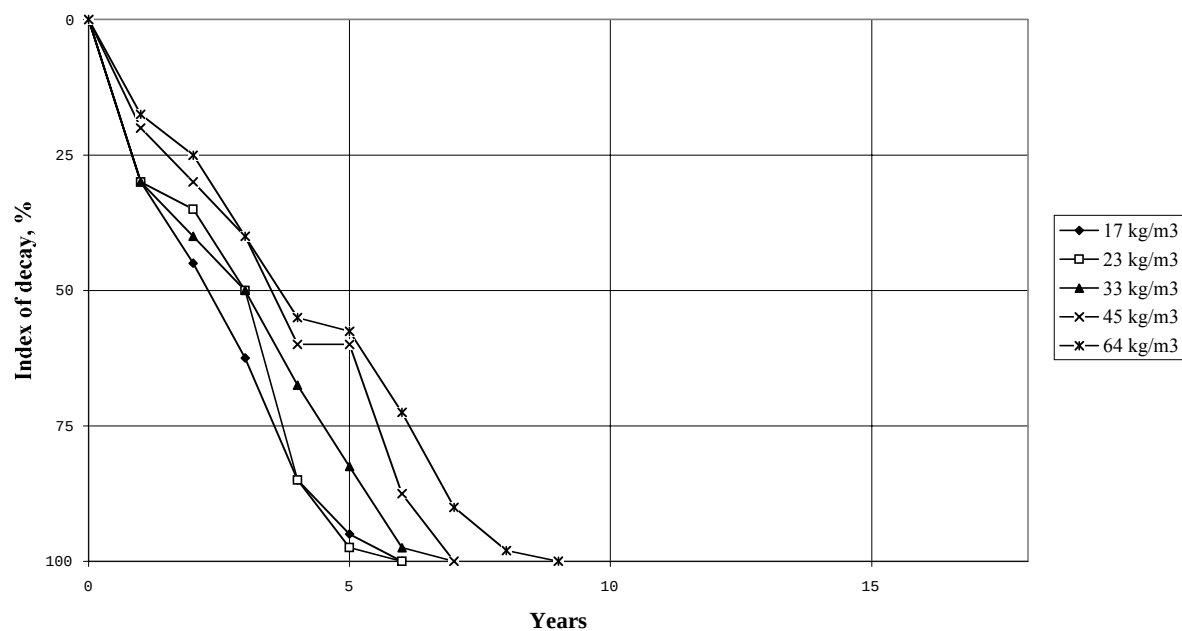


Figure 124. Field trial 1981. Rate of decay for stakes treated with Arquard IC.

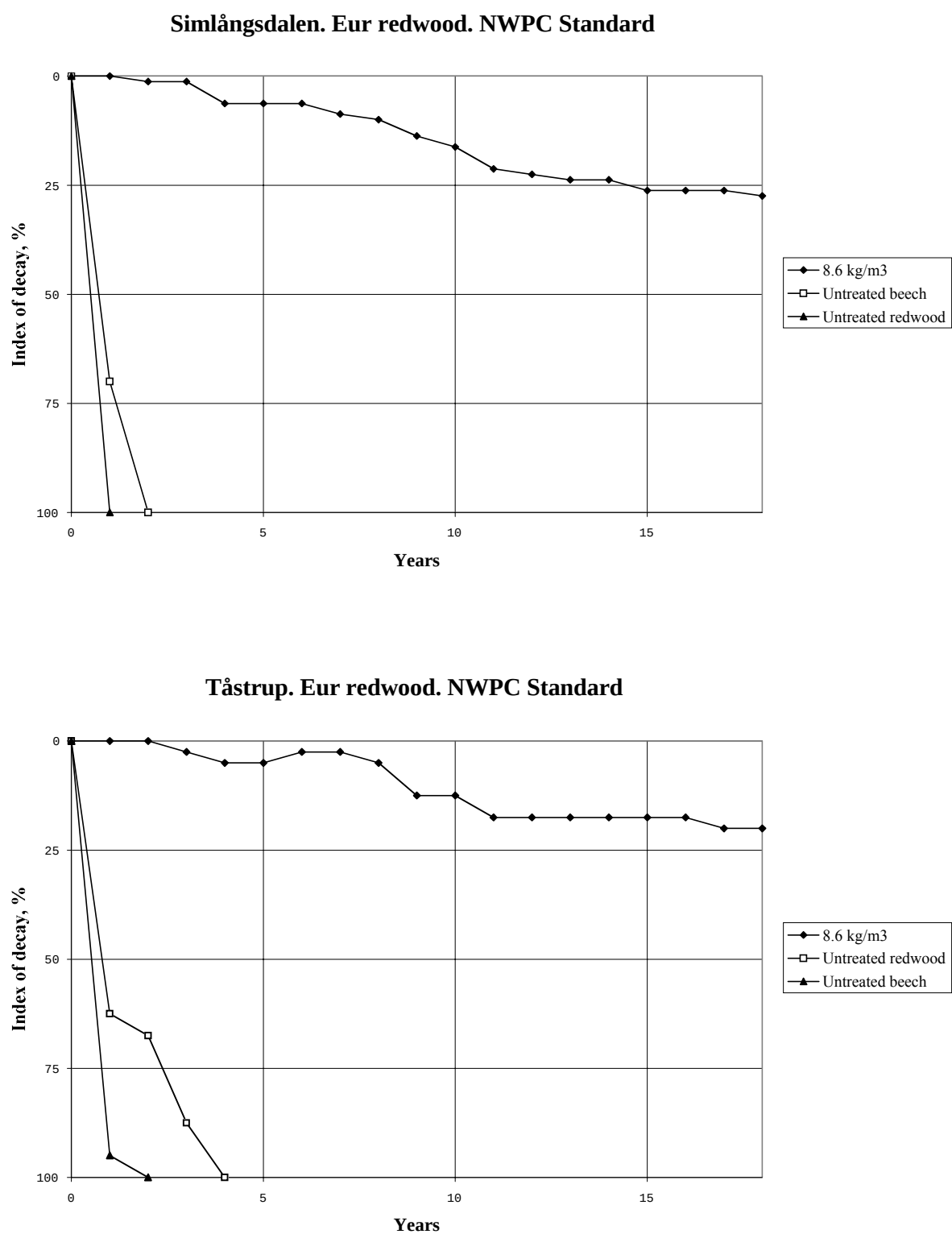
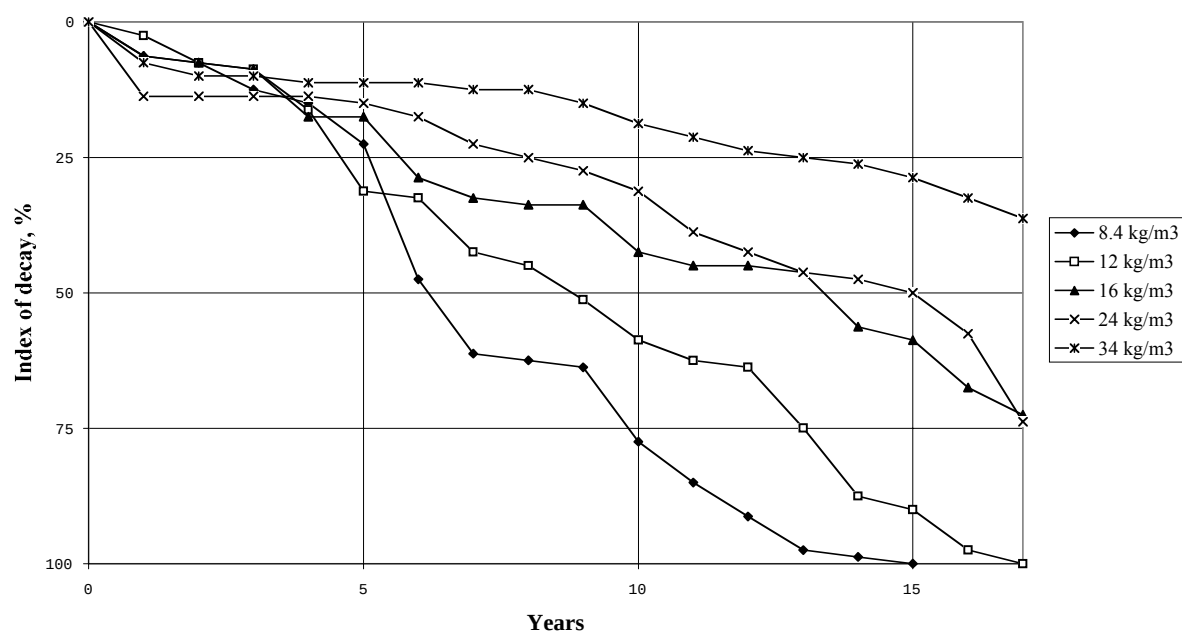


Figure 125. Field trial 1981. Rate of decay for stakes treated with NWPC Standard and untreated stakes.

Simlångsdalen. Eur redwood. H82-alfa



Viikki. Eur redwood. H82-alfa

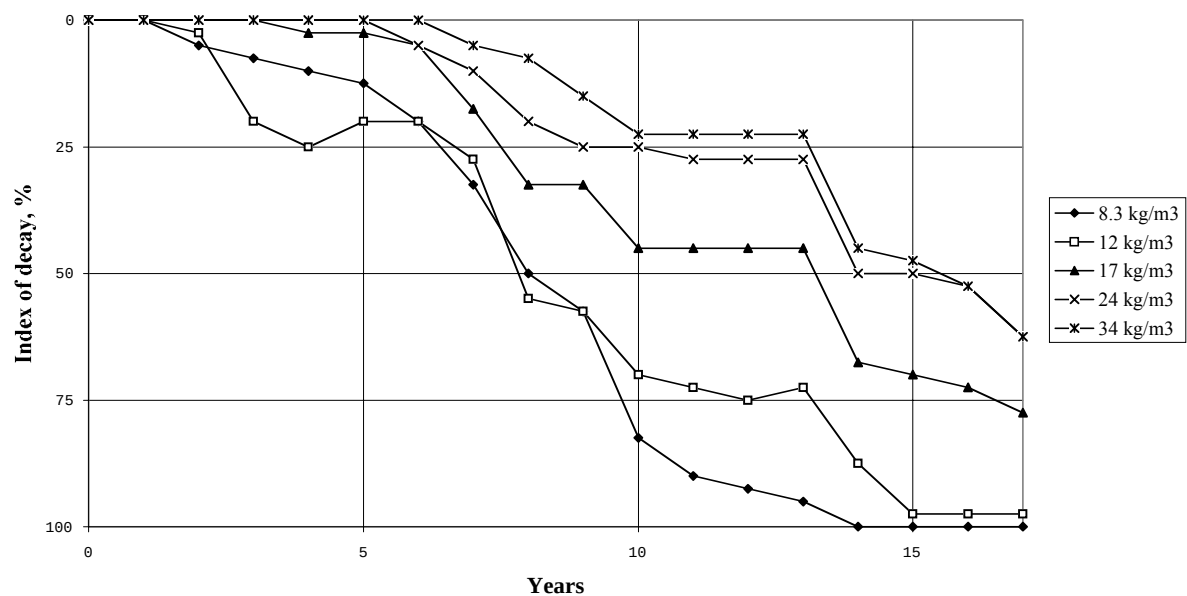


Figure 126. Field trial 1982. Rate of decay for stakes treated with H82-alfa.

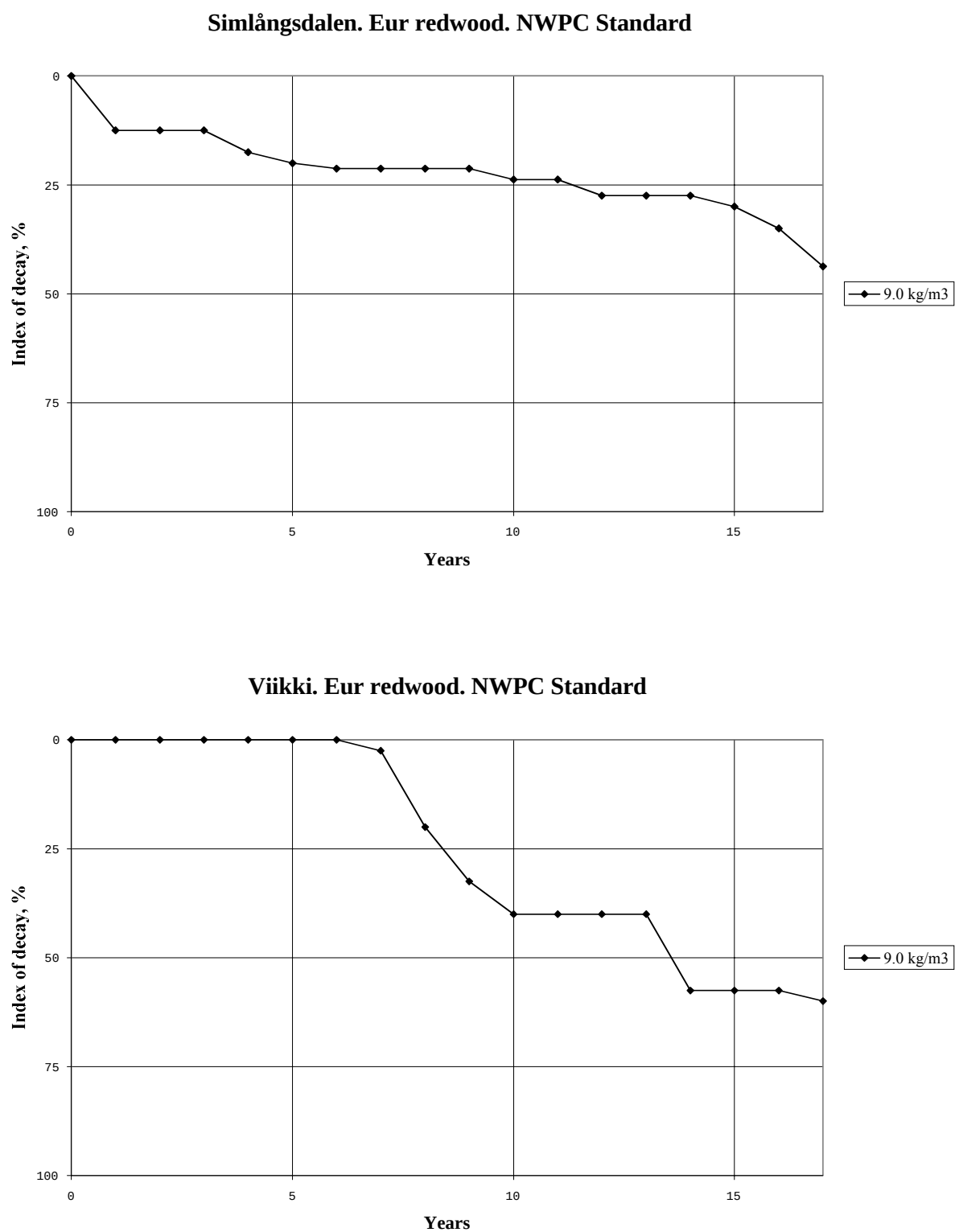
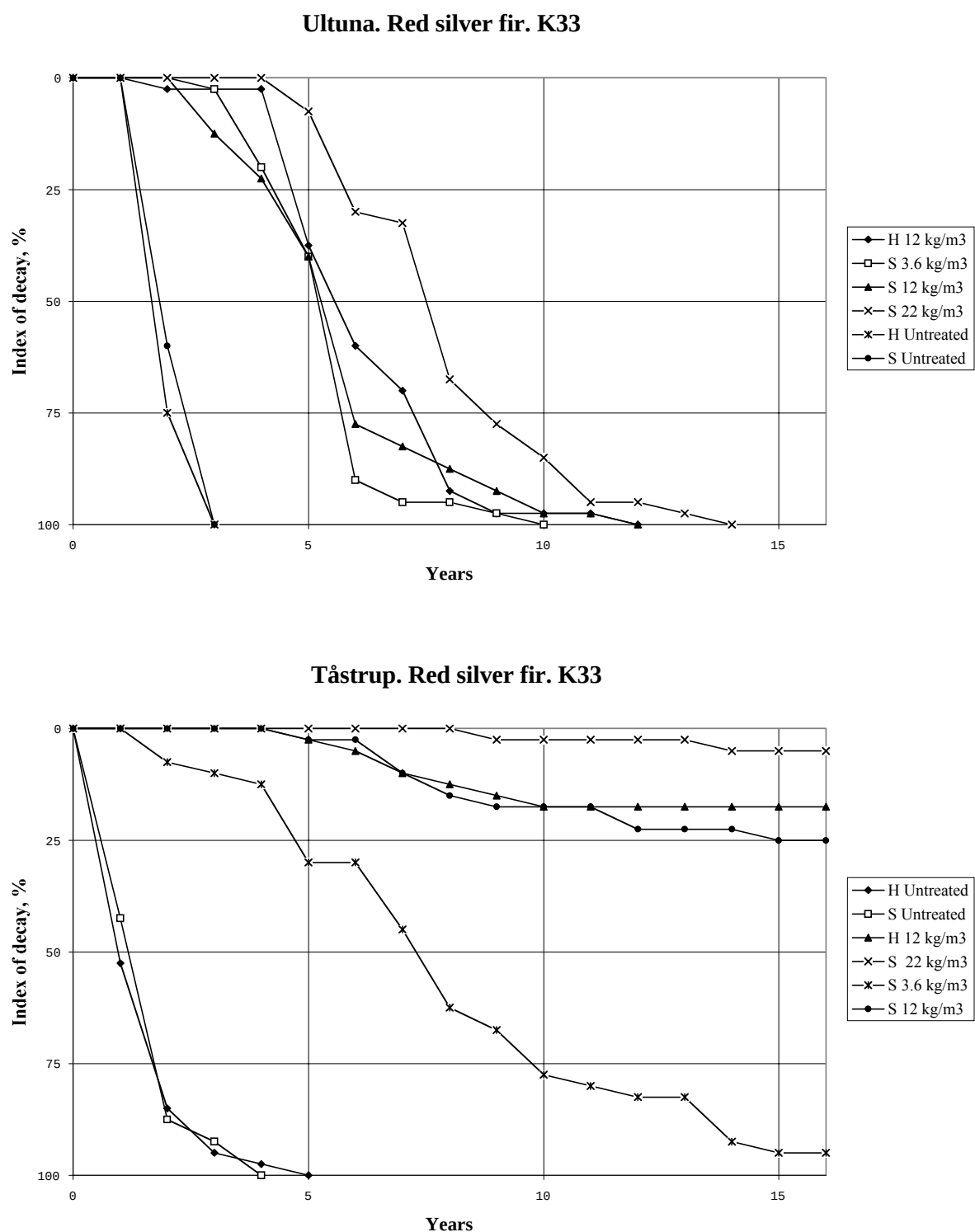
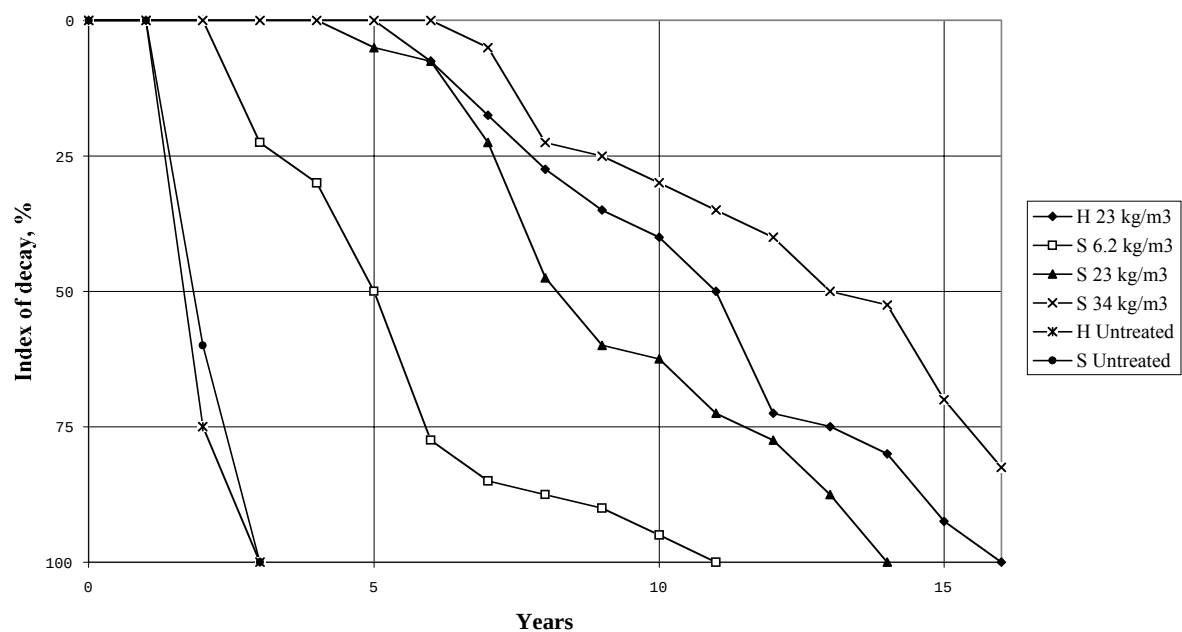


Figure 127. Field trial 1982. Rate of decay for stakes treated with NWPC Standard.



Ultuna. Red silver fir. Cuprinol Tryck



Tåstrup. Red silver fir. Cuprinol Tryck

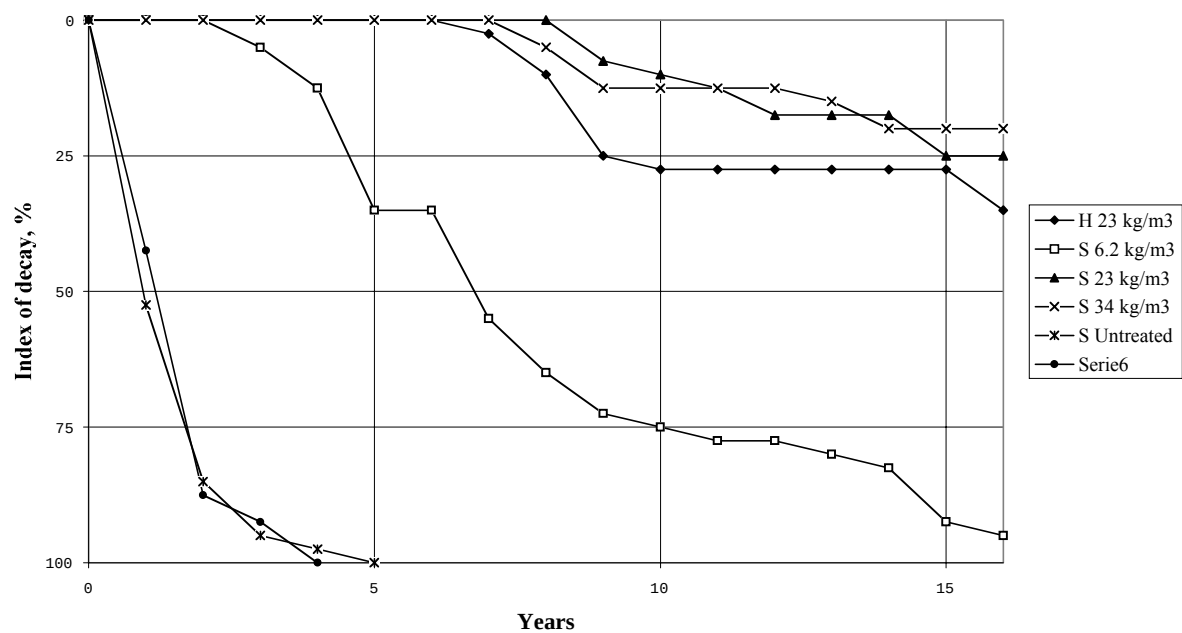
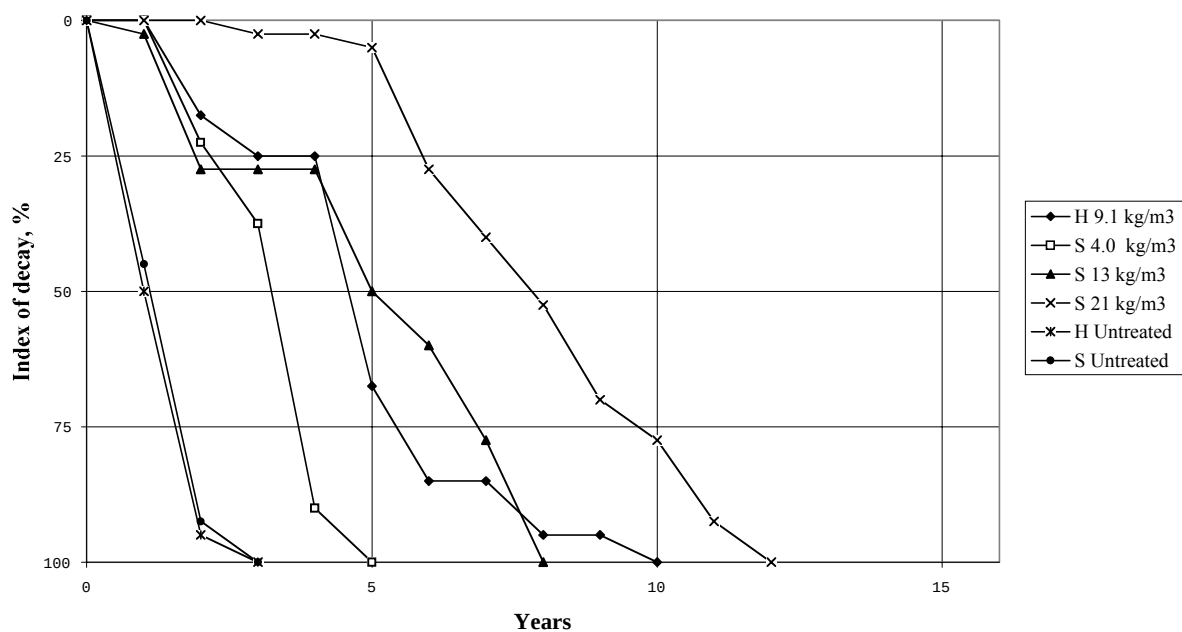


Figure 129. Field trial 1983:1. Rate of decay for stakes treated with Cuprinol Tryck. H = heartwood, S = sapwood.

Ultuna. Lodgepole pine. K33



Tåstrup. Lodgepole pine. K33

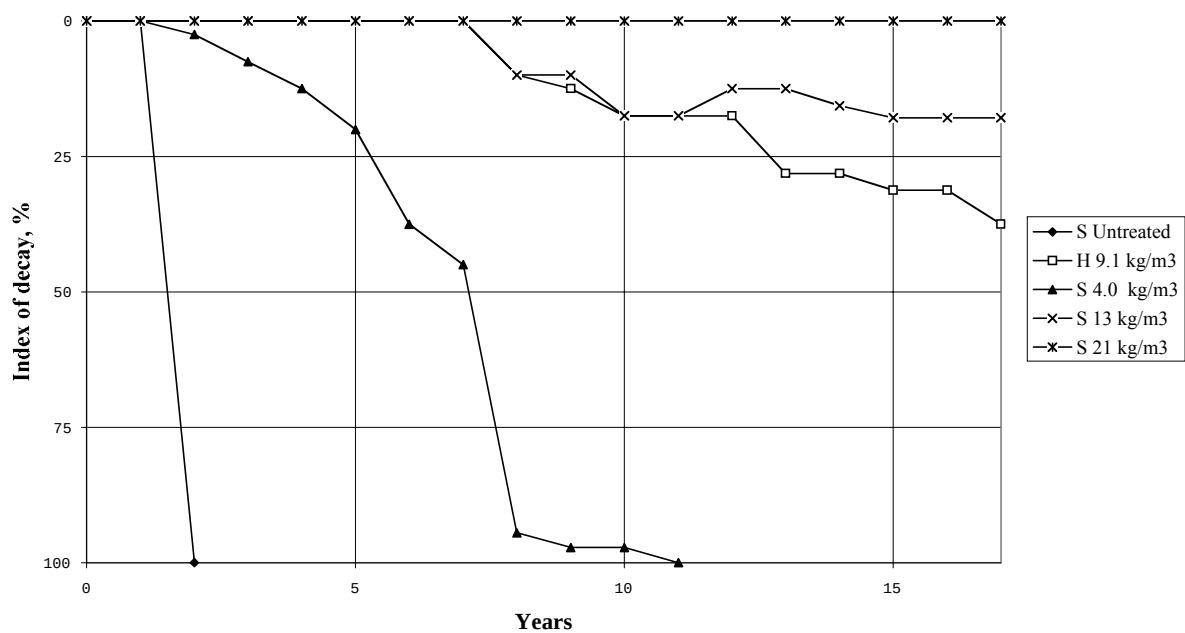


Figure 130. Field trial 1983:1. Rate of decay for stakes treated with K33.
H = heartwood, S = sapwood.

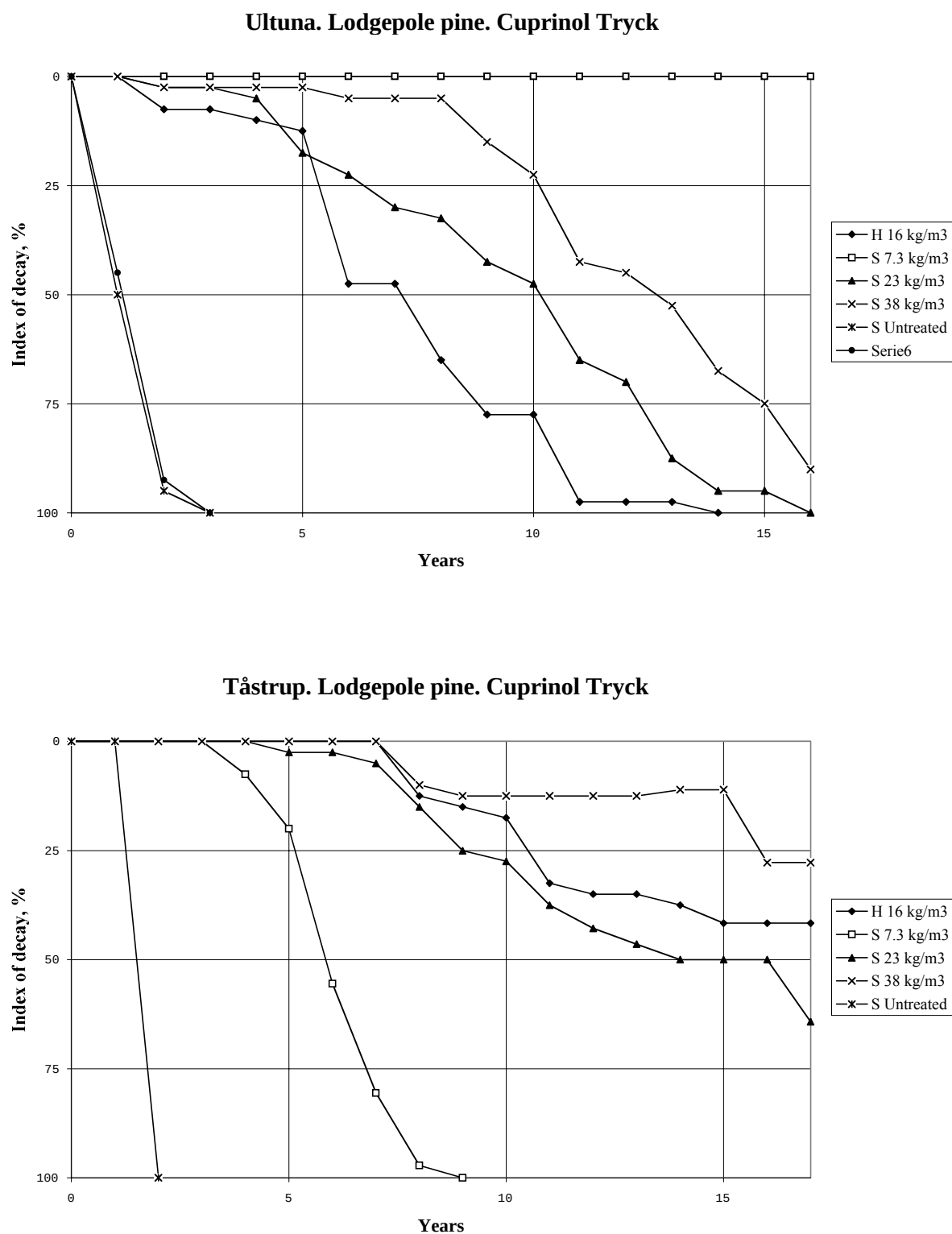


Figure 131. Field trial 1983:1. Rate of decay for stakes treated with Cuprinol Tryck.
H = heartwood, S = sapwood.

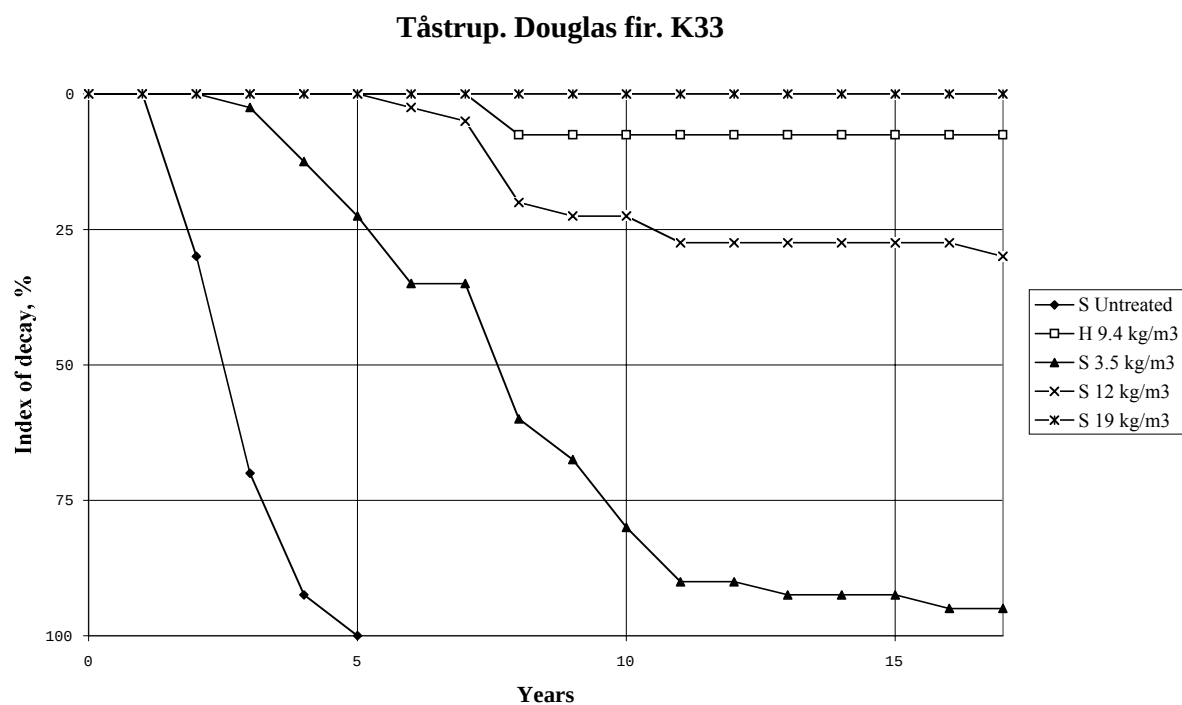
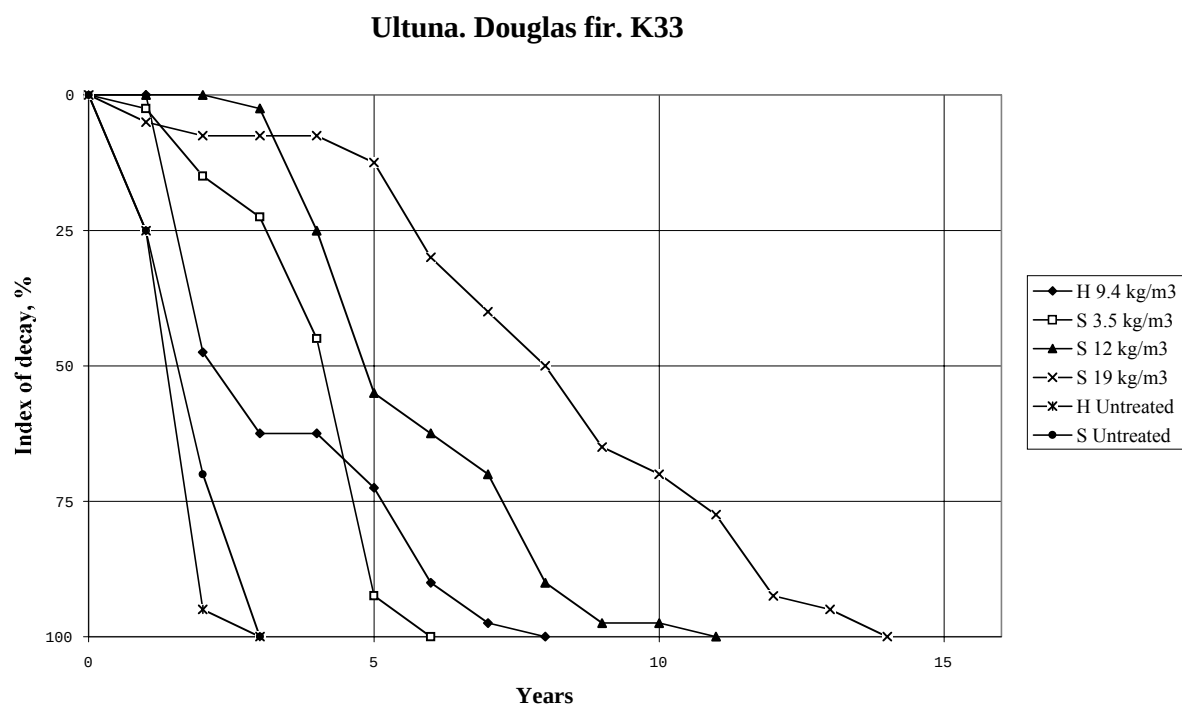
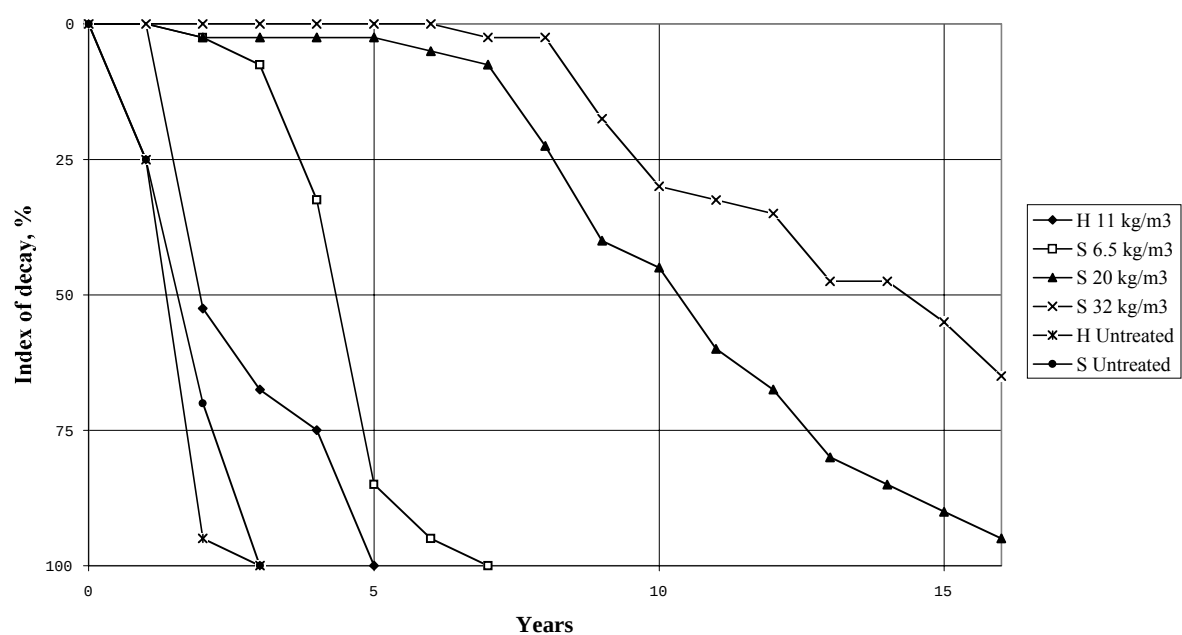


Figure 132. Field trial 1983:1. Rate of decay for stakes treated with K33.
H = heartwood, S = sapwood.

Ultuna. Douglas fir. Cuprinol Tryck



Tåstrup. Douglas fir. Cuprinol Tryck

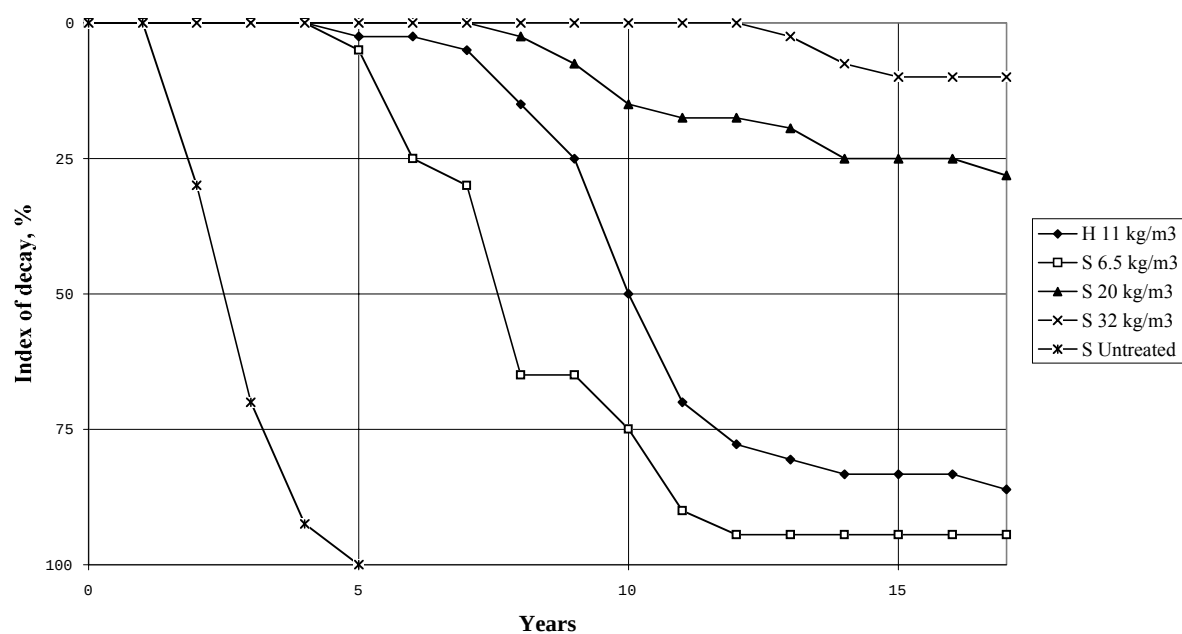
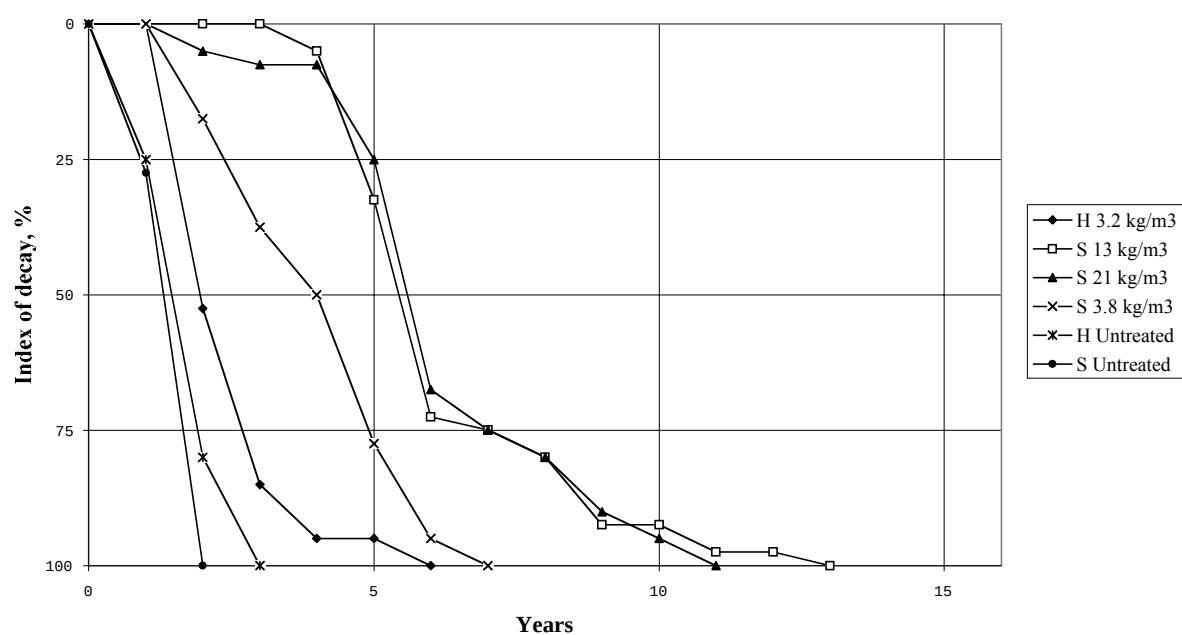


Figure 133. Field trial 1983:1. Rate of decay for stakes treated with Cuprinol Tryck. H = heartwood, S = sapwood.

Ultuna. Larch. K33



Tåstrup. Larch. K33

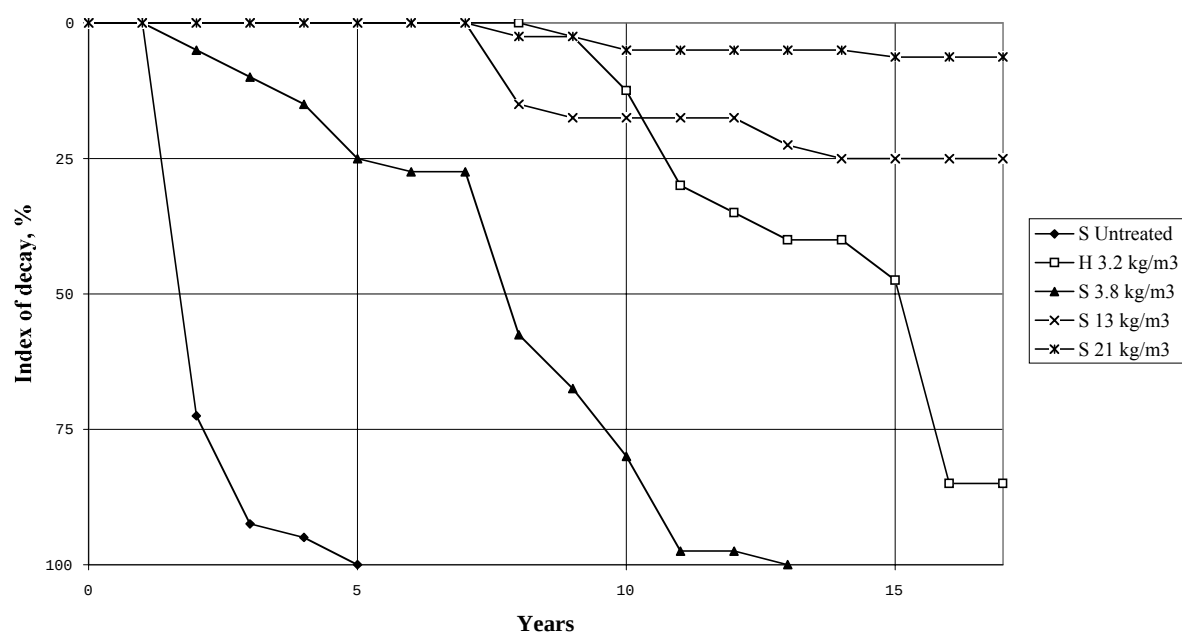
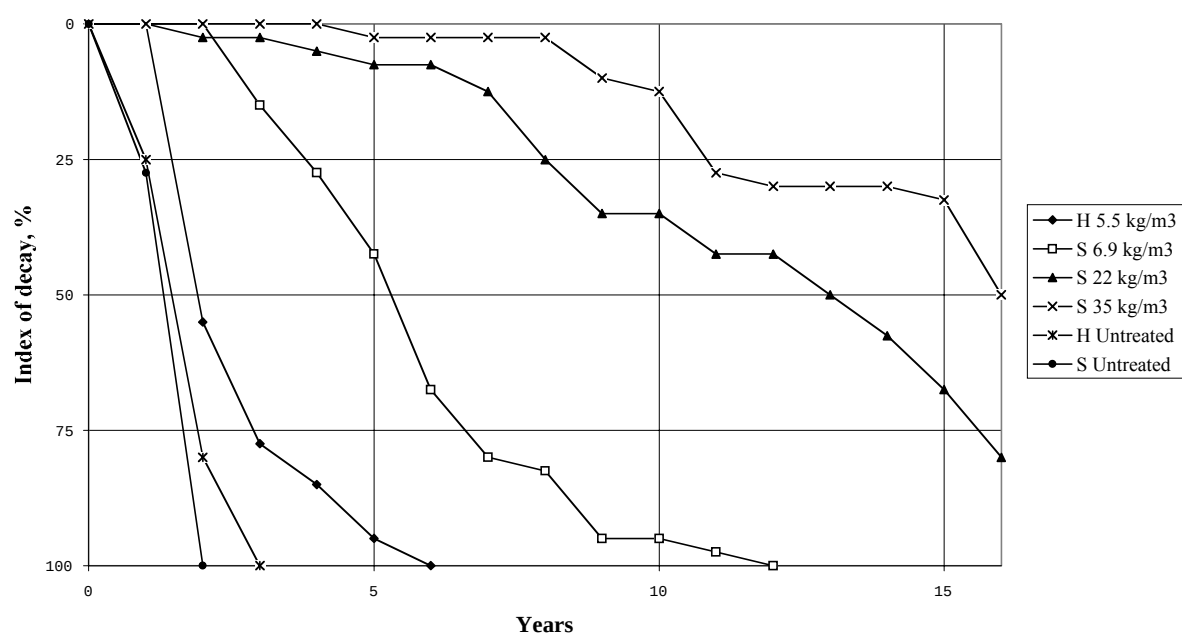


Figure 134. Field trial 1983:1. Rate of decay for stakes treated with K33.
H = heartwood, S = sapwood.

Ultuna. Larch. Cuprinol Tryck



Tåstrup. Larch. Cuprinol Tryck

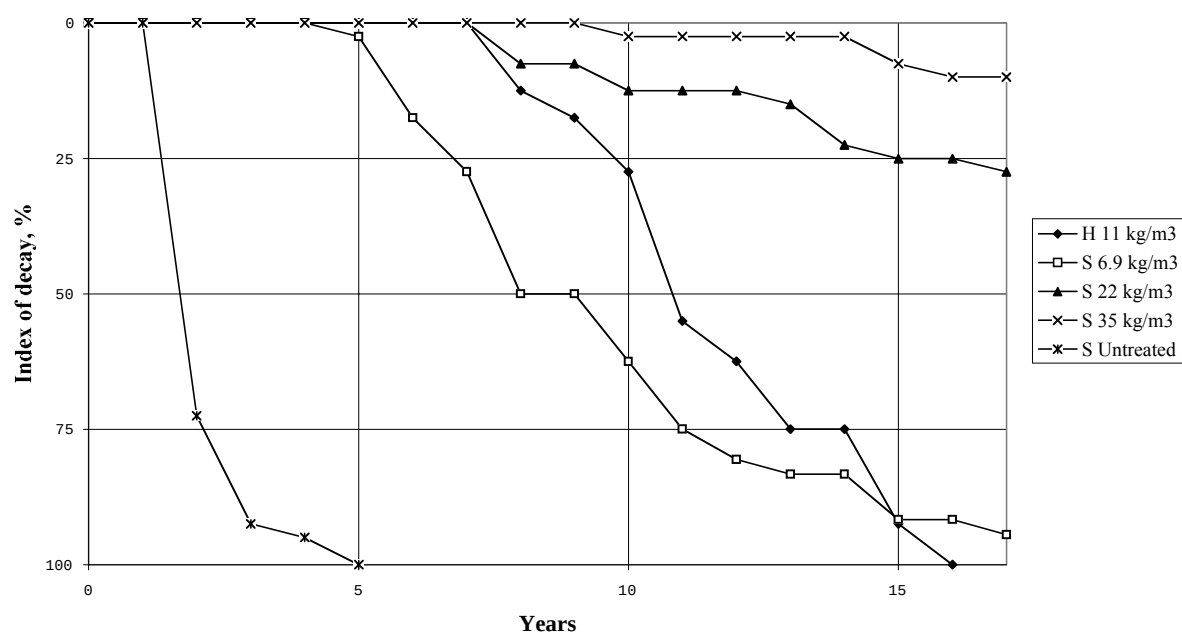
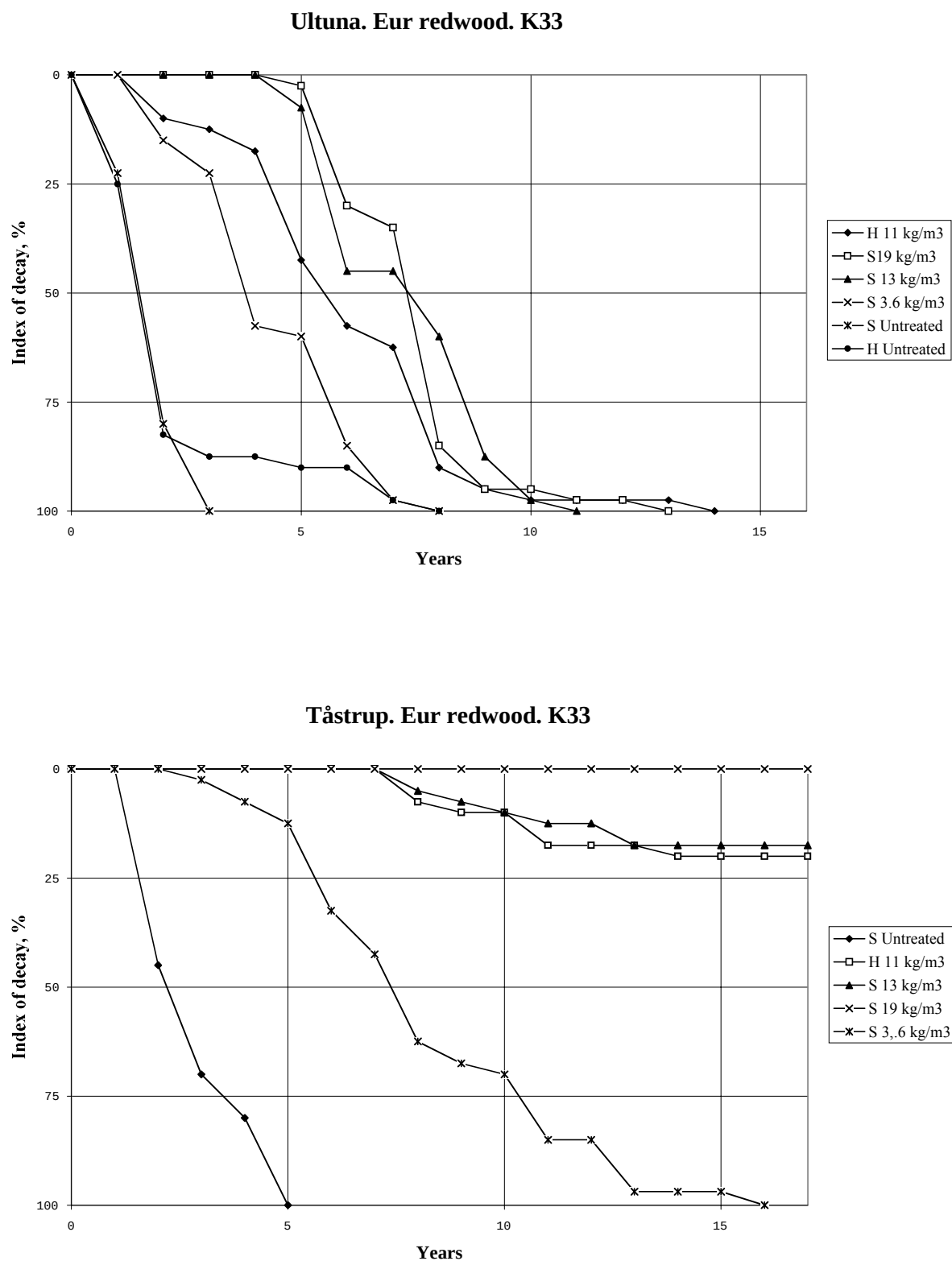


Figure 135. Field trial 1983:1. Rate of decay for stakes treated with Cuprinol Tryck.
H = heartwood, S = sapwood.



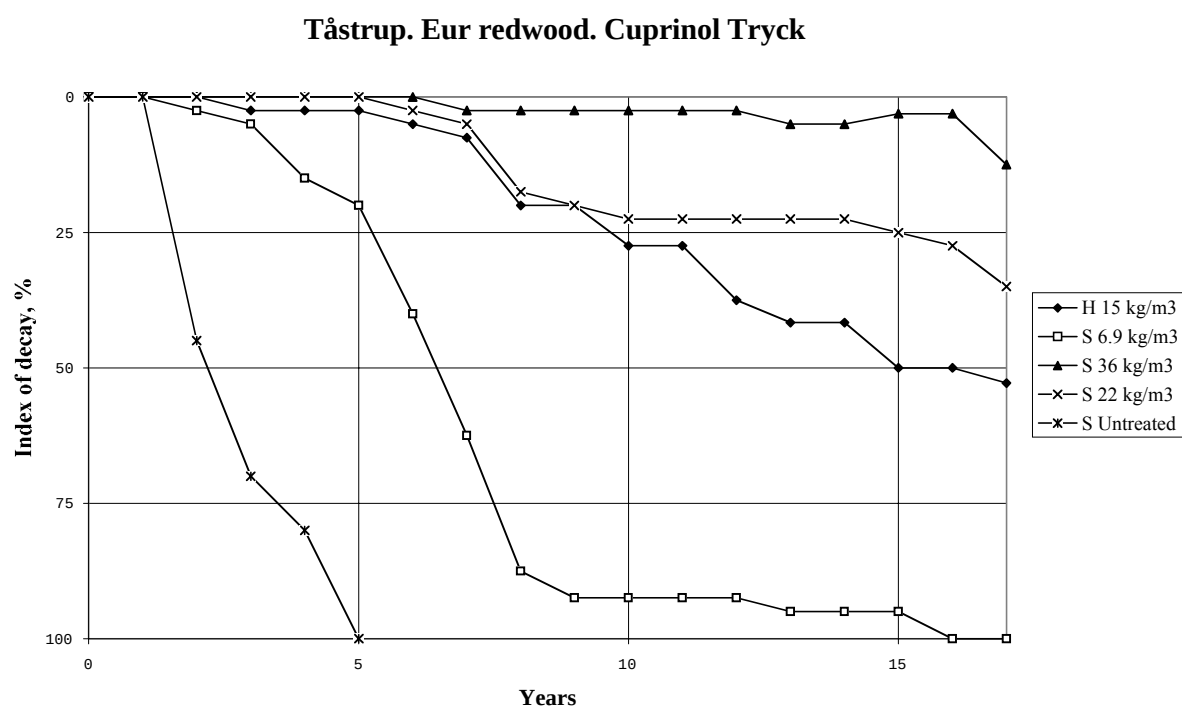
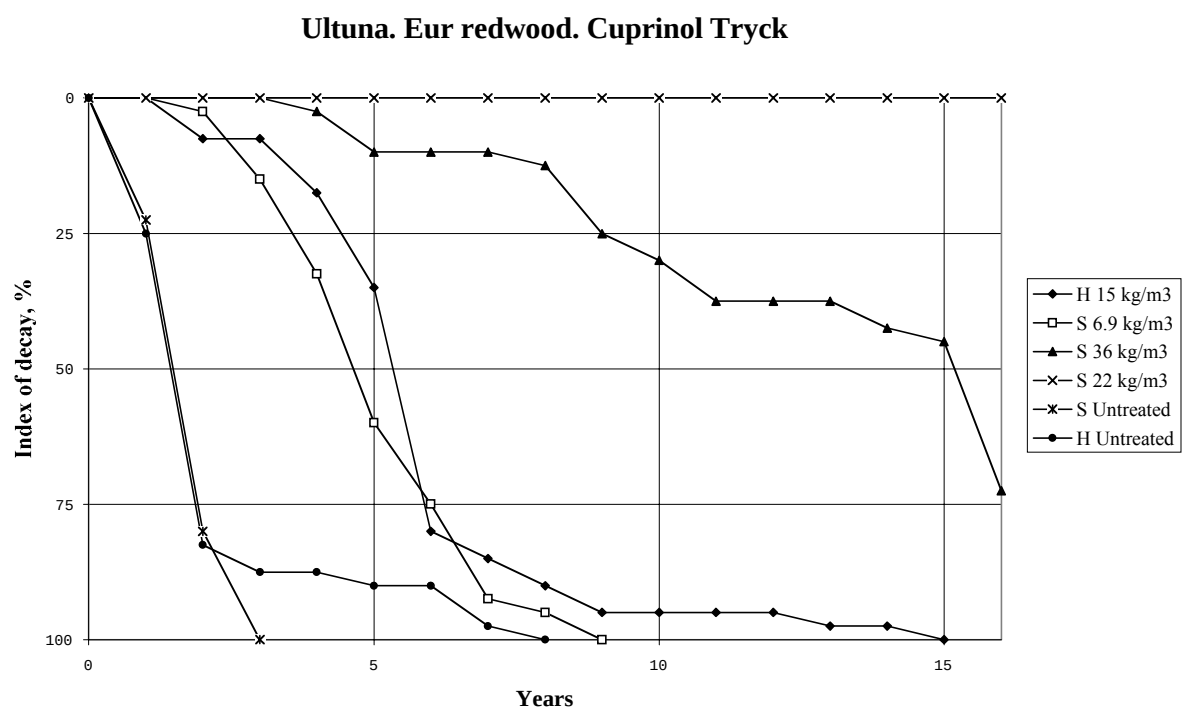
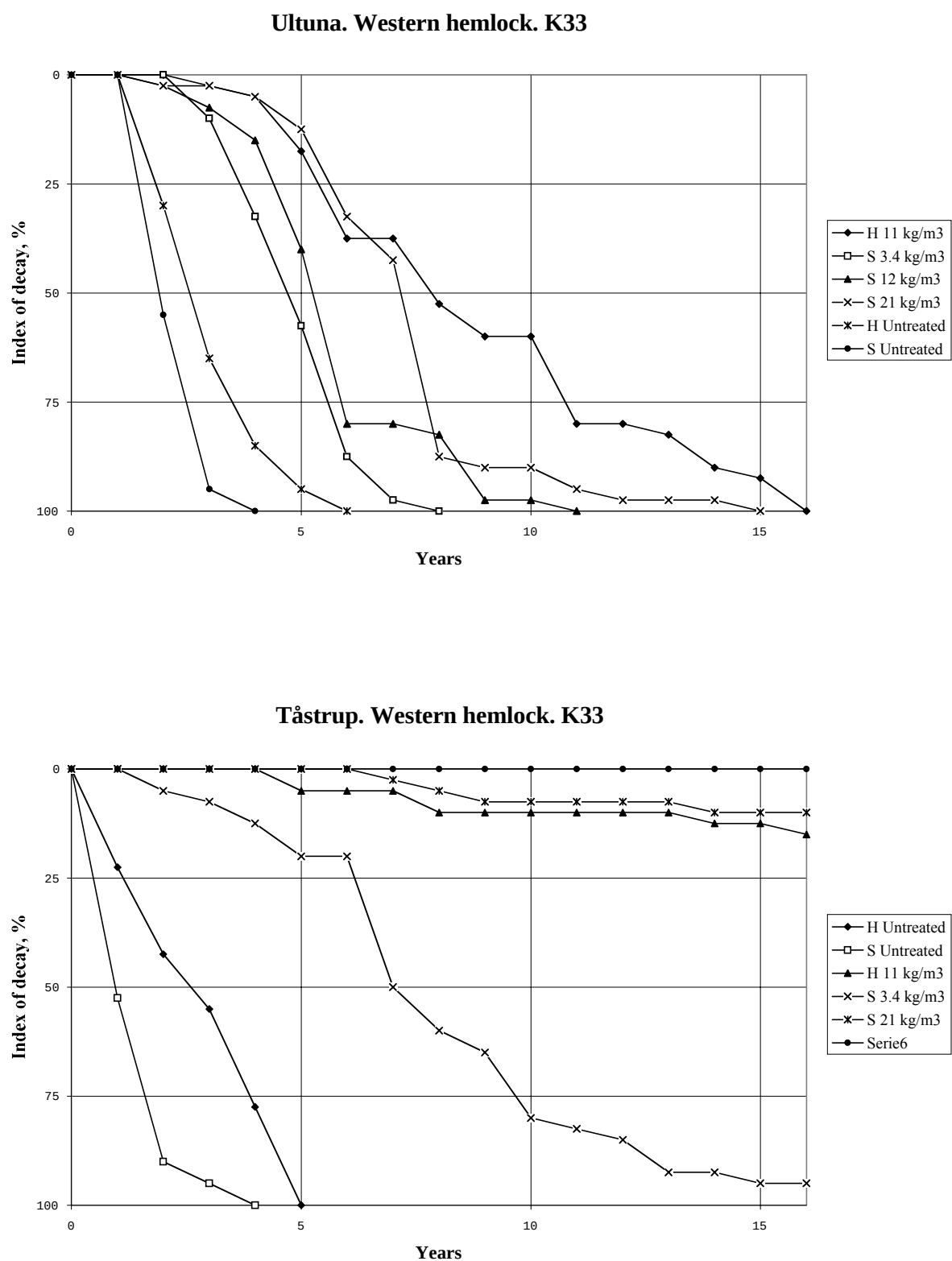


Figure 137. Field trial 1983:1. Rate of decay for stakes treated with Cuprinol Tryck.
H = heartwood, S = sapwood.



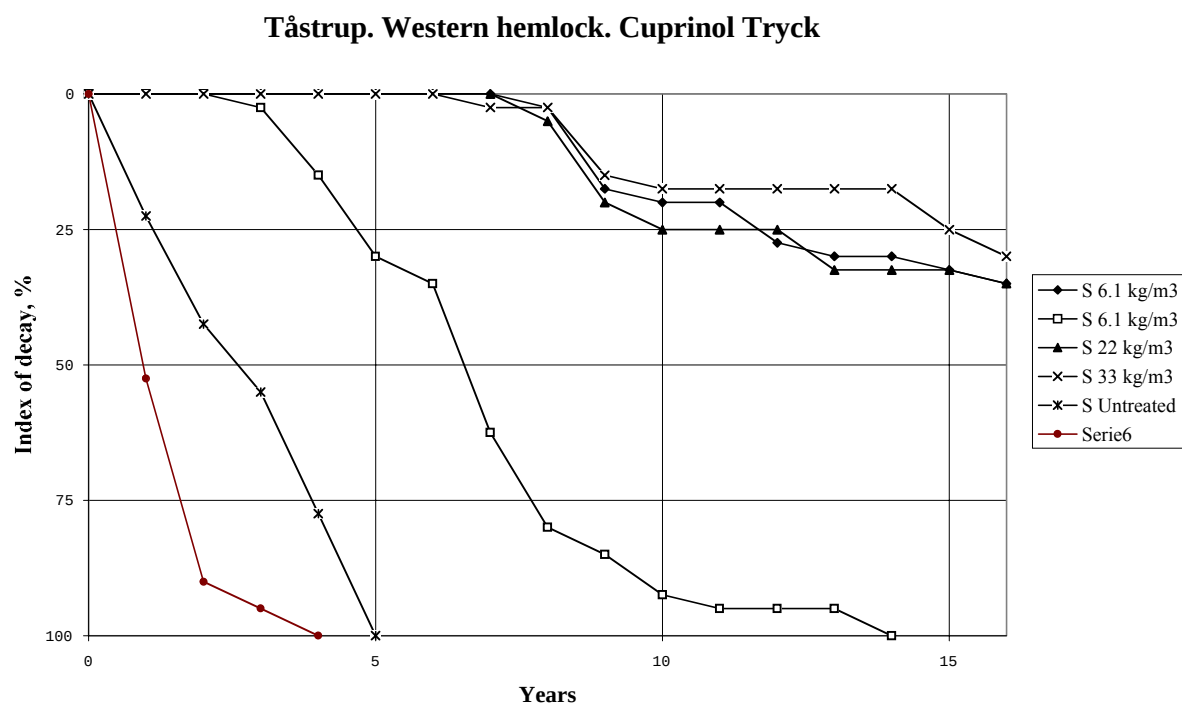
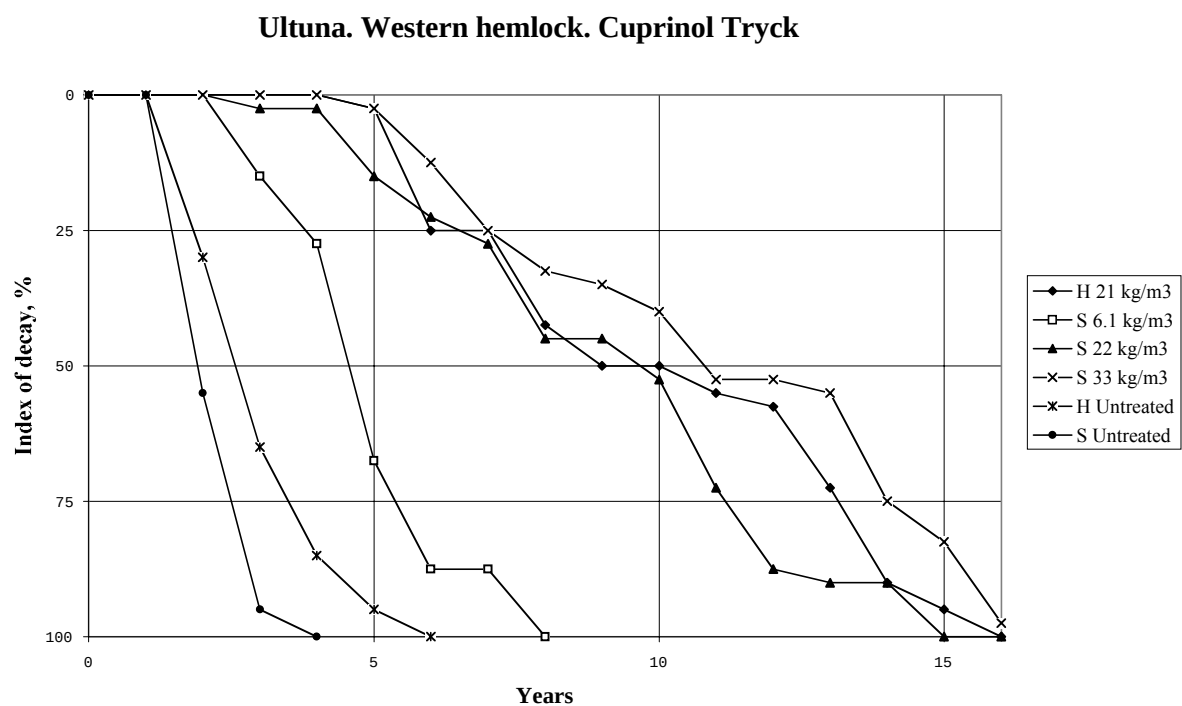


Figure 139. Field trial 1983:1. Rate of decay for stakes treated with Cuprinol Tryck.
H = heartwood, S = sapwood.

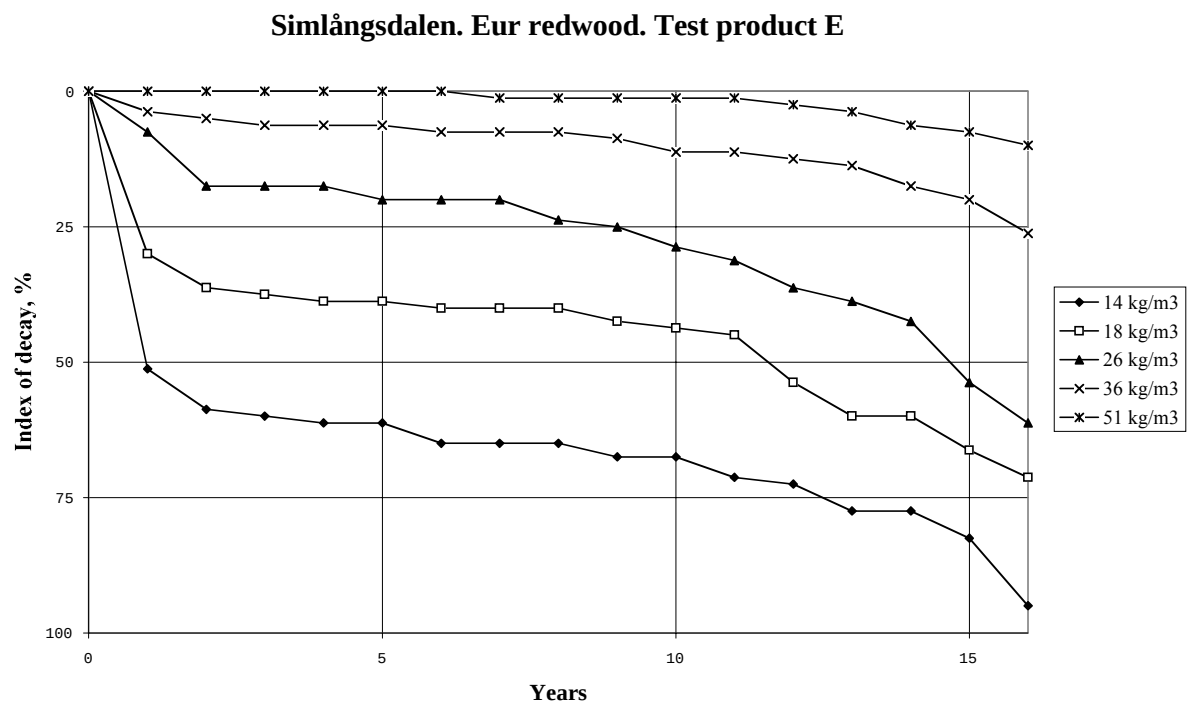
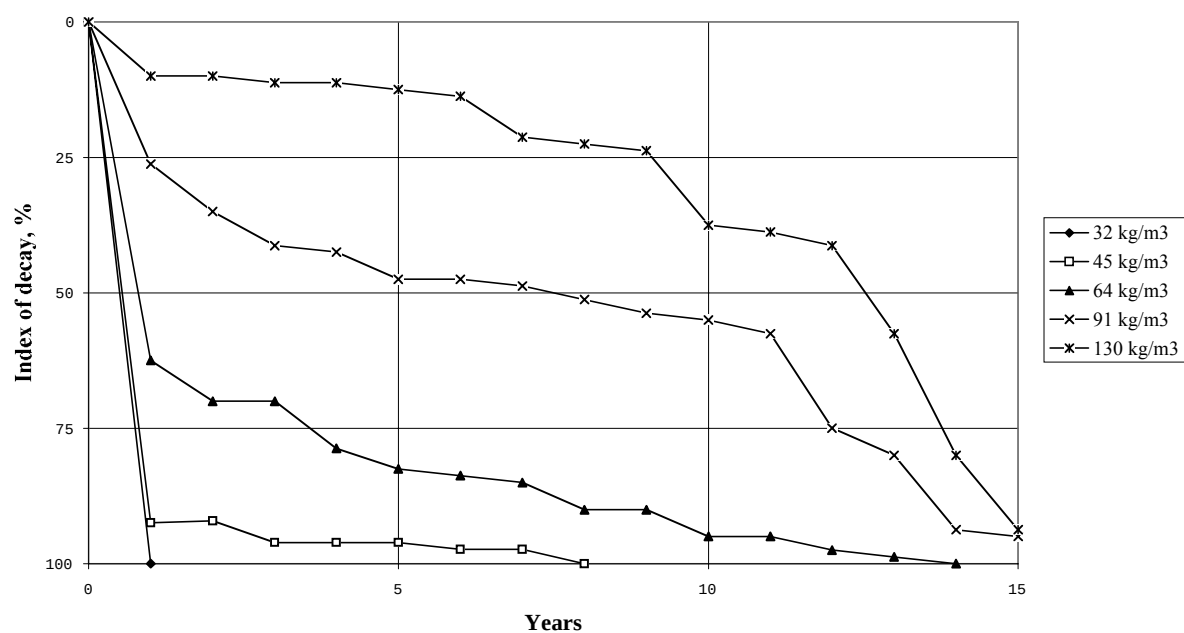


Figure 140. Field trial 1983:2. Rate of decay for stakes treated with Test product E.

Simlångsdalen. Eur redwood. Kempol 100



Sørkedalen. Eur redwood. Kempol 100

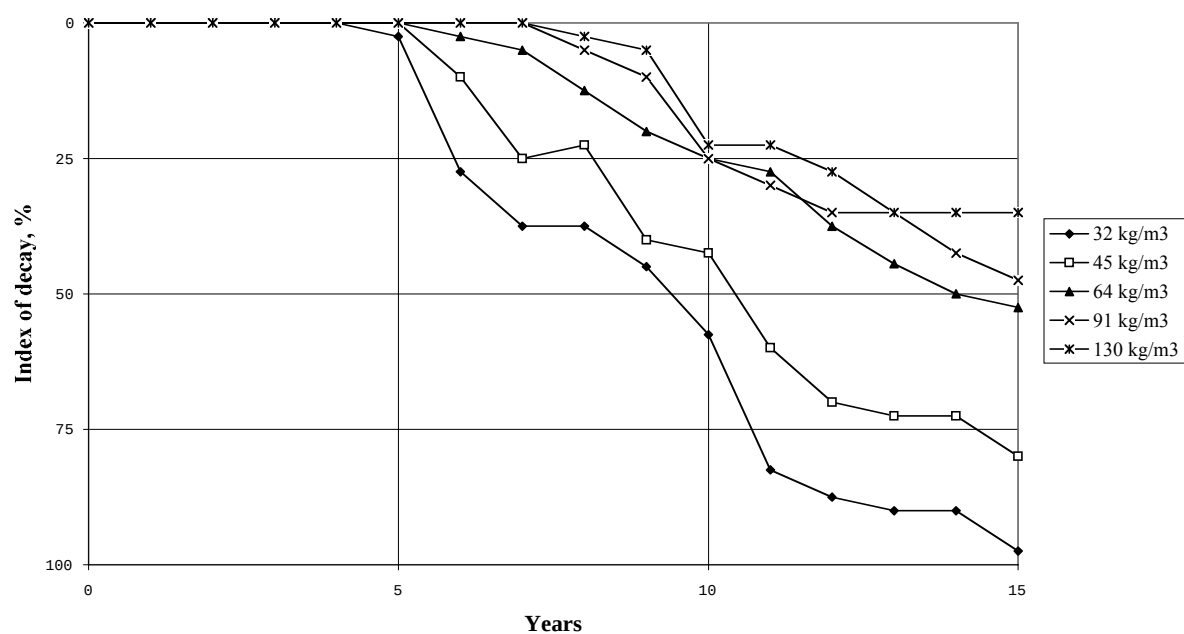
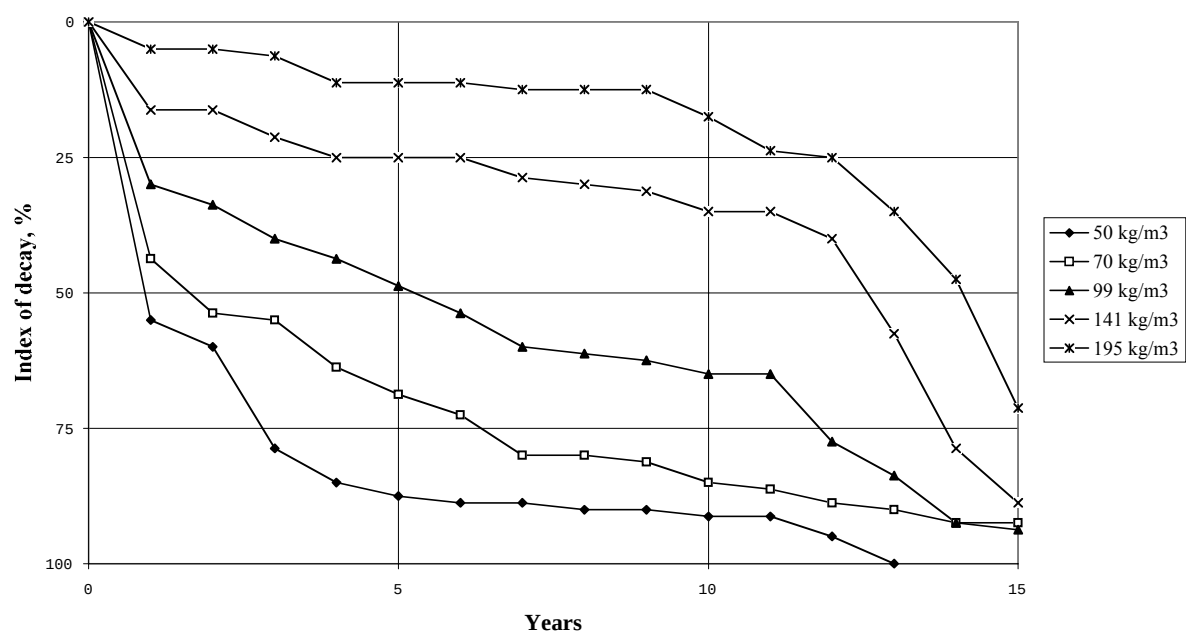


Figure 141. Field trial 1984. Rate of decay for stakes treated with Kempol 100.

Simlångsdalen. Eur redwood. Kempol 101



Sørkedalen. Eur redwood. Kempol 101

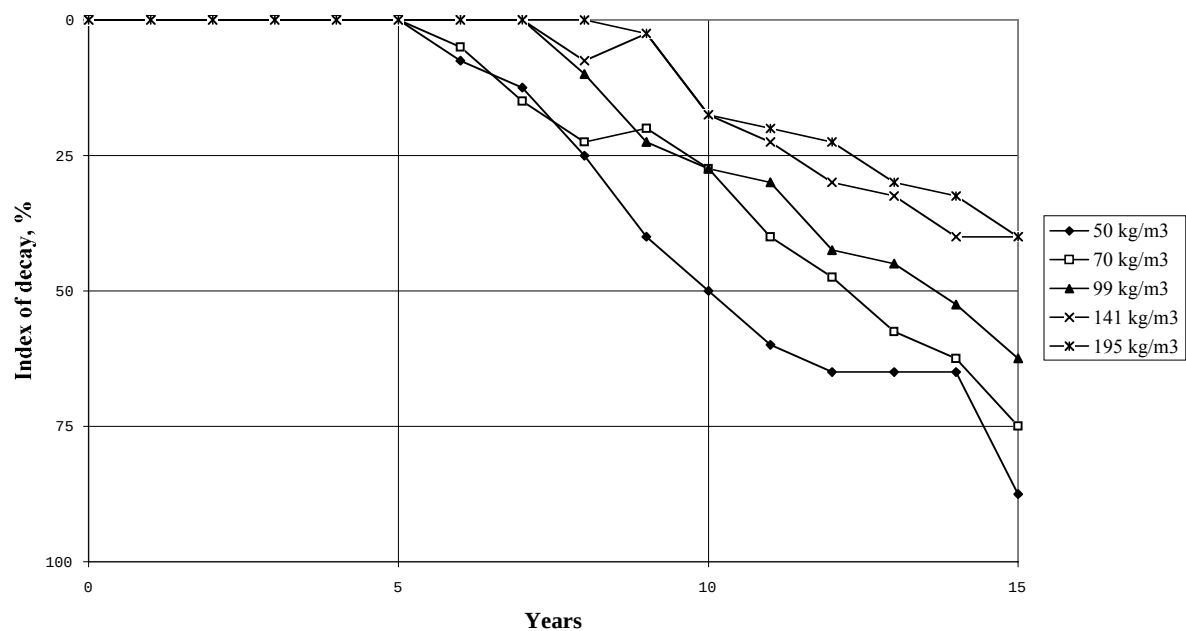


Figure 142. Field trial 1984. Rate of decay for stakes treated with Kempol 101.

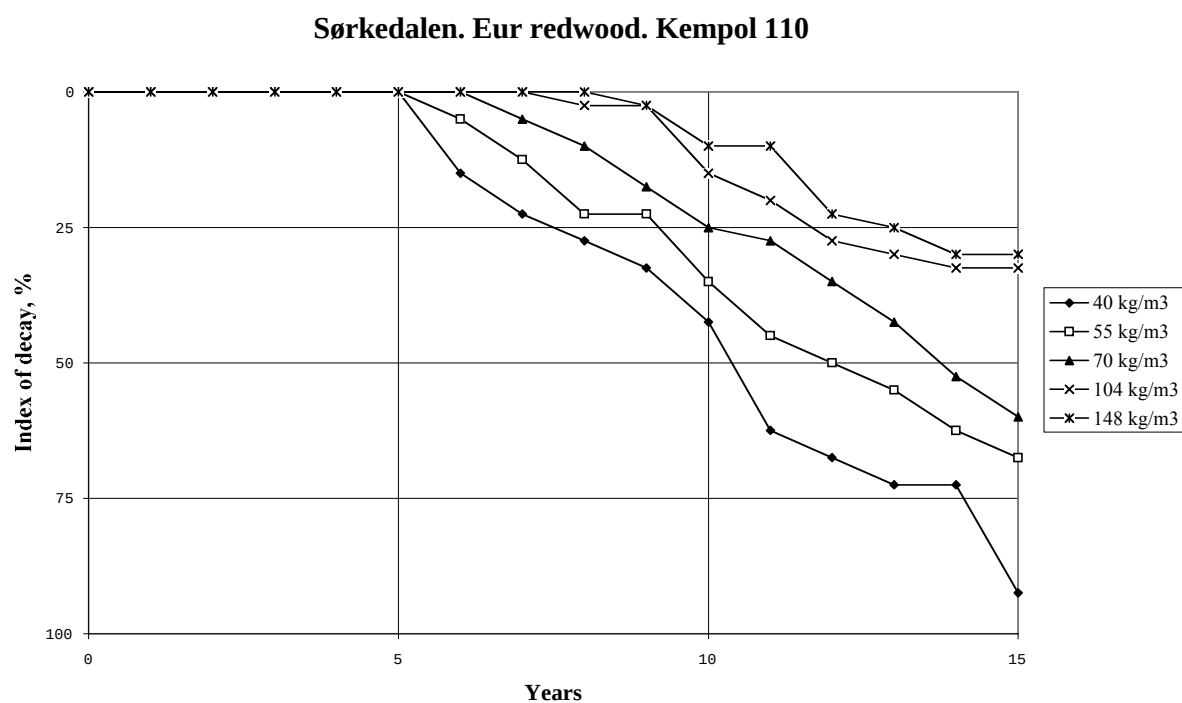
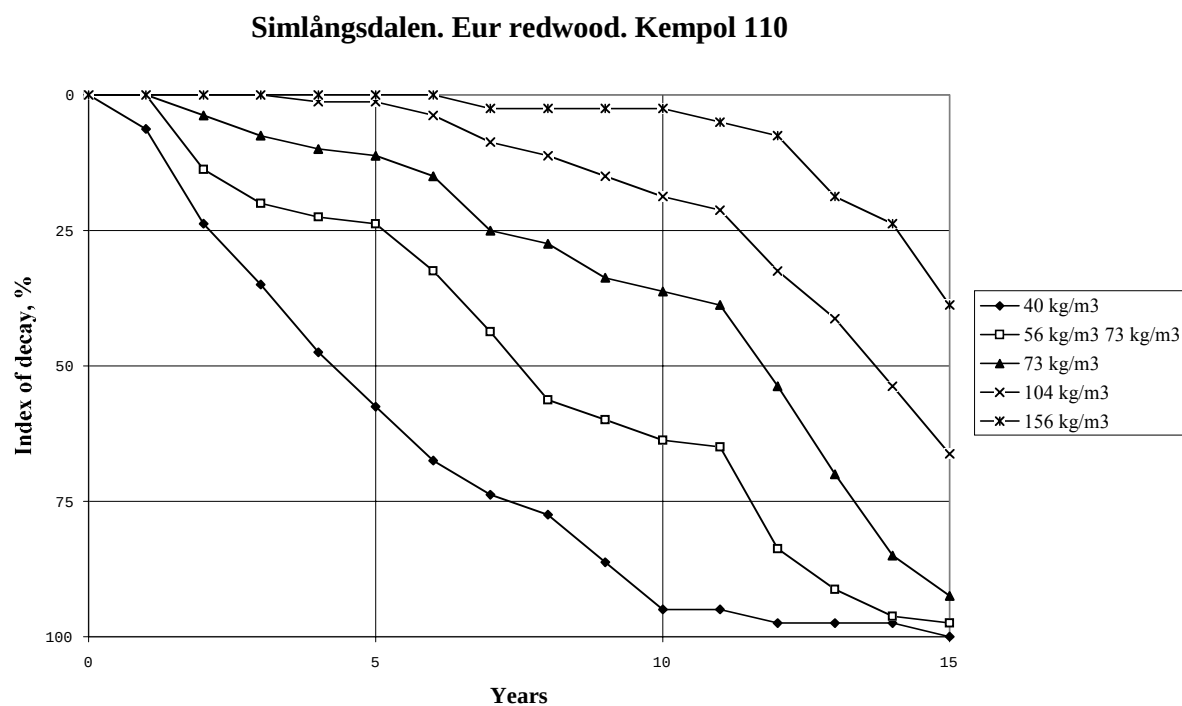


Figure 143. Field trial 1984. Rate of decay for stakes treated with Kempol 110.

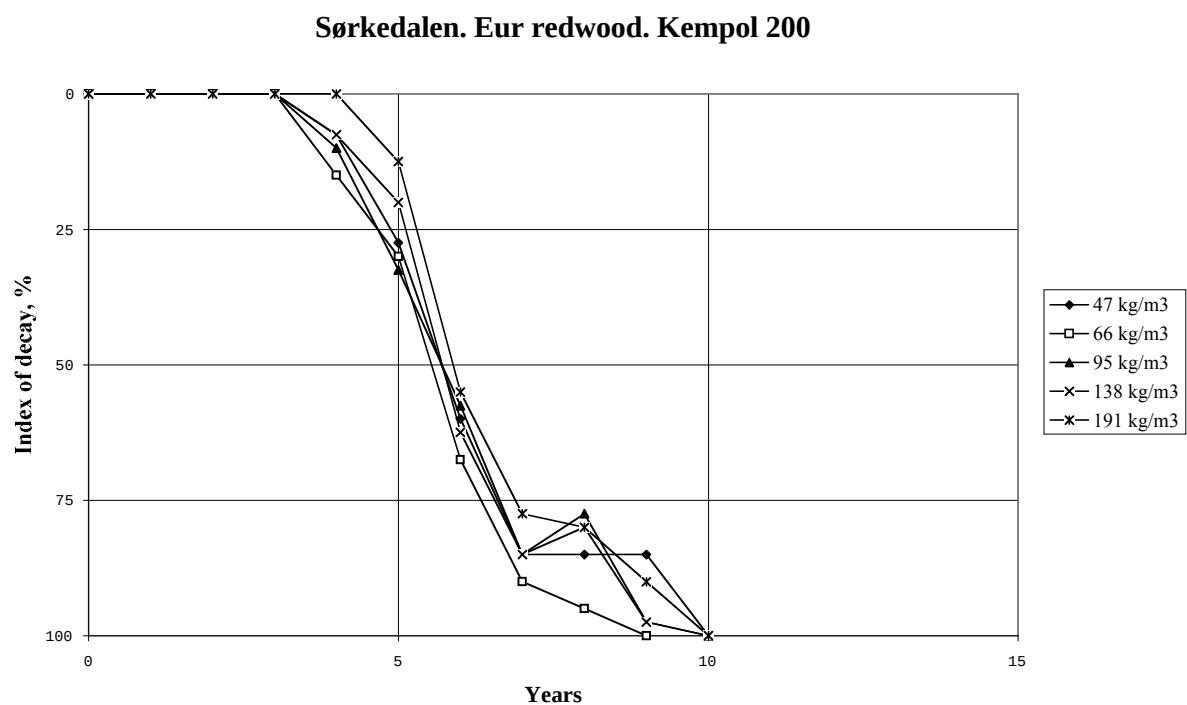
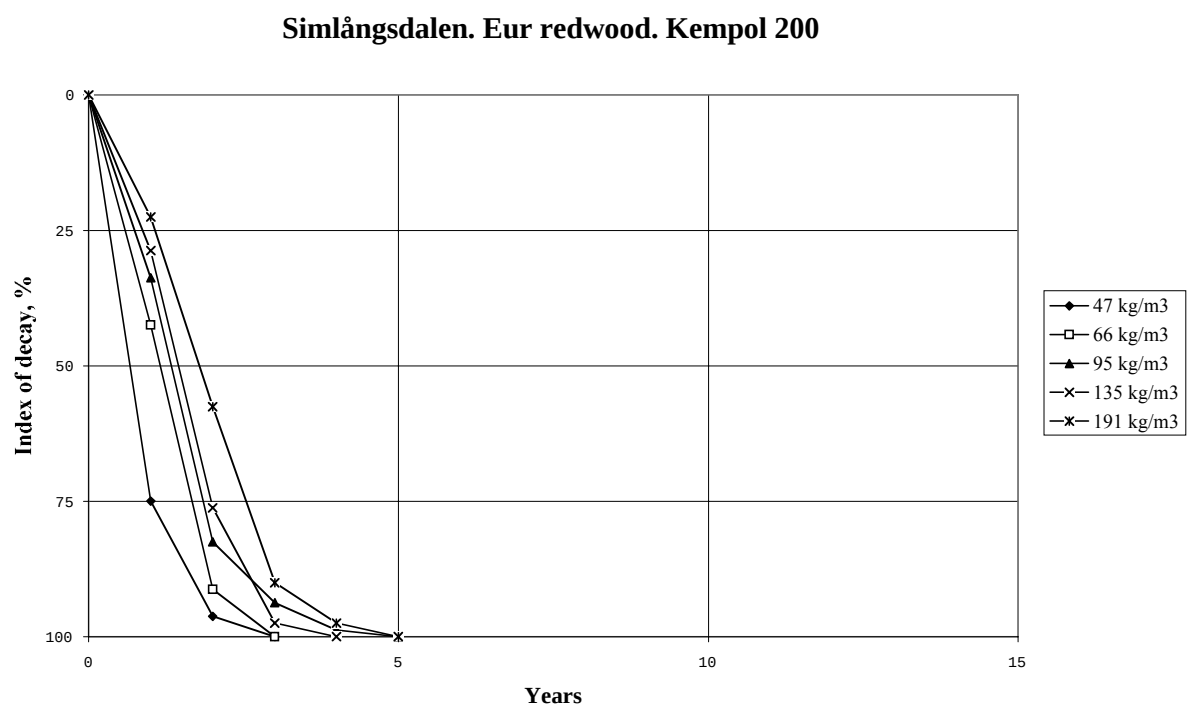


Figure 144. Field trial 1984. Rate of decay for stakes treated with Kempol 200.

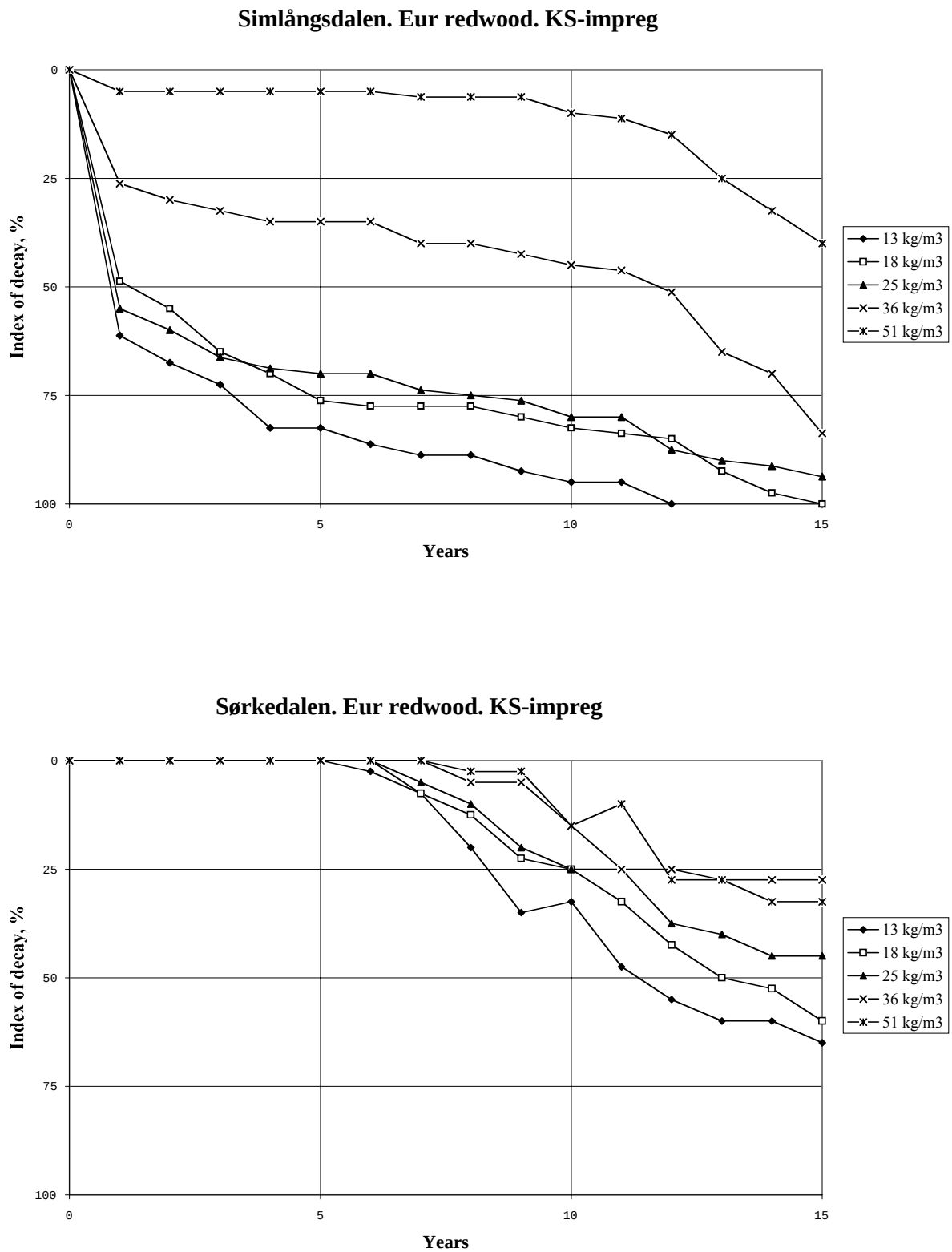


Figure 145. Field trial 1984. Rate of decay for stakes treated with KS-impreg.

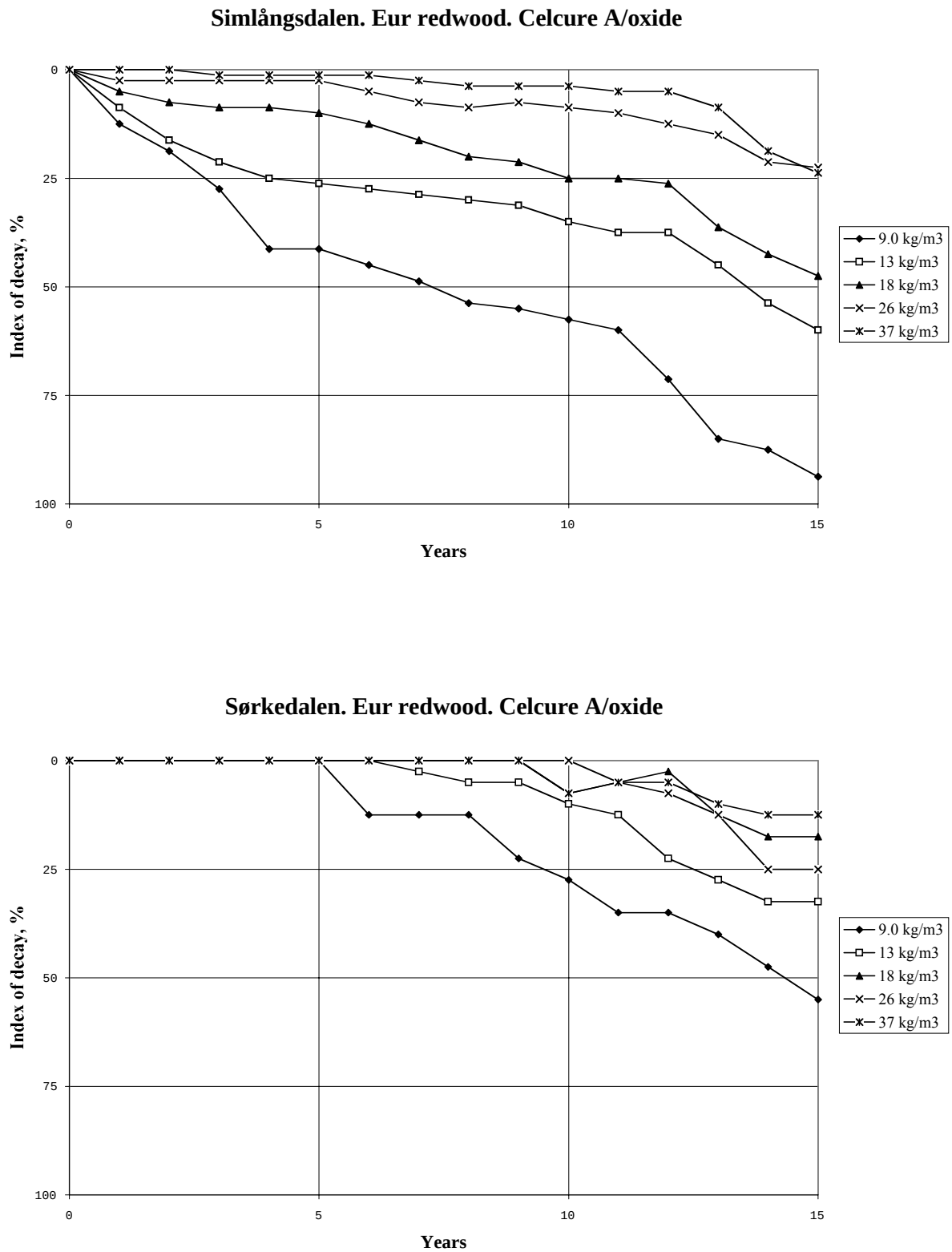


Figure 146. Field trial 1984. Rate of decay for stakes treated with Celcure A/oxide.

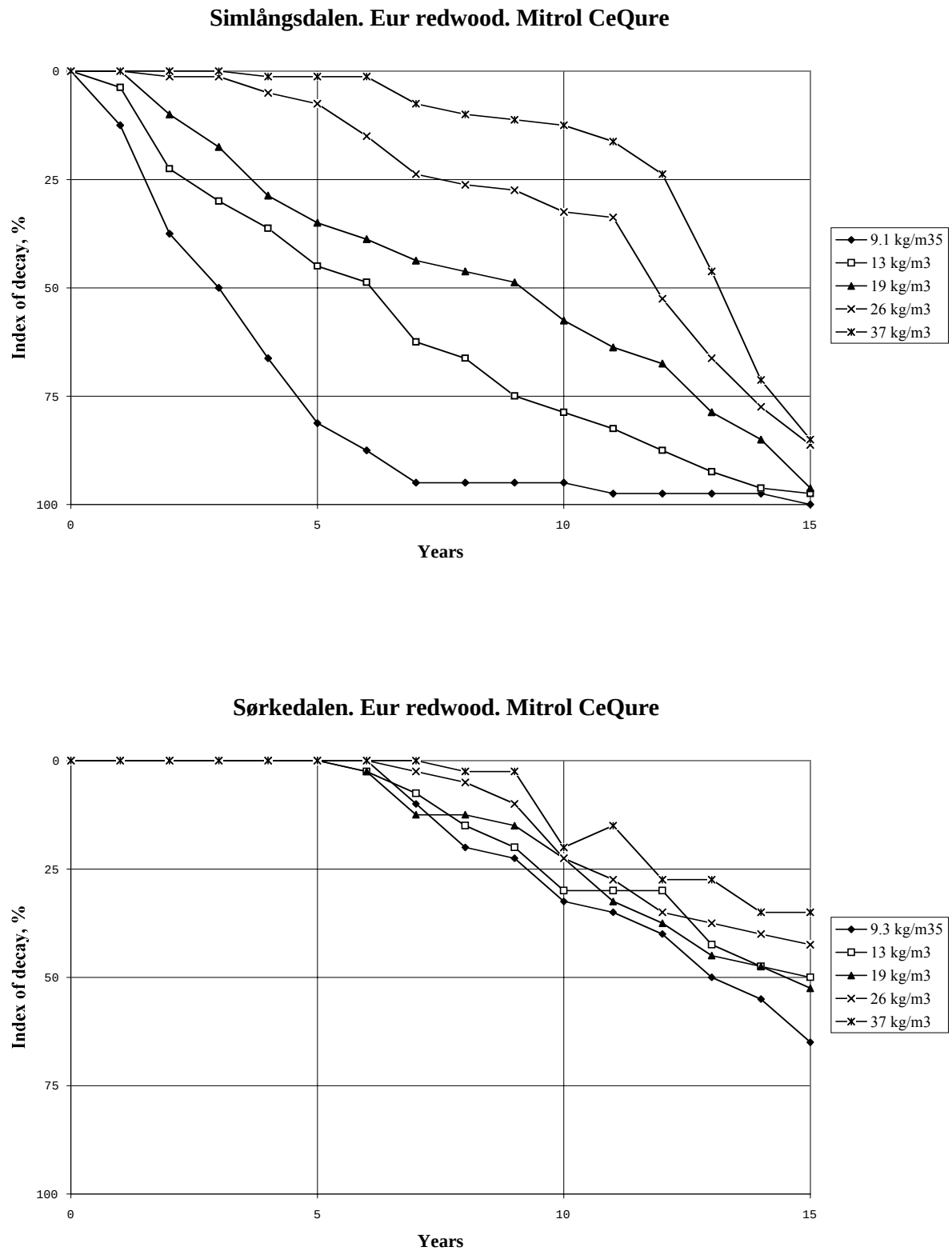


Figure 147. Field trial 1984. Rate of decay for stakes treated with Mitrol CeQure.

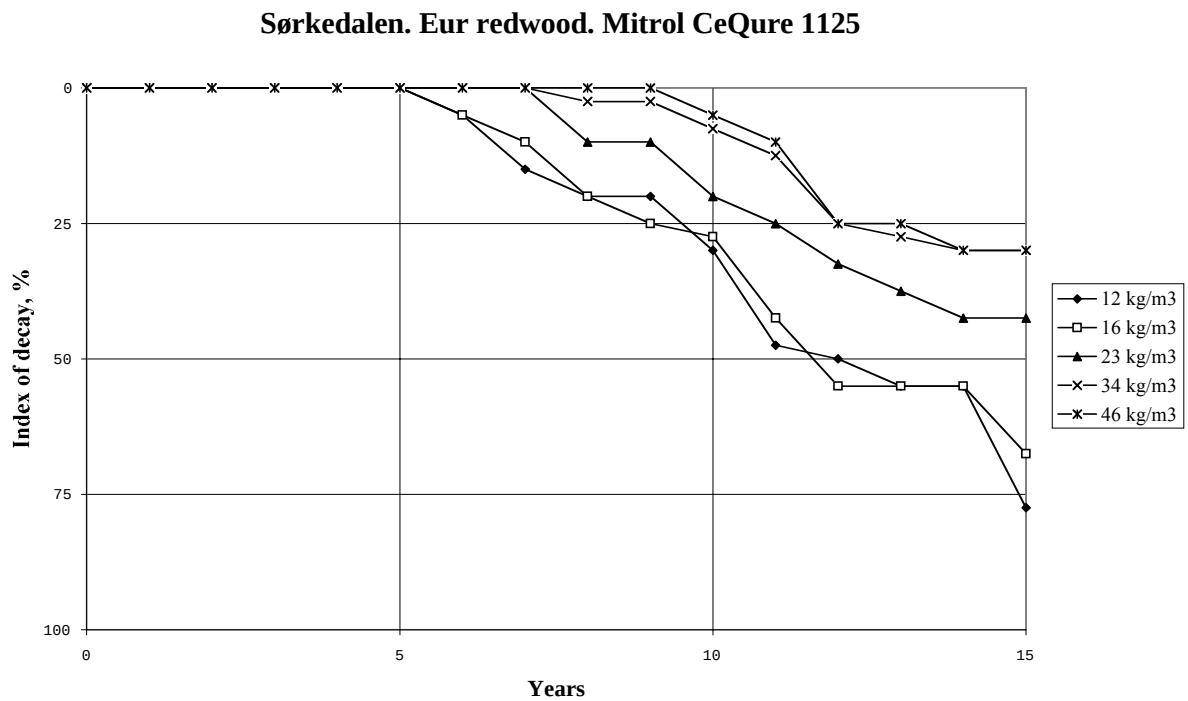
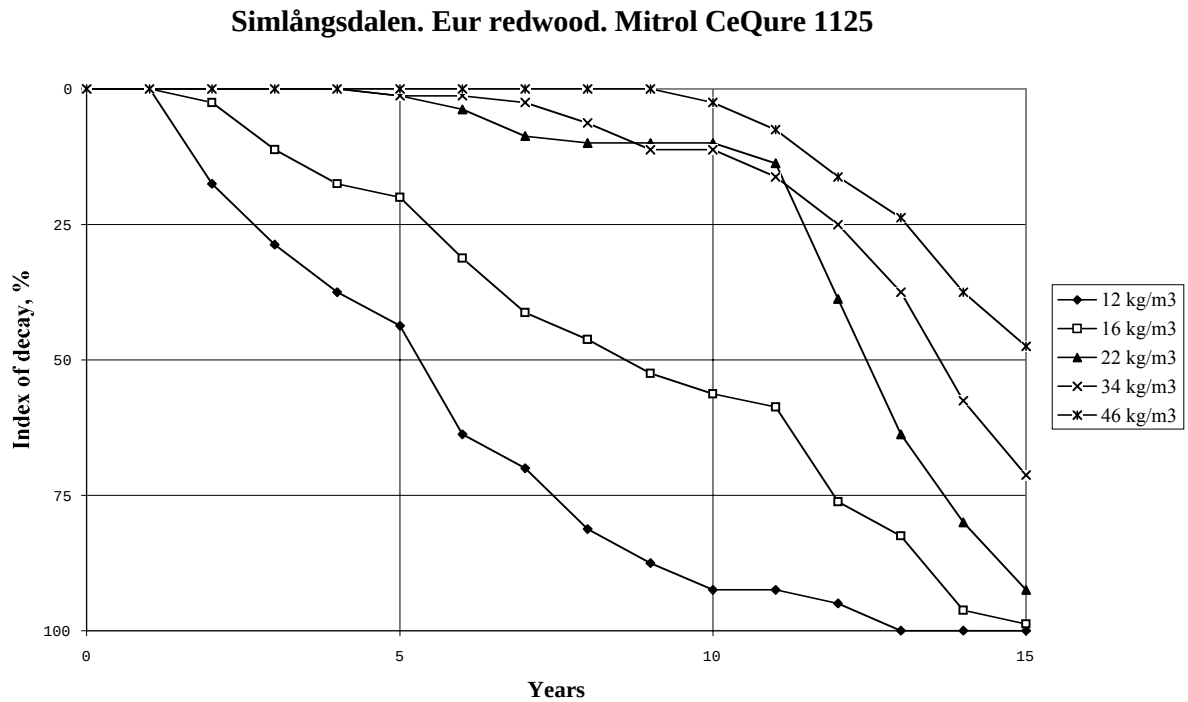


Figure 148. Field trial 1984. Rate of decay for stakes treated with Mitrol CeQure 1125.

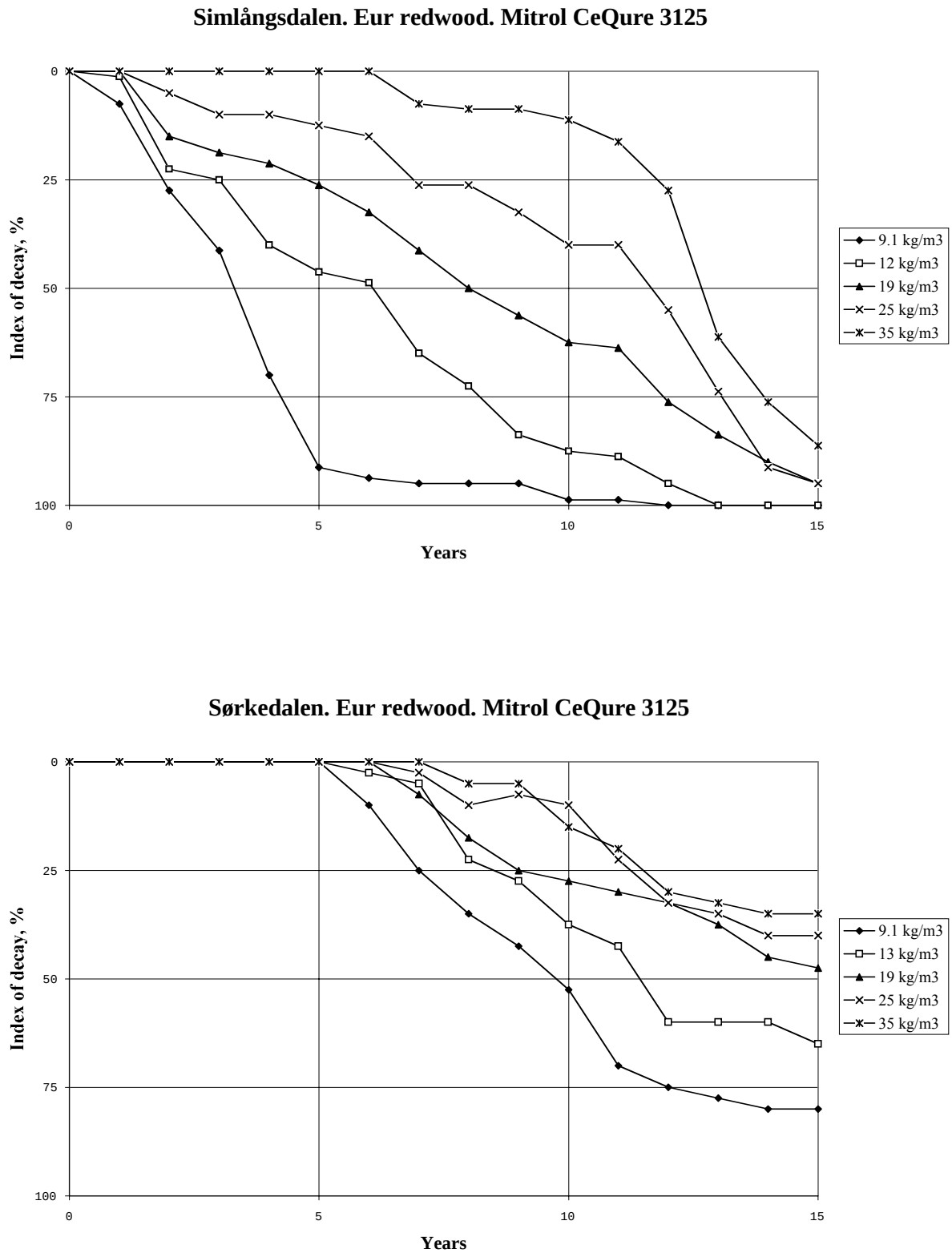


Figure 149. Field trial 1984. Rate of decay for stakes treated with Mitrol CeQure 3125.

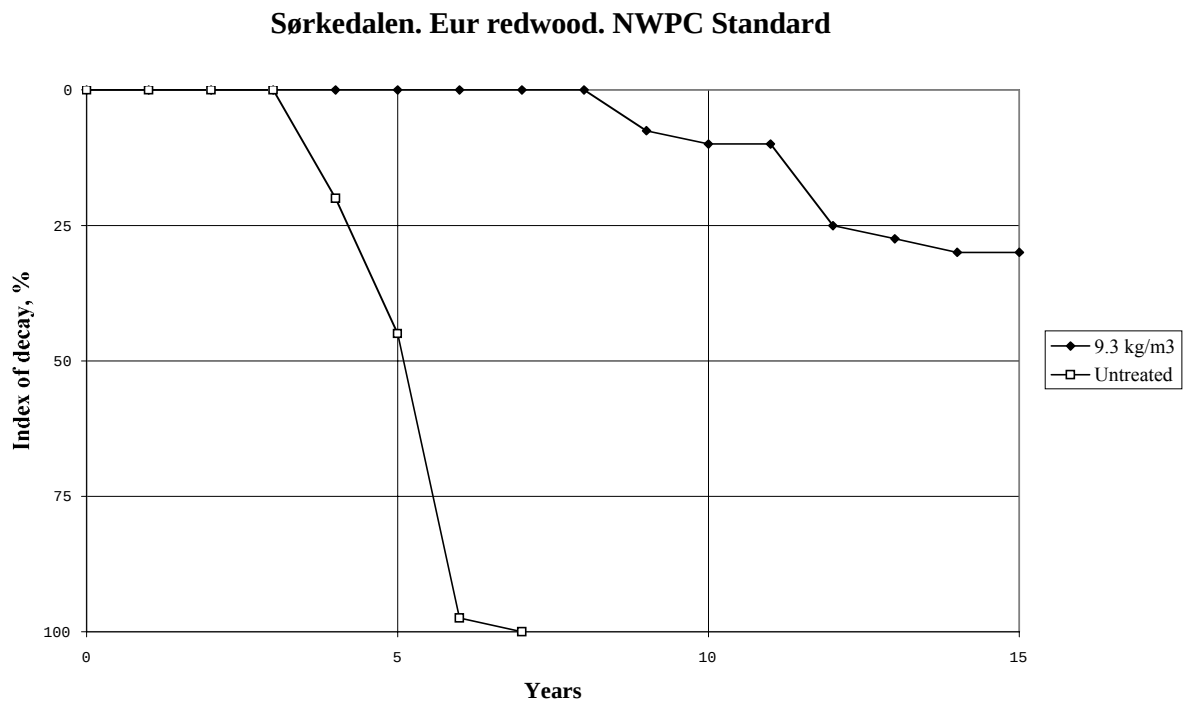
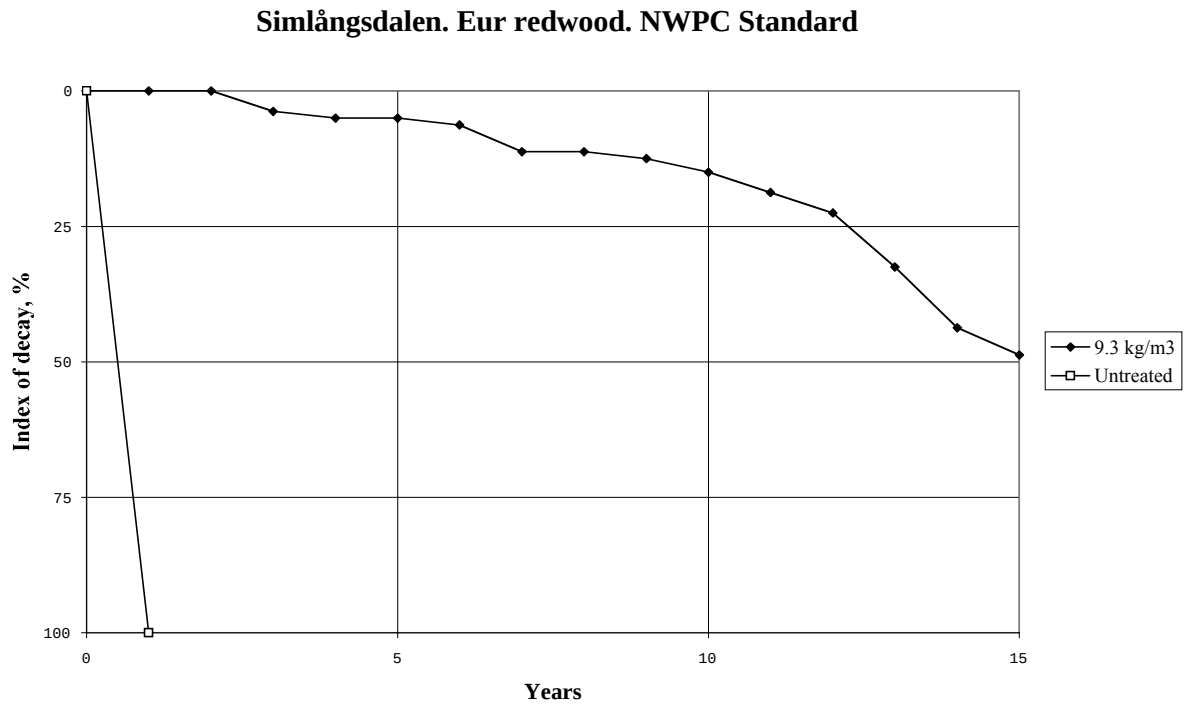


Figure 150. Field trial 1984. Rate of decay for stakes treated with NWPC Standard and untreated stakes.

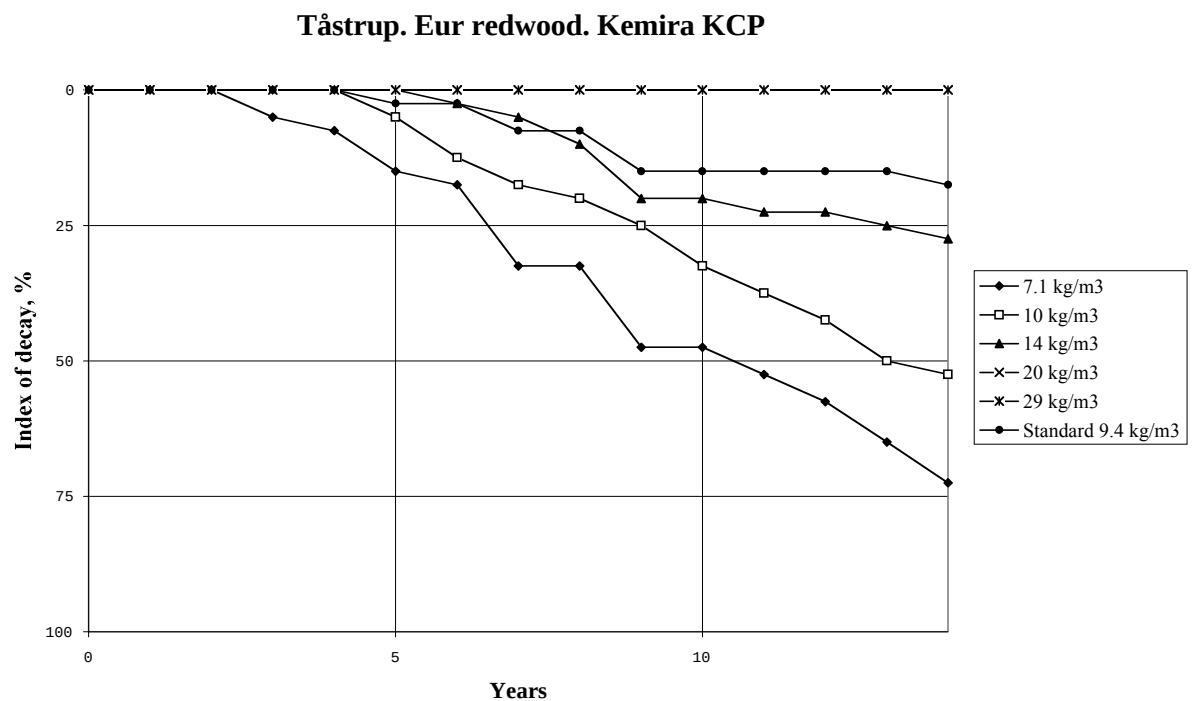
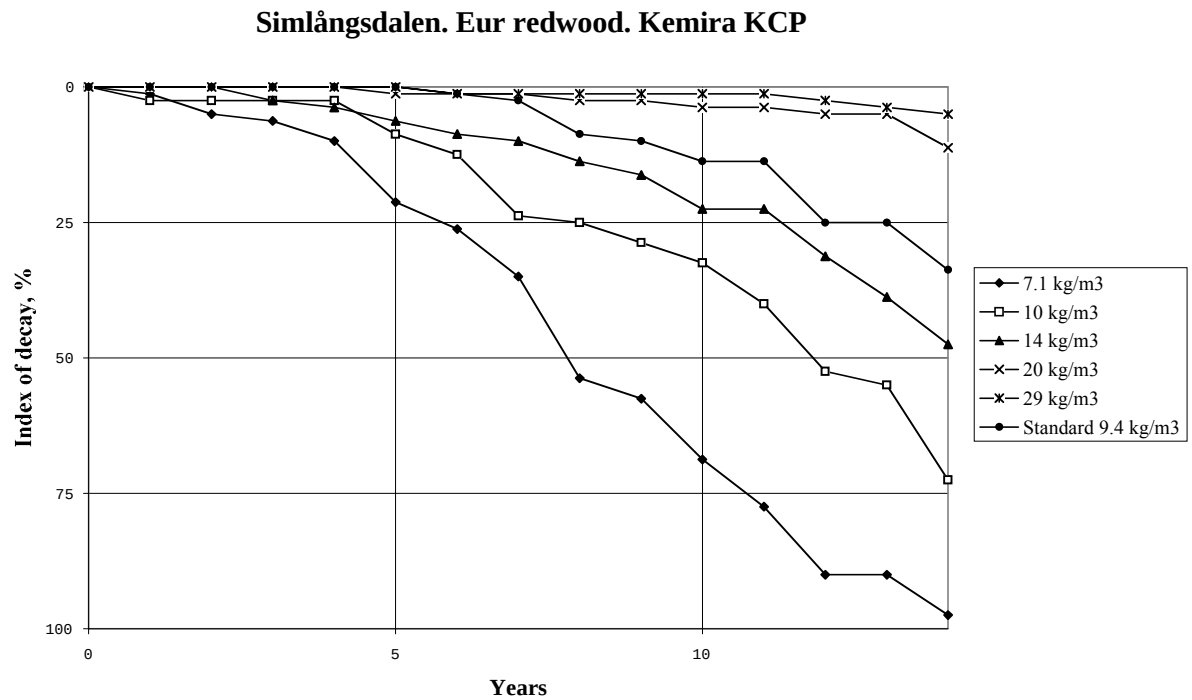


Figure 151. Field trial 1985. Rate of decay for stakes treated with Kemira KCP.

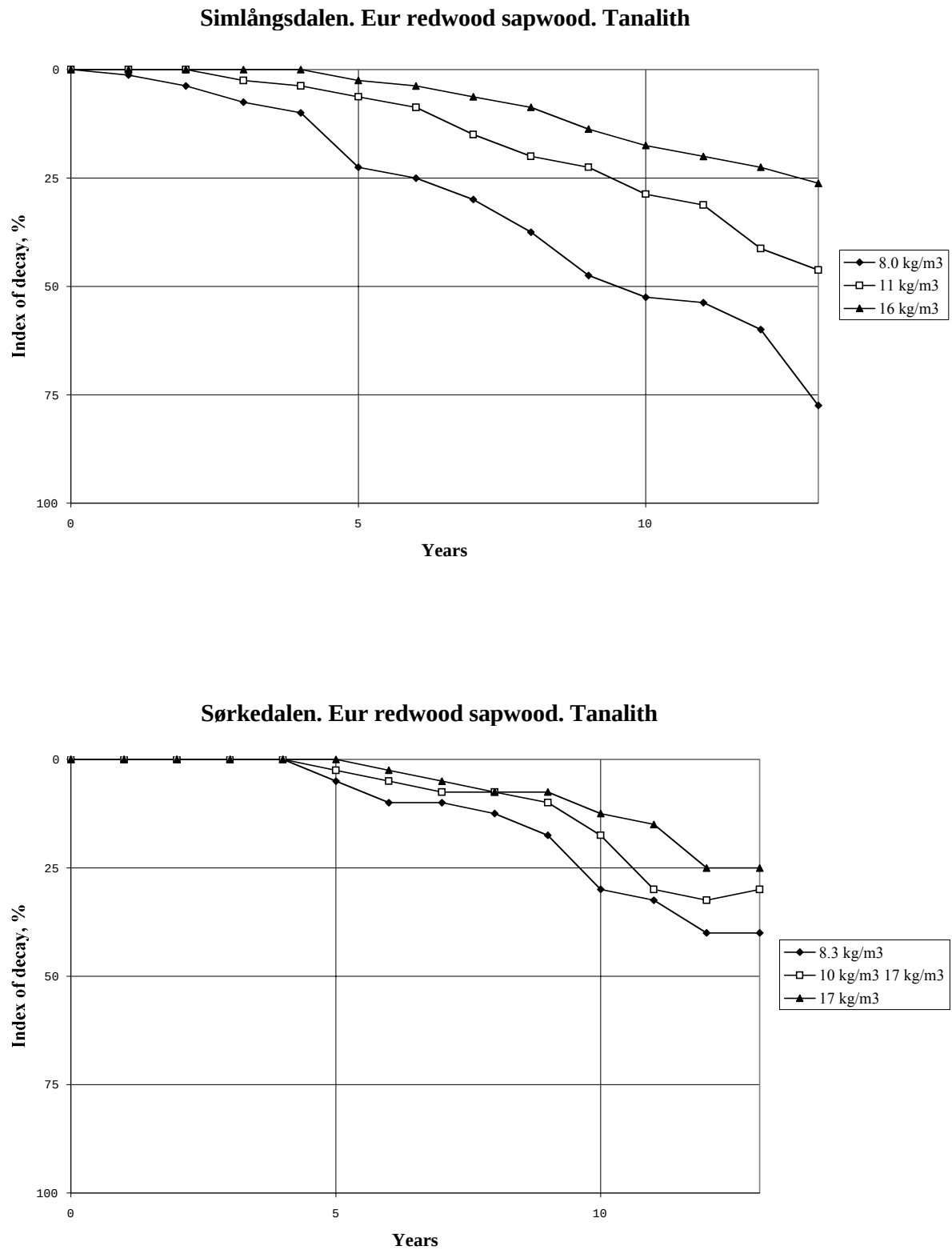


Figure 152. Field trial 1986. Rate of decay for stakes treated with Tanalith CCA oxide B.

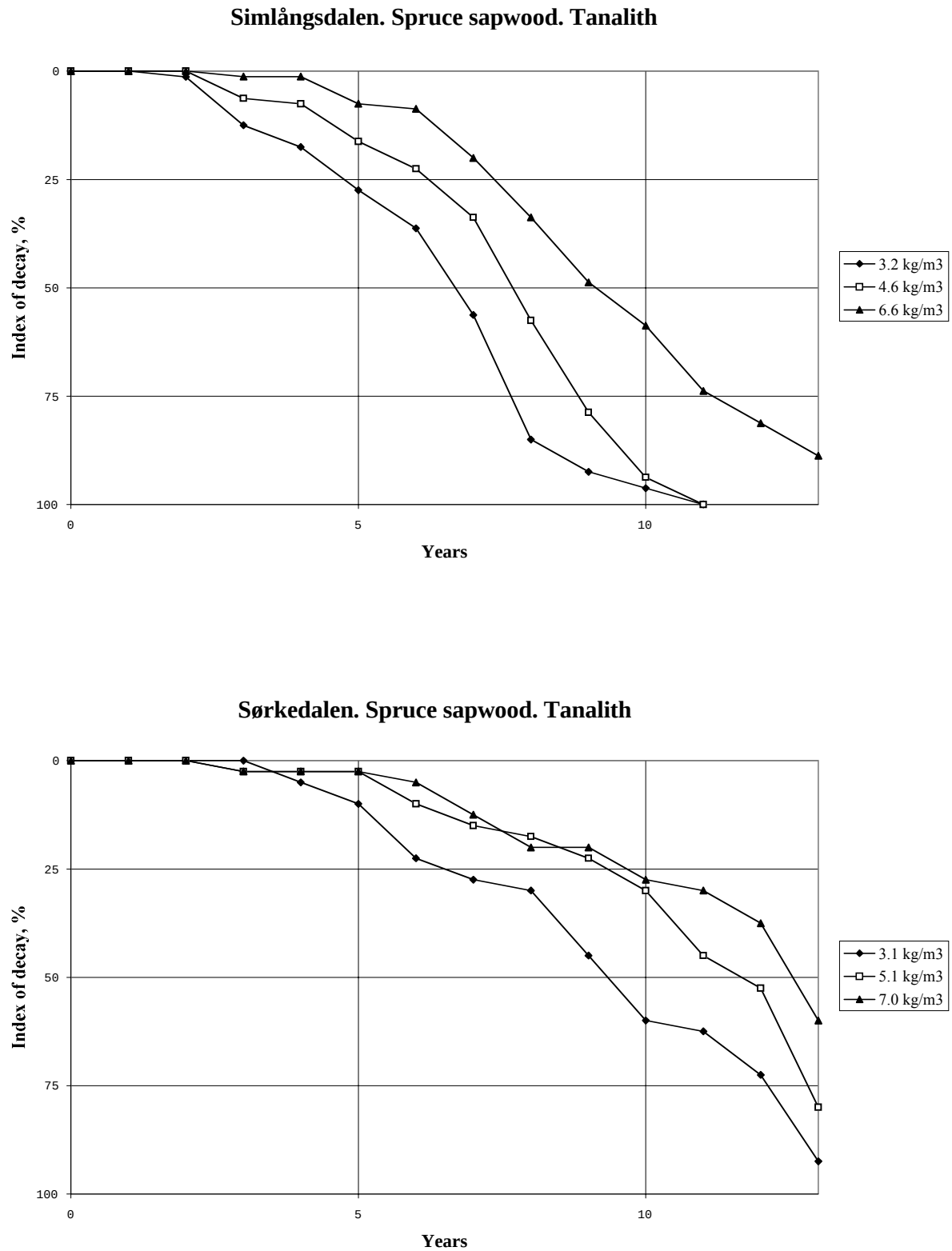


Figure 153. Field trial 1986. Rate of decay for stakes treated with Tanalith CCA oxide B.

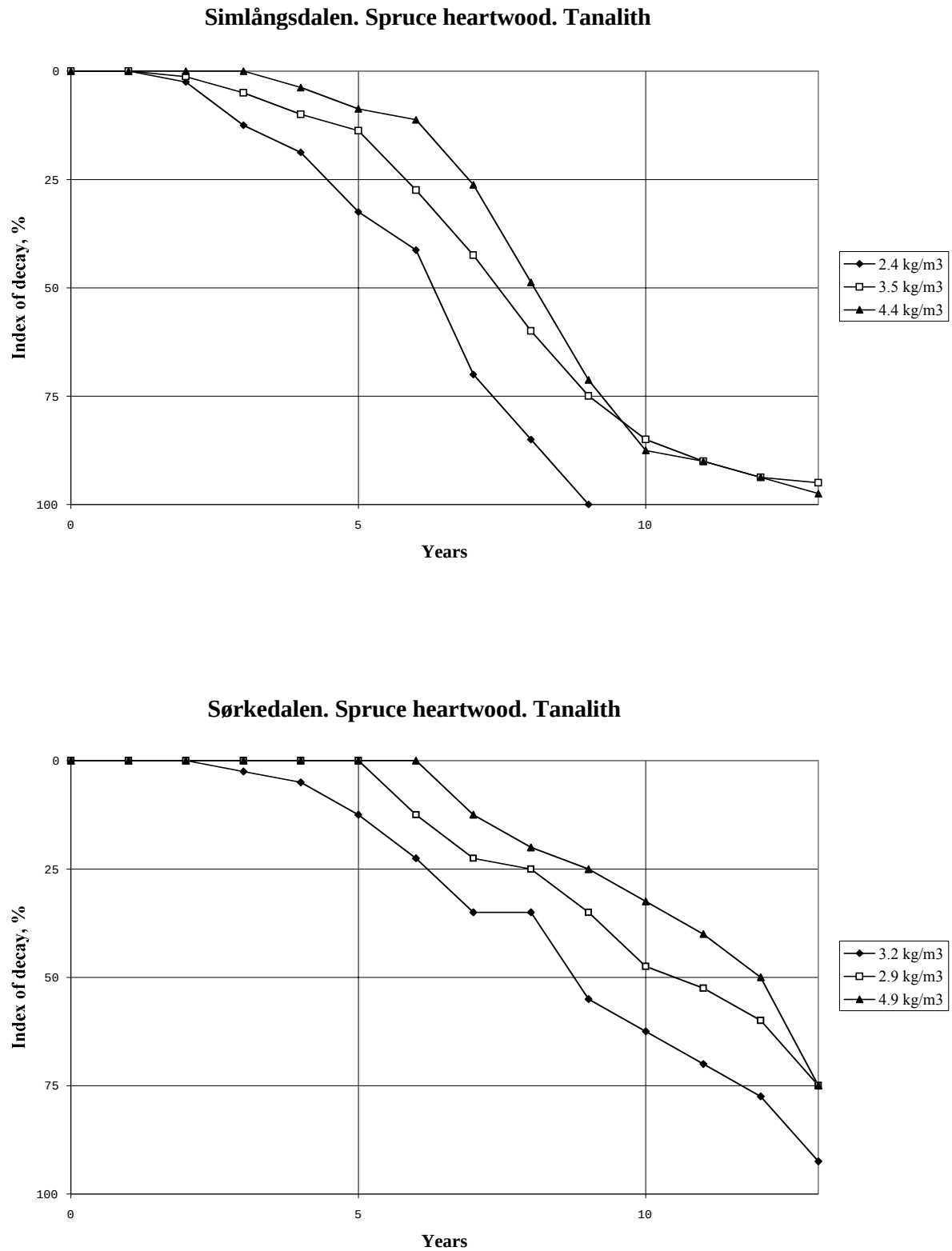


Figure 154. Field trial 1986. Rate of decay for stakes treated with Tanalith CCA oxide B.

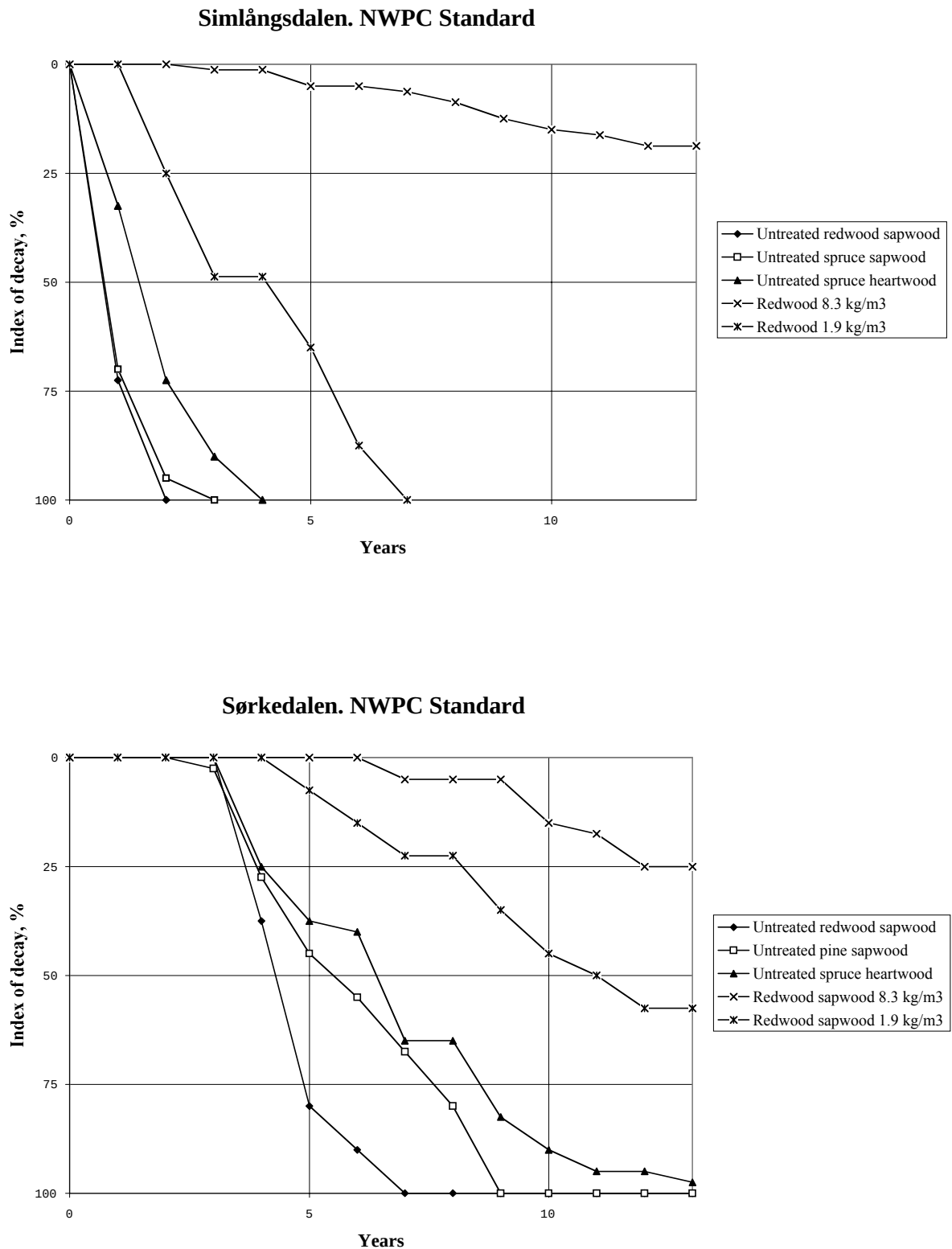


Figure 155. Field trial 1986. Rate of decay for stakes treated with NWPC Standard and untreated stakes.

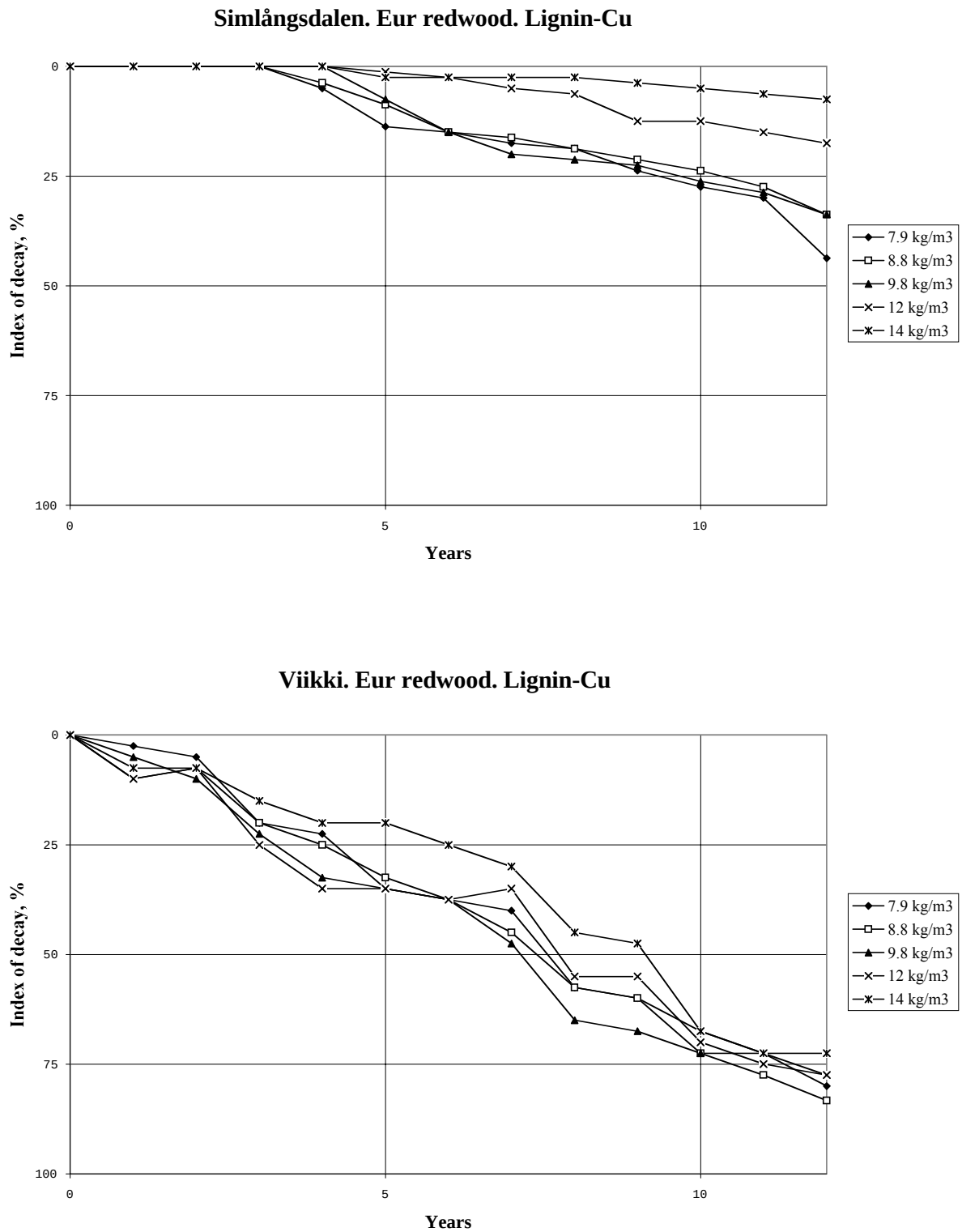


Figure 156. Field trial 1987. Rate of decay for stakes treated with Lignin-Cu.

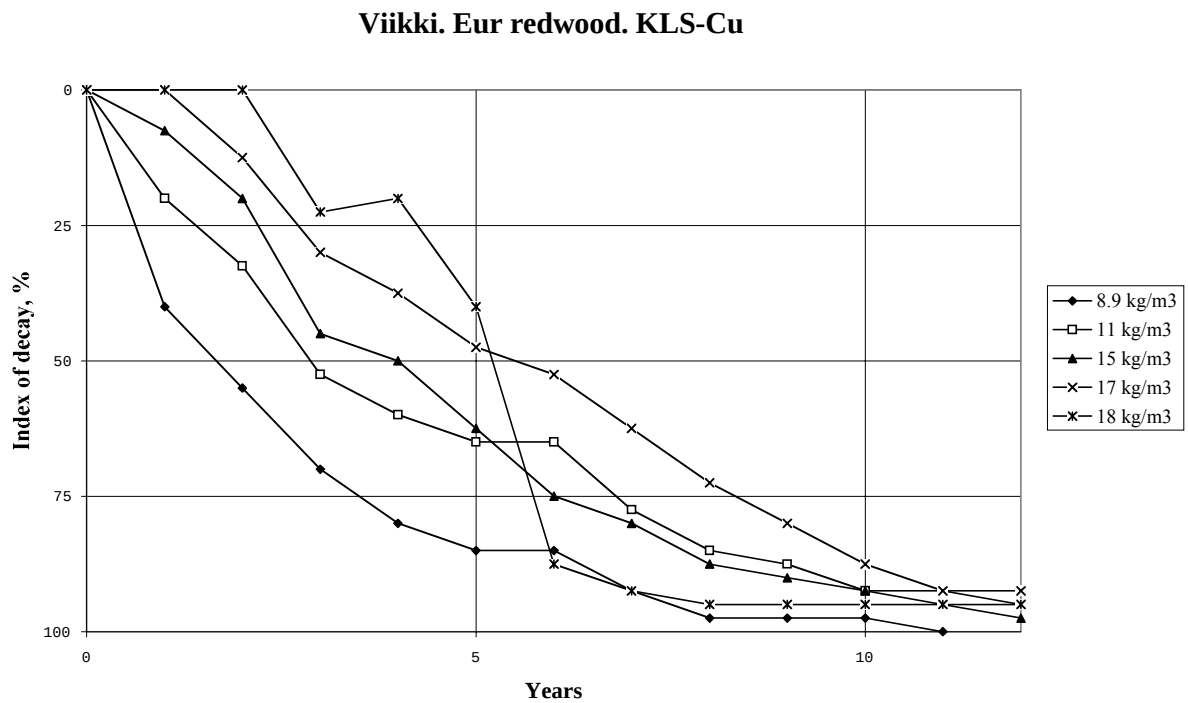
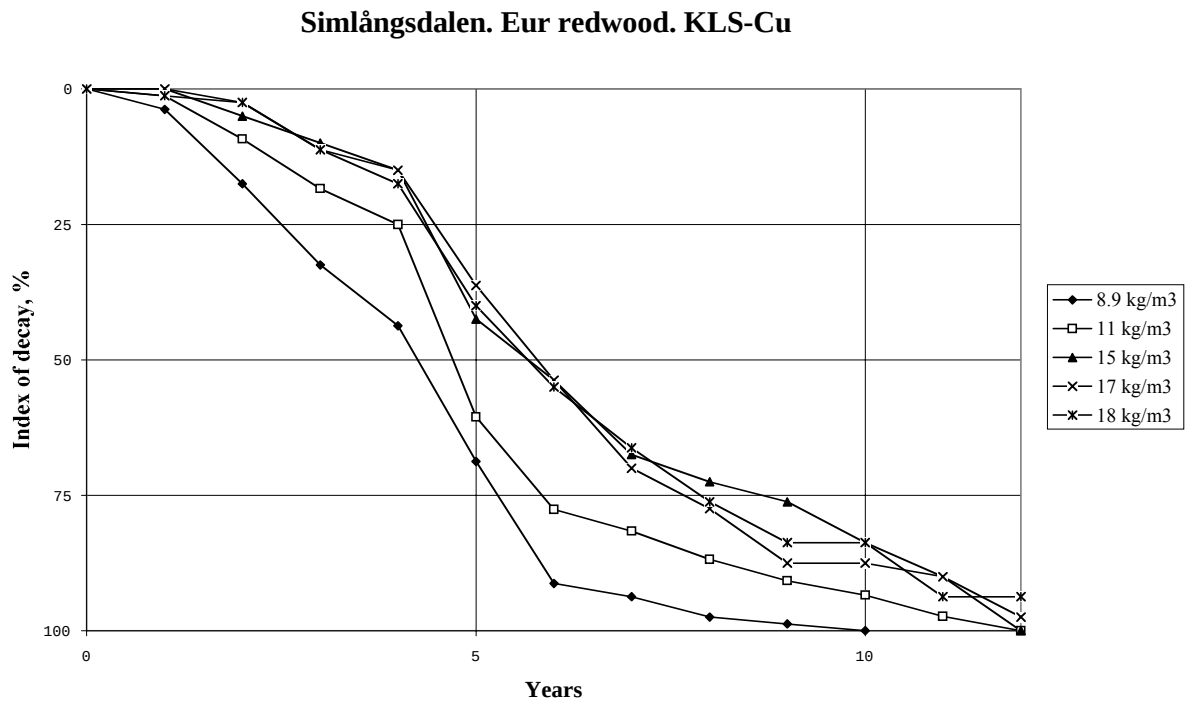


Figure 157. Field trial 1987. Rate of decay for stakes treated with KLS-Cu.

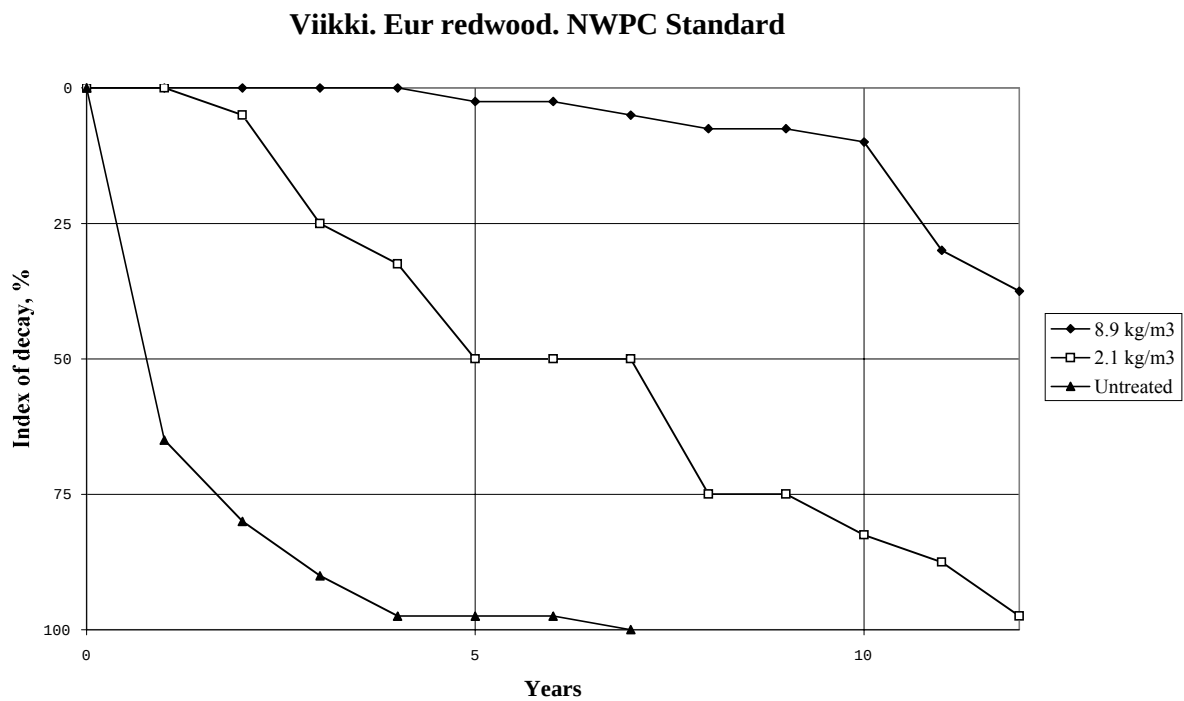
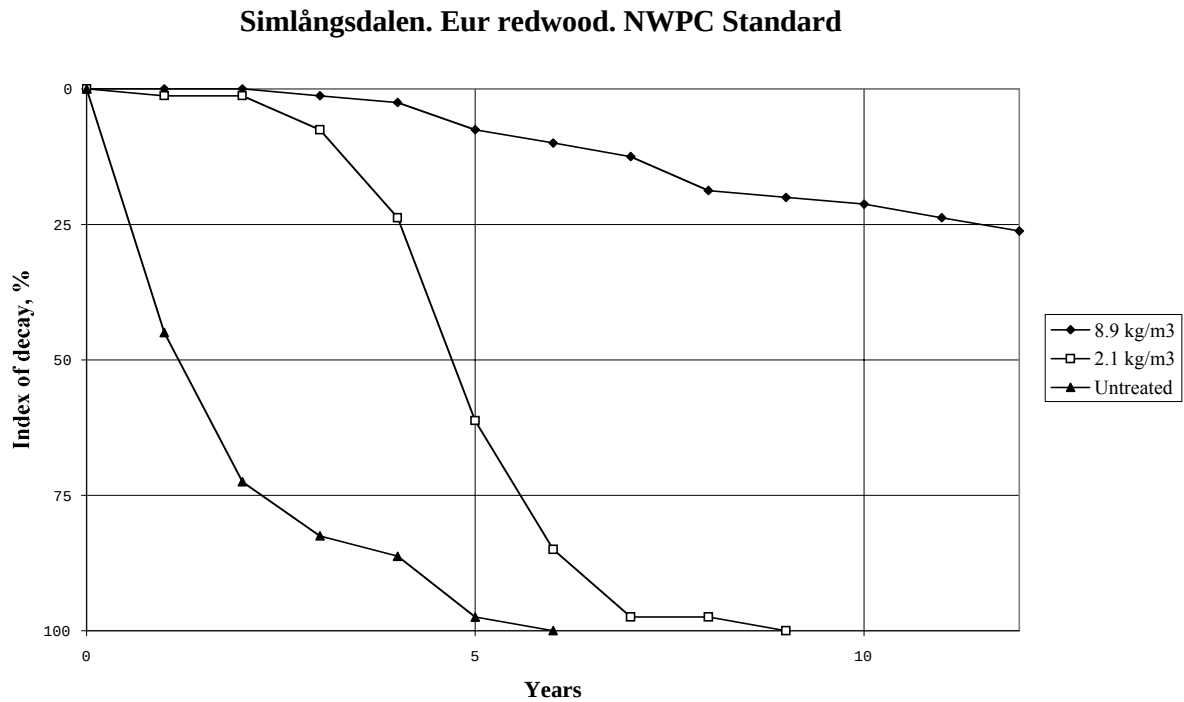


Figure 158. Field trial 1987. Rate of decay for stakes treated with NWPC Standard and untreated stakes.

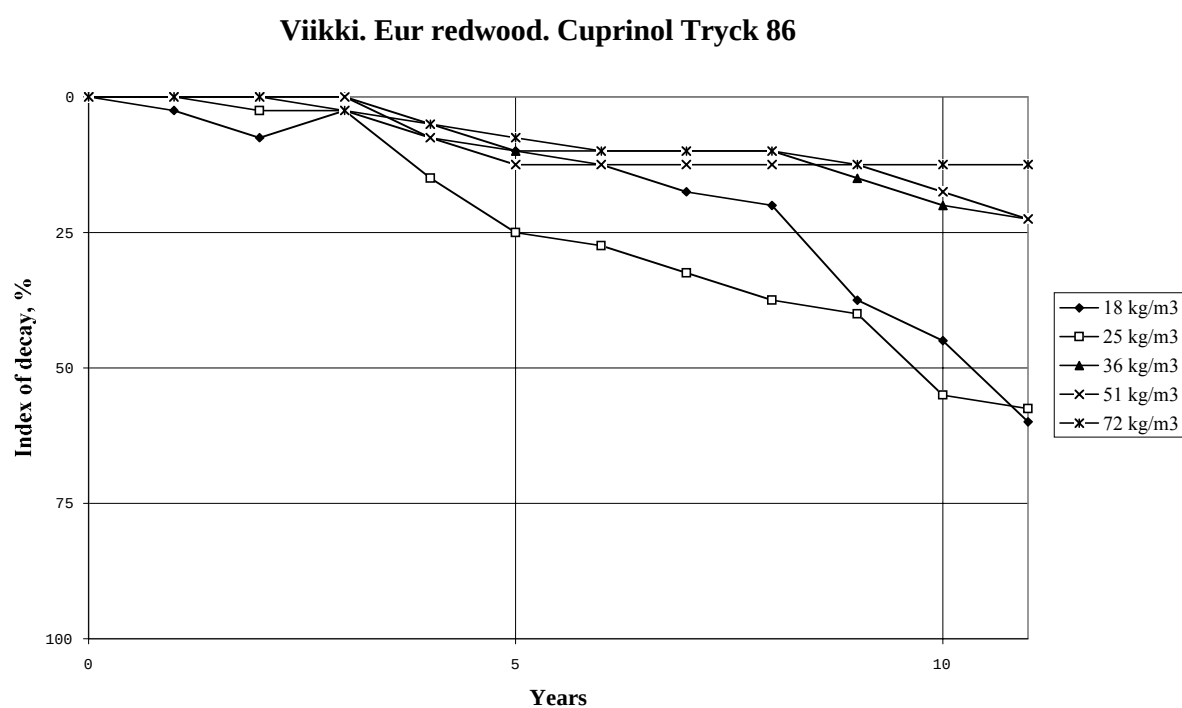
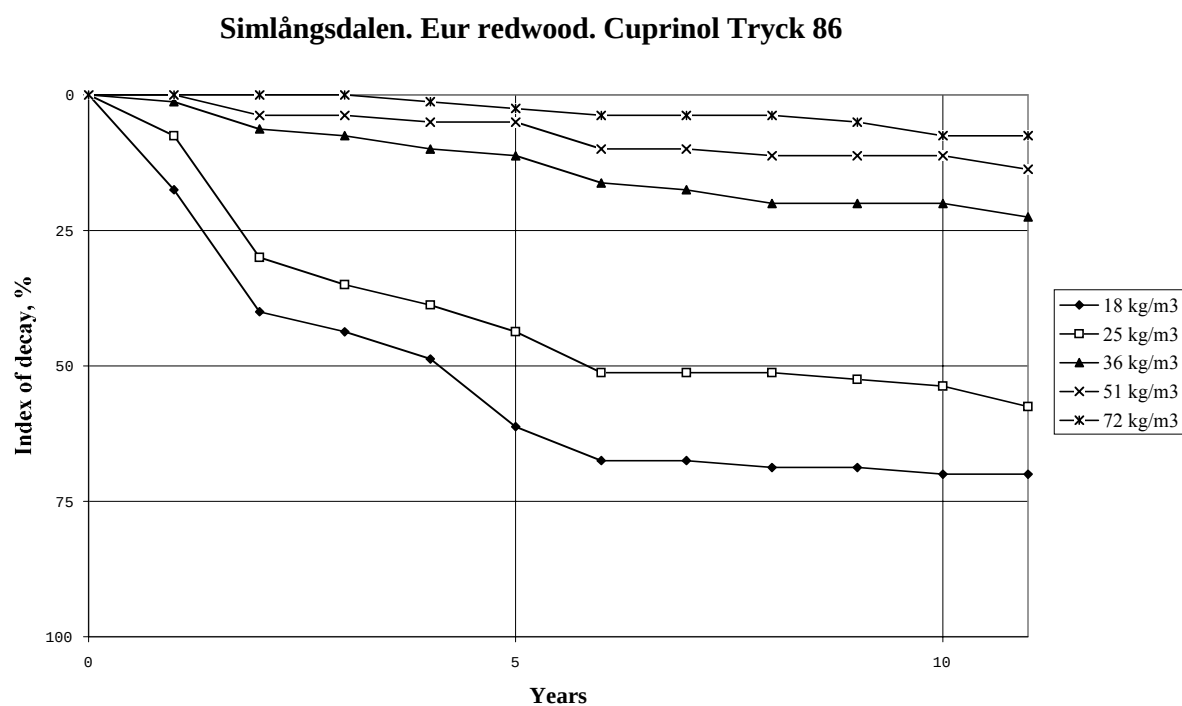
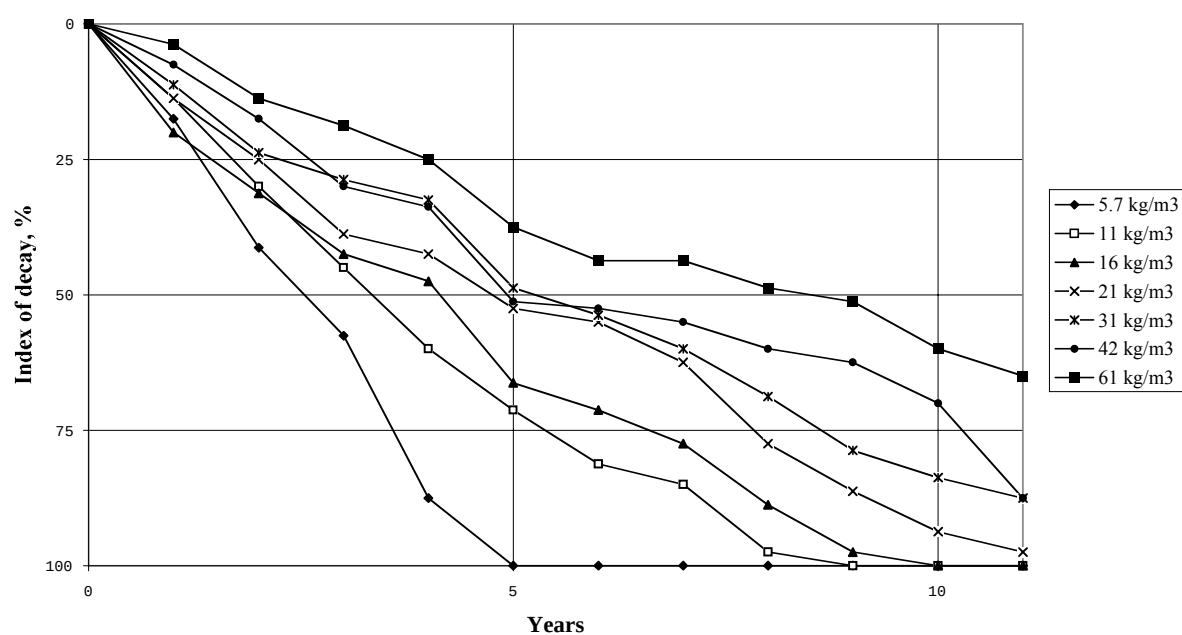


Figure 159. Field trial 1988. Rate of decay for stakes treated with Cuprinol Tryck 86.

Simlångsdalen. Eur redwood. Test product F



Viiikki. Eur redwood. Test product F

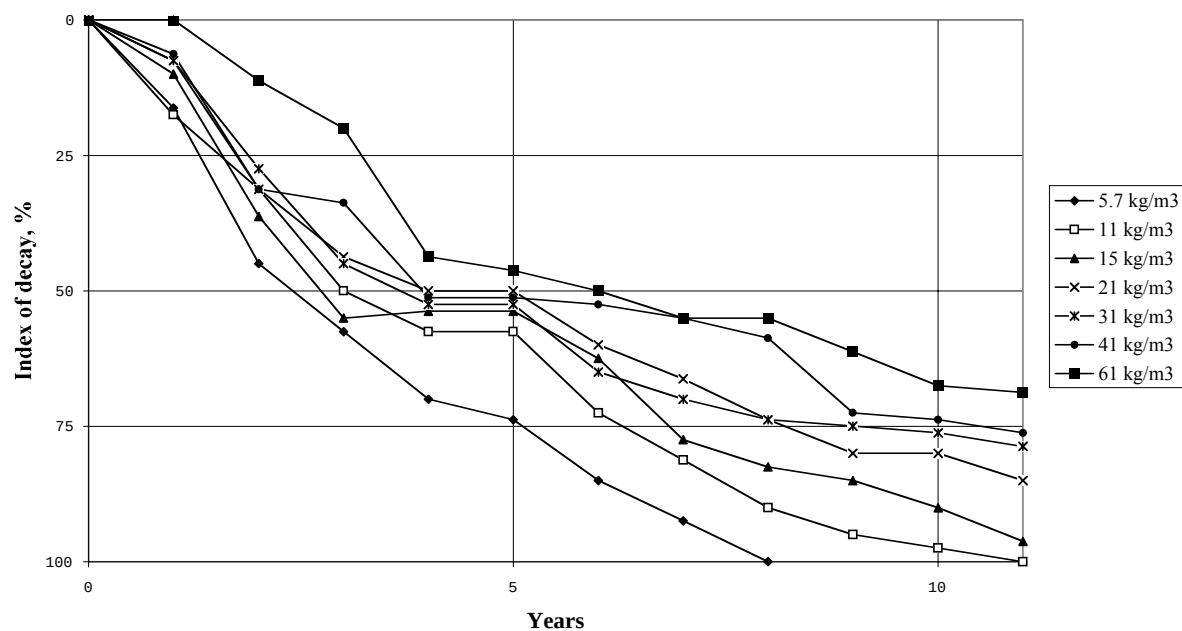


Figure 160. Field trial 1988. Rate of decay for stakes treated with Test product F.

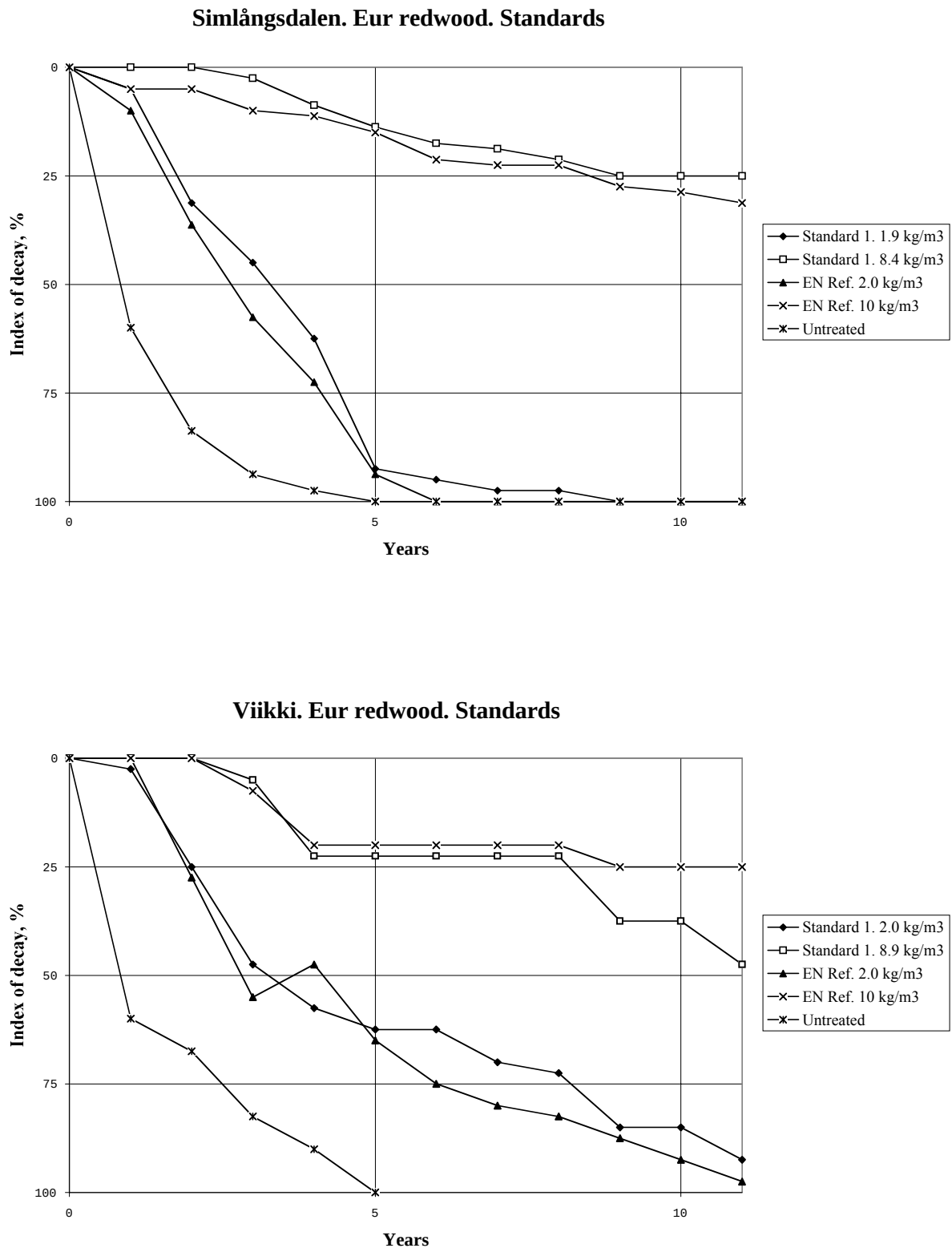


Figure 161. Field trial 1988. Rate of decay for stakes treated with NWPC Standard No 1, EN Ref., CCA and untreated stakes.

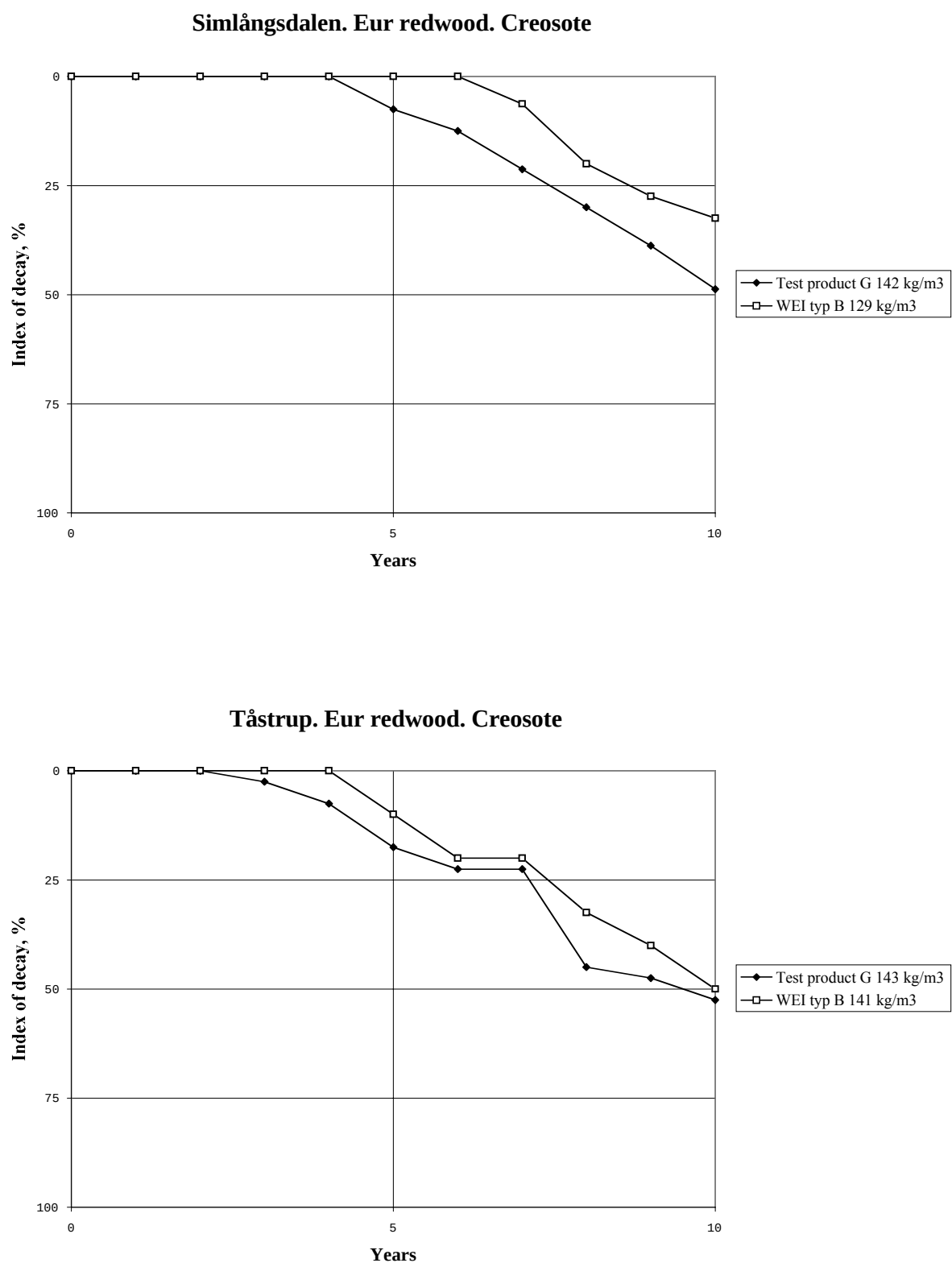


Figure 162. Field trial 1989. Rate of decay for stakes treated with creosote.

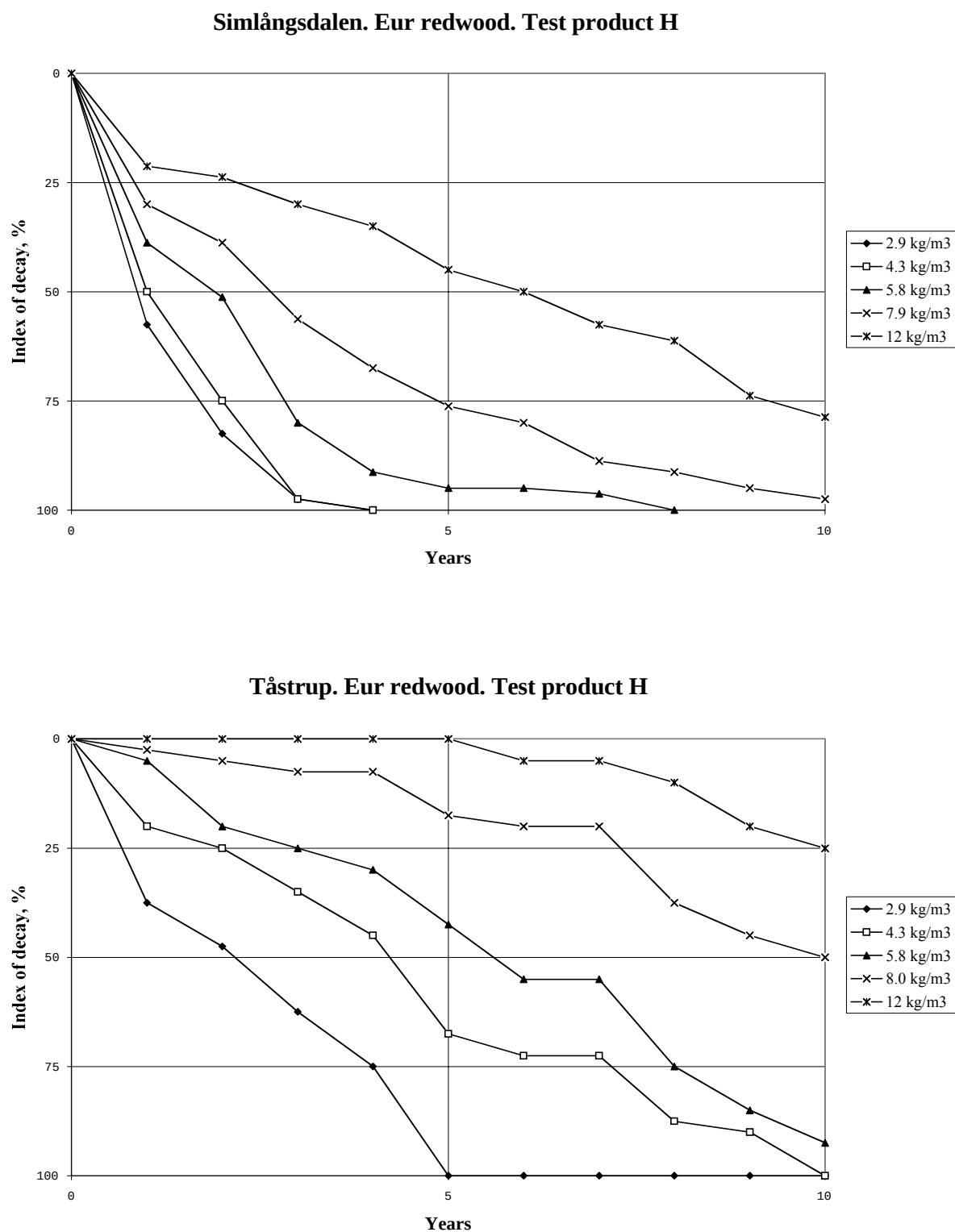


Figure 163. Field trial 1989. Rate of decay for stakes treated with Test product H.

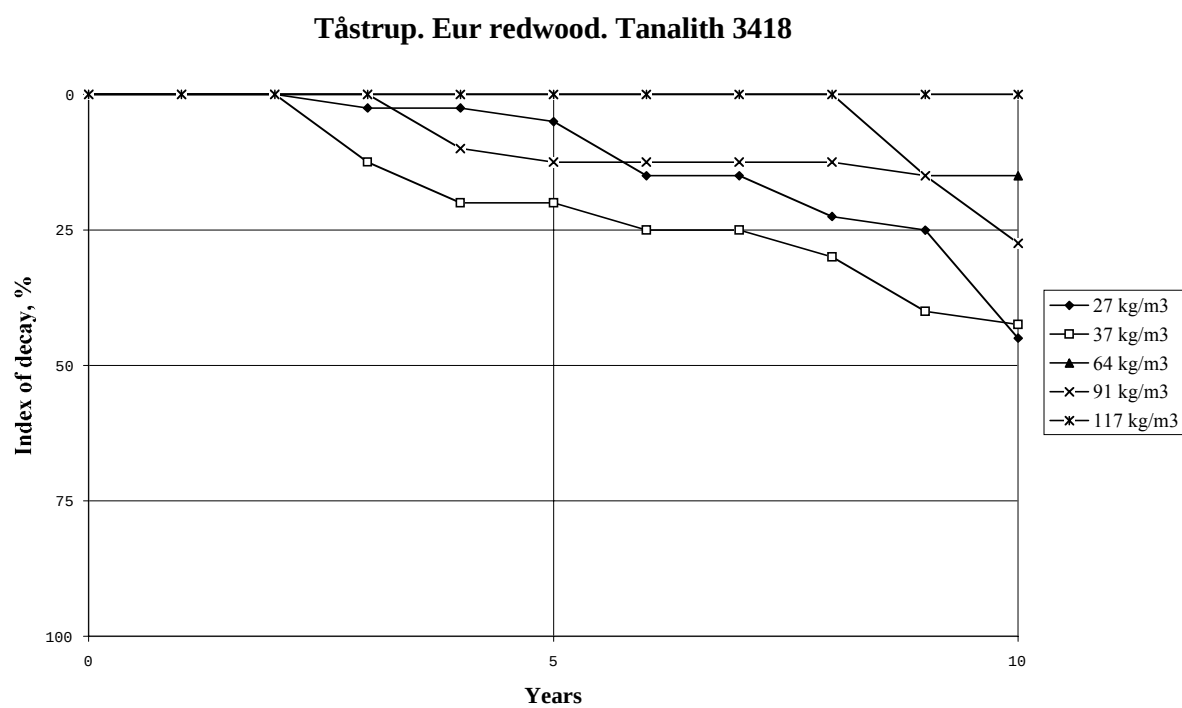
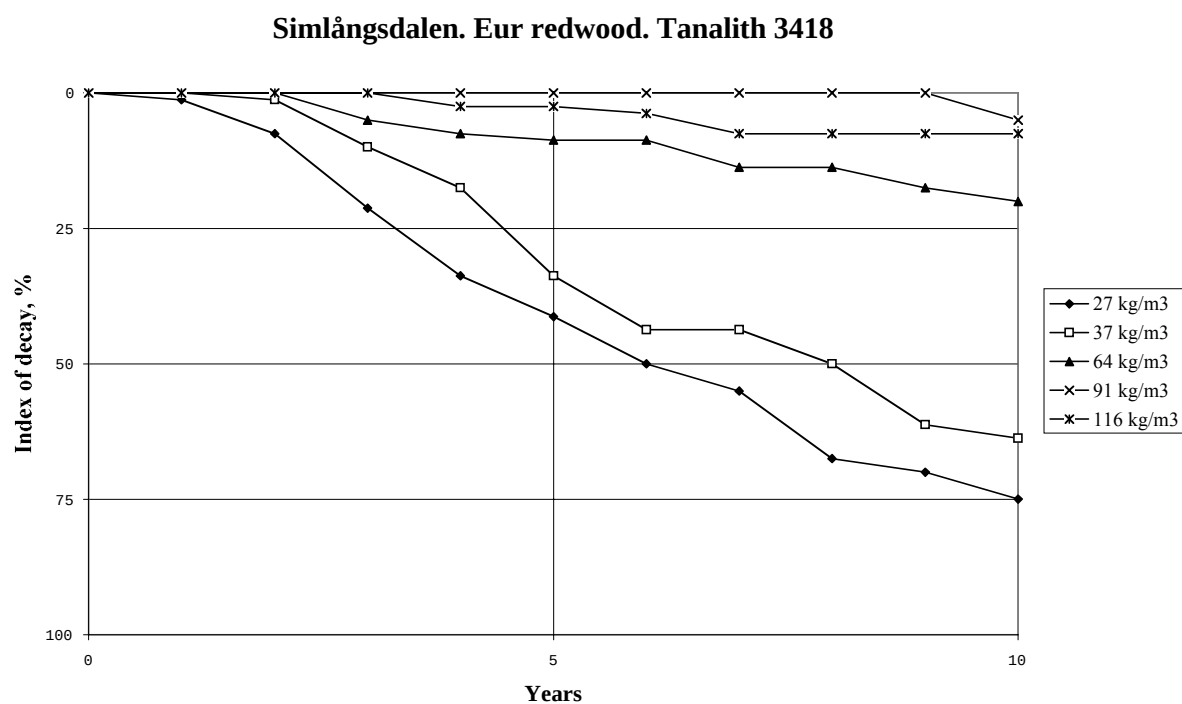


Figure 164. Field trial 1989. Rate of decay for stakes treated with Tanalith 3418.

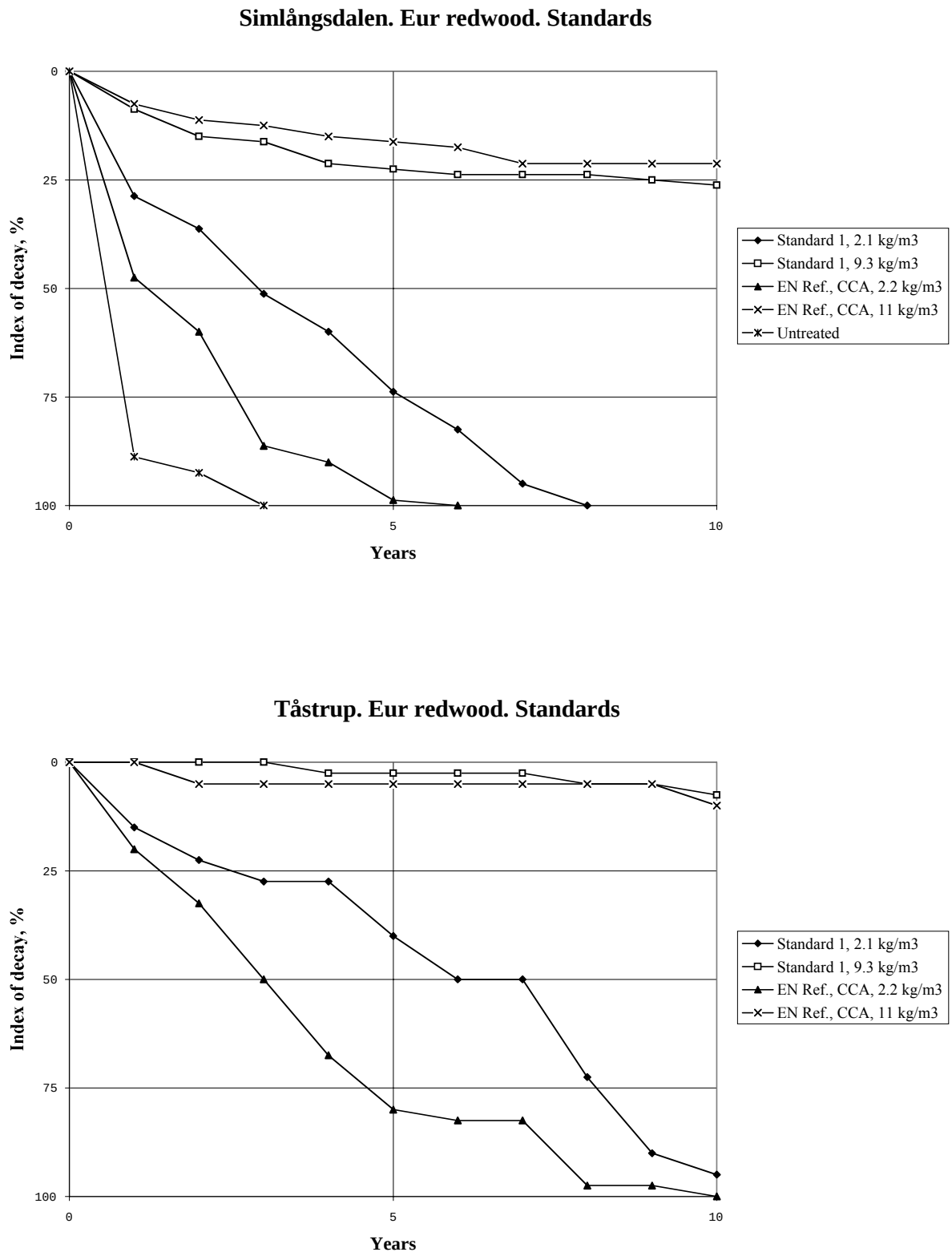


Figure 165. Field trial 1989. Rate of decay for stakes treated with NWPC Standards No 1, EN Ref., CCA and untreated stakes.