SVENSKA TRÄSKYDDSINSTITUTET

SWEDISH WOOD PRESERVATION INSTITUTE

Meddelanden
Reports

Nr 174 1999

ISSN 0346-7090

Inventory of the use of preservative-treated wood and wood preservatives in Sweden 1900 – 1997

Jöran Jermer

and

Kent Nilsson

STOCKHOLM 1999

Inventory of the use of preservative-treated wood and wood preservatives in Sweden 1900-1997

Jöran Jermer* and Kent Nilsson**

*SP Swedish National Testing and Research Institute
PO Box 857, SE-501 15 Borås, Sweden

**SLU Swedish University of Agricultural Sciences
Dept of Wood Science
PO Box 7008, SE-750 07 Uppsala, Sweden

Rapporten ursprungligen publicerad som IRG 99-50137 och presenterad vid The International Research Group on Wood preservation 30th Anuual Meeting i Rosenheim, Tyskland 6-11 June 1999.

Foreword

In 1994 the Swedish Wood Preservation Institute (SWPI) published a report in Swedish (Träskyddsinstitutets miljöprojekt 1990-1994, report no 170) summarising a wide range of different projects related to the environmental impact of the use of preservative treated wood. One project reported on the use of wood preservatives in Sweden between 1900-1990.

The present study is a follow up of the above mentioned study adding the last seven years until 1997 and specifically studying the period 1990-1997, i.e. because of the restrictions posed by the Swedish environmental authorities during that period.

The work presented in this report has been prepared by Jöran Jermer, SP Swedish National Testing and Research Institute, and Kent Nilsson, Fungiwood Consulting, on statistical data compiled by the Swedish Wood Preservation Institute.

This report will be published by International Research Group on Wood Preservation (IRG) as paper IRG/WP 99-50137 prepared for, and to be presented at IRG 30th Annual Meeting in Rosenheim, Germany 6-11 June 1999.

SWEDISH WOOD PRESERVATION INSTITUTE

Stockholm in June 1999

Magnus Estberg

© Svenska Träskyddsinstitutet/Swedish Wood Preservation Institute

Inventory of the use of preservative-treated wood and wood preservatives in Sweden 1900-1997

Jöran Jermer* and Kent Nilsson**

*SP Swedish National Testing and Research Institute
PO Box 857, SE-501 15 Borås, Sweden

**SLU Swedish University of Agricultural Sciences
Dept of Wood Science
PO Box 7008, SE-750 07 Uppsala, Sweden

Abstract

The objective of this study was to present an overview of the use of wood preservatives and their active ingredients and industrially preservative-treated wood in Sweden since the beginning of the 20th century. The data presented in the report could for example be used as a basis for different waste management scenarios for preservative-treated wood.

Before 1960 railway sleepers and utility poles were the most important preservative-treated commodities used in Sweden. Since 1960 sawn timber and other commodities have dominated the market. The total production of preservative-treated wood during the last ten years has been between 400 000 and 600 000 m^3 per year. During this period about 60% of the production has been for the Swedish domestic market.

A relatively small number of preservative types has been used in Sweden. Creosote has been used mainly for sleepers and poles. CCA dominates for sawn timber, but since 1994 preservatives based on other active ingredients than arsenic and chromium - such as ACQ, copper-azole and copper-HDO - have gained market for above ground commodities. Light organic solvent type preservatives (LOSP), with active ingredients such as organotin compounds and, recently, triazoles, were introduced in the 1970s for the treatment of external window joinery.

Since 1900 up to 1997, in total, approximately 640 000 tonnes creosote, 14 000 tonnes arsenic and 9 000 tonnes of each of copper and chromium have been used in Sweden for industrial wood preservation for the domestic market only.

Keywords: Wood preservatives, preservative-treated wood, active ingredients, Sweden, production statistics

1. Introduction

Industrial wood preservation, i.e. wood preservation mainly carried out by vacuum-pressure or double vacuum processes, was established in Sweden in the 1850s and the wood preserving industry is nowadays one of the country's most important wood processing industries. Since about 1970 the total production, including the exported volumes, has been between 400 000 m^3 and 600 000 m^3 per year (Figures 1 and 3). Characteristically, a relatively small number of wood preservative types has been used by the industry. The most commonly used, however, creosote and CCA are also those often being questioned from the environmental point of view, not only in Sweden but also in other countries.

In order to carry out realistic risk assessments for the use of treated wood and scenarios for waste management options with treated wood it is advantageous to have knowledge about, e.g:

- wood preservative types used,
- commodities/constructions treated, and
- amounts of preservative (retentions) normally used.

The aim of the present study, carried out in collaboration between SP Swedish National Testing and Research Institute, Dept of Building Technology, and SLU Swedish University of Agricultural Sciences, Dept of Wood Science, was to present an overview of the use of wood preservatives and their active ingredients and industrially preservative-treated wood in Sweden since the beginning of the 20th century. Another objective was to present a more detailed survey of the period 1991-1997 and the effects of the restrictions on the use of arsenic and chromium based wood preservatives that became effective in 1994.

2. Method

The basis for the present study has mainly been:

- wood preservation statistics in Sweden from 1950 to 1997, compiled by the Swedish Wood Preservation Committee and, since 1973, the Swedish Wood Preservation Institute.
- personal communications with former employees from the wood preserving industry and major users of treated wood, such as the Swedish Telecom and the Swedish State Railways, who supplied company specific information and related historical documents, mainly in order to get more information about the period 1900-1950 for which information in published literature is rather sparse.
- information on wood preservative formulations and retentions used. This information has been available in the literature, e.g. in publications by the Swedish Wood Preservation Institute, the National Chemicals Inspectorate and in lists of approved wood preservatives issued by the Nordic Wood Preservation Council.
- the authors' experience and general knowledge of the wood preserving industry and the market and use of preservative-treated wood in Sweden.

As to the amount of active ingredients used an extensive survey carried out by the Swedish Wood Preservation Institute in 1991 (Anon., 1994) has been the basis for this report. It has been updated with figures for the period 1991-1997. The calculations have been based on figures for the production of preservative-treated wood in Sweden adjusted for export. Details concerning, e.g. the calculation models are reported in Anon. (1994).

3. Results

3.1 Wood preservatives and active ingredients

A relatively small number of wood preservative types has been used in Sweden during the studied period. These types are specified in Table 1.

The total production of preservative-treated wood by type of preservative 1950-1997, including the exported volumes, is shown in Figure 1.

Creosote has been used mainly for utility poles and railway sleepers since 1899. The treatment with creosote had its peak in the 50s and has decreased dramatically since then.

Before 1950, along with creosote, two types of water-borne systems dominated, copper sulphate which was used for the treatment of poles for almost 90 years, and Boliden BIS, the first arsenic containing preservative introduced in Sweden. Boliden BIS was used for approximately 15 years, again mainly for the treatment of poles.

Table 1. Most commonly used wood preservative types in Sweden

Wood preservative type	Period on the market	Commercial product (examples)	Active ingredient(s)
Water-borne type			
Copper sulphate	1858-1944	-	copper
CZA	1936-ca 1950	Boliden BIS	chromium, zinc, arsenic
CCA type B	1952-1993	Boliden K33	copper, chromium, arsenic
CCA type C	1994-	Rentokil CCA type C60	copper, chromium, arsenic
CC	1955-	Celcure O	copper, chromium
CCB	1972-	Tanalith CBC	copper, chromium, boron
CCP	1979-	Rentokil P50	copper, chromium, phosphorous
Cu-PCPNa	1955-1978	KP Cuprinol	copper, sodium-PCP
ACQ	1979-	Kemwood ACQ 1900	copper, quats
Copper-azole	1994-	Tanalith E	copper, tebuconazole
Copper-HDO	1993-	Wolmanit CX-S	copper, boron, HDO
Organic solvent type			
PCP	1963-1978	BP Hylosan	pentachlorophenol
Organotin	1974-1995	Vacsol EWR 52	tributyltin oxide
Organotin	1976-1995	Gori vac 007	tributyltin naphthenate
Triazoles	1994-	Gori vac TH 92	tebuconazole, propiconazole, IPBC
Creosote	1899-		

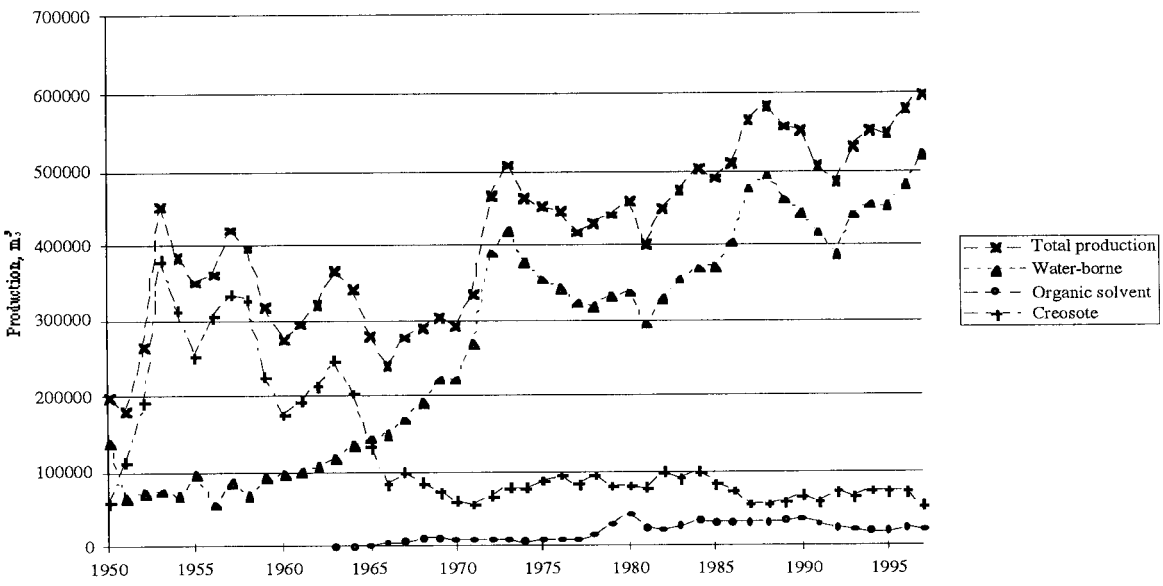

Figure 1. Production of preservative-treated wood in Sweden 1950-1997 by type of preservative, m^3.

On 1 January 1994 the National Chemicals Inspectorate introduced restrictions on the use of creosote and chromium and arsenic containing preservatives (Anon., 1990). These restrictions dramatically changed the use of different wood preservatives in Sweden. Before 1994 the CCAs had approximately 85% of the domestic market for treated sawn timber. In 1994 it was suddenly reduced to approximately 40 % of this market. At the same time the wood treated with chromium and arsenic free preservatives gained a market share of approximately 55%. This development is illustrated in Figure 2.

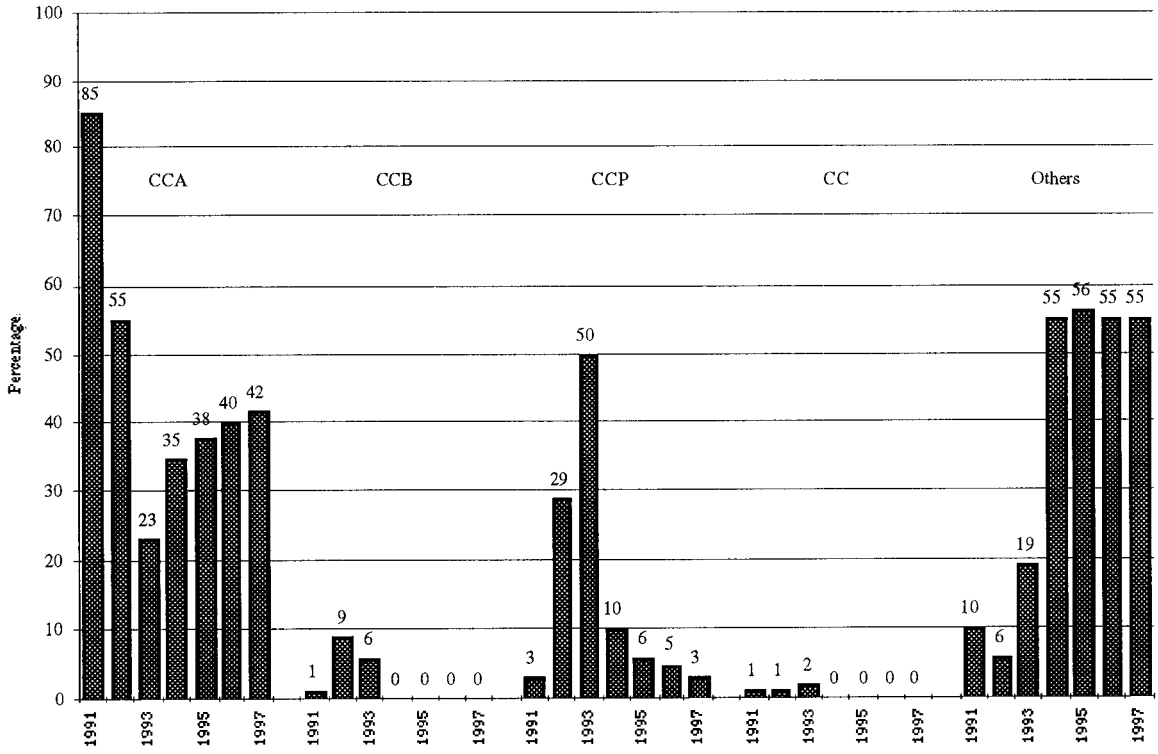

Figure 2. Percentage of different water-borne preservative types used for treatment of sawn timber of European redwood produced for the Swedish domestic market 1991-1997.

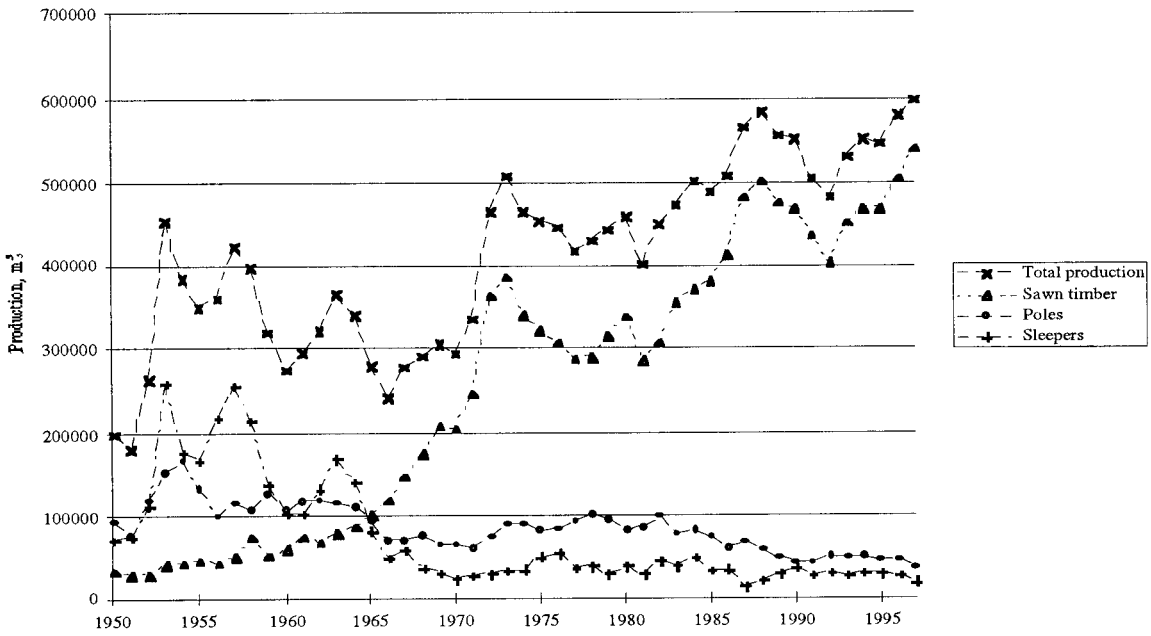

Figure 3. Production of preservative-treated wood in Sweden 1950-1997 by type of commodity, m^3.

The treatment with LOSP has been rather limited in Sweden. During the period 1963-1978 pentachlorophenol was used for the treatment of sawn timber and fence posts. In the mid 70s LOSPs were introduced for the treatment of external joinery. Wood preservatives based on organotins were used until they were banned in 1995. In 1994 preservatives based on triazoles (tebuconazole and propiconazole) and IPBC (3-iodo-2-propynylbutyl carbamate) were introduced for the treatment of external joinery.

3.2 Commodities and constructions of treated wood

Industrially treated wood has traditionally been used for commodities and constructions where long durability and a minimum of maintenance have been desired. The total production of treated wood in Sweden specified for railway sleepers, poles and sawn timber is shown in Figure 3. Poles and sleepers are unambiguous commodities whereas sawn timber is a very heterogeneous group. However, the vast amount is used for various outdoor commodities (see Figure 4) and treated wood is rarely used indoor. In Table 2 the main commodities for treated wood and corresponding types of preservative are shown.

Table 2. Main end-uses for industrially preservative-treated wood in Sweden

End-use	Wood preservatives mainly used
Railway sleepers	Creosote CCA in small amounts
Poles (utility, telephone)	Creosote CCA CCB to some extent
Fence posts	CCA Other water-borne (mainly CC, CCB, CCP) to some extent PCP was used to some extent 1963-78
External timbers, mainly garden timbers (see Figure 4)	CCA and other water-borne preservatives* LOSP (organotin, triazoles) to some extent Creosote in used railway sleepers
Civil engineering (bridges, piling, noise barriers)	CCA and other water-borne preservatives* Creosote
Sports and recreation	CCA and other water-borne preservatives*
Playgrounds	CCA and other water-borne preservatives* LOSP (organotin, triazoles)
Agriculture (constructional timbers)	CCA and other water-borne preservatives* Creosote to limited extent
Marine timbers	CCA Creosote
House building (constructional timbers, cladding etc)	All types are used to limited extent. Water-borne are most frequently used but LOSP (organotin, triazols) are used for external joinery

*Since 1994 arsenic and chromium free preservative types are mainly used for above ground commodities.

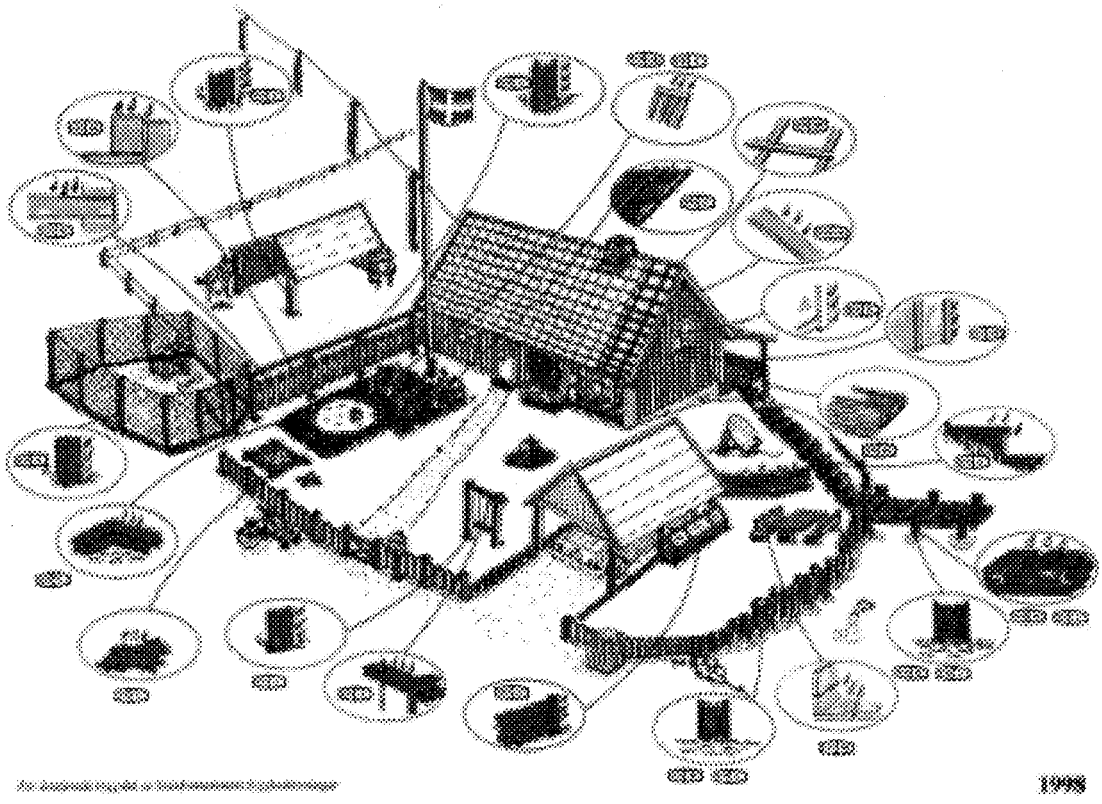

Figure 4. Main end-uses for preservative-treated sawn timber in Sweden.
Courtesy of the Swedish Wood Preserving Association.

Table 3. Amounts of active ingredients used in Sweden before and after 1970 for the production of treated wood for the Swedish domestic market (tons of elements and compounds respectively)

Active ingredient	Amounts used (tons of elements and compounds respectively)		
	Before 1970	After 1970	Total
Elements			
Arsenic	6 600	7 700	14 300
Boron	-	150	150
Phosphorus	-	270	270
Copper	2 500	6 100	8 600
Chromium	3 000	5 900	8 900
Zinc	2 900	-	2 900
Tin (in organotins)	-	40	40
Compounds			
Creosote	499 000	145 000	644 000
Pentachlorophenol	190	450	640
Quats	-	500	500
Triazoles	-	12	12
IPBC	-	5	5

3.3 Amounts of active ingredients

Table 3 contains a compilation of the amounts of active ingredients used in Sweden before and after 1970 for the production of treated wood for the domestic market. The reason for showing the amounts before and after 1970 is that in the early 1970s the use of treated sawn timber increased heavily. Thus, the timber treated from 1970 and onwards is of primary interest from waste management point of view.

In Table 4 the amounts of active ingredients used are shown for the periods before and after 1950. For the period after 1950 the amounts of active ingredients used are shown for sawn timber/other commodities and sleepers/poles respectively. Before 1950 it has not been possible to find information concerning different commodities. However, if the assumption that most of the treated wood before 1950 was in fact poles and sleepers is accepted one will get information about the relative importance of the two groups of commodities with respect to their content of active ingredients. When considering waste management options such information is very useful.

Table 4. Amounts of active ingredients used in Sweden before and after 1950 for the production of treated wood for the Swedish domestic market (tons of elements and compounds respectively)

Active ingredient	Amounts used (tons of elements and compounds respectively)			
	Before 1950	After 1950		Total
		Sawn timber/others	Poles/sleepers	
Elements				
Arsenic	3 900	8 000	2 400	14 300
Boron	-	140	10	150
Phosphorus	-	270	-	270
Copper	770	6 500	1 330	8 600
Chromium	1 270	6 100	1 530	8 900
Zinc	2 900	-	-	2 900
Tin (in organotins)	-	40	-	40
Compounds				
Creosote	225 000	15 000	404 000	644 000
Pentachlorophenol	-	640	-	640
Quats	-	500	-	500
Triazoles	-	12	-	12
IPBC	-	5	-	5

The restrictions against the use of treated wood containing chromium and arsenic introduced in 1994 have influenced the amounts of active ingredients used, mainly for sawn timber. Table 5 shows how the use of active ingredients has developed between 1991 to 1997. Copper is the major component in all water-borne preservatives used for sawn timber. Figure 5 shows the percentage copper used for sawn timber treated with chromium containing and chromium free preservatives respectively for the period 1991-1997.

Table 5. Amounts of active ingredients used for sawn timber for the Swedish domestic market 1991-1997 (tons of elements and compounds respectively)

Active ingredient	Year (tons of elements and compounds respectively) 1991	1992	1993	1994	1995	1996	1997
Copper	180	185	190	130	145	145	160
Chromium	185	200	185	100	95	105	110
Arsenic	270	160	65	65	70	80	90
Boron	1	7	4	4	2	4	4
Phosphorus	6	24	80	15	10	8	6
Quats	13	6	12	70	30	16	21
Triazoles	-	-	-	0,4	0,5	1,5	1,5

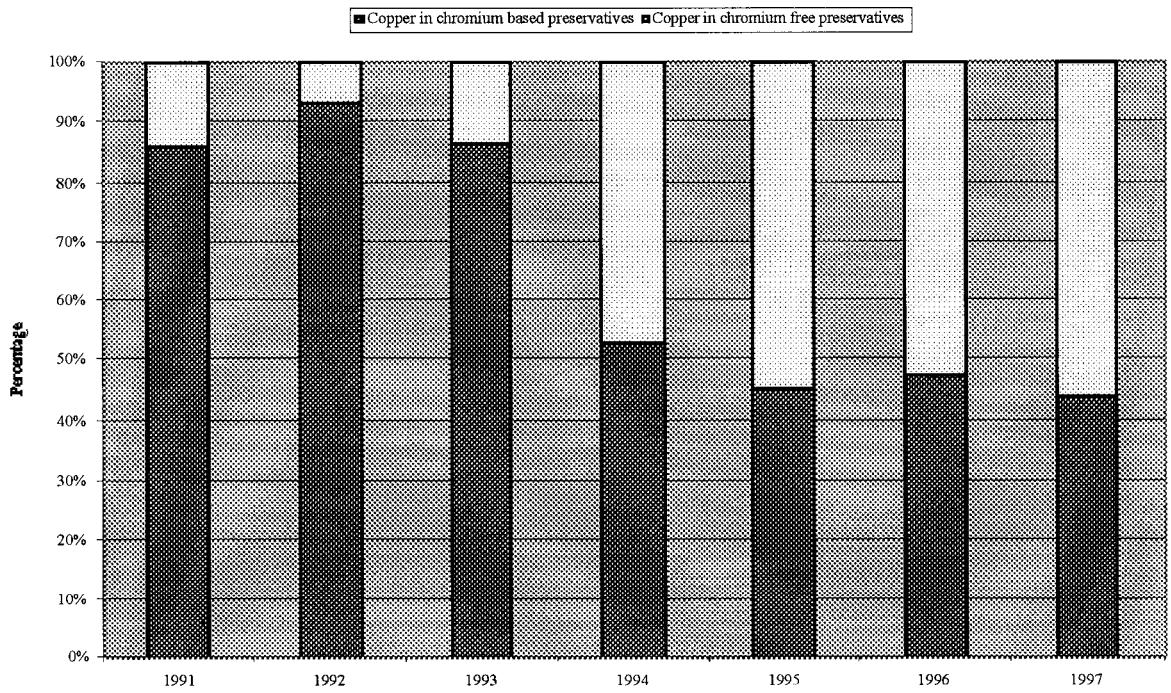

Figure 5. Percentage copper for sawn timber of European redwood treated with chromium based and chromium free preservatives respectively for the Swedish domestic market 1991-1997.

4. Discussion

The information presented in this study provides a Swedish basis for risk assessment in connection with the use of treated wood but also for different waste management options for treated wood. The data on amounts of active ingredients used for the Swedish domestic market are unique and previously not publicly available.

As mentioned already a relatively small number of preservative types has been used in Sweden during the studied period. Retention levels for different preservatives have been well defined and the data on treated amounts of wood have been sufficiently reliable and accurate. It has therefore been possible to satisfactorily calculate the amounts of active ingredients used.

Looking at the use of different wood preservatives in Sweden one can note the following:

- The use of creosote had its peak during the 50s and early 60s. Since then the Swedish production and domestic use has decreased considerably.
- Pentachlorophenol was used during a short period, 1963-1978, and in rather small amounts. It was banned in 1978.
- Organotin compounds were used for external joinery between 1974 and 1994. Since 1995 they are banned. They have been replaced by triazoles.
- When looking at the amounts of active ingredients used for the period 1900-1997 according to different commodities it shows that 44% of the used arsenic, 24% of the copper and 31% of the chromium has been used for the well defined, rather easily identified commodities poles and sleepers.
- The use of CCA has decreased radically as a consequence of the restrictions introduced by the National Chemicals Inspectorate. Before 1994 approximately 85% of the sawn timber for the domestic market was treated with CCA. Since 1994 that percentage is approximately 40%.
- For sawn timber - the major commodity - the use of arsenic has decreased from more than 250 tons per year in 1991 to just less than 100 tons in 1997. The use of chromium has also decreased but not to the same extent - from approximately 200 tons per year in the early 90s to approximately 100 tons today. The amount of copper has only decreased slightly - from approximately 180 tons to approximately 160 tons per year.
- CCA type B preservatives were replaced by CCA type C, with a lower arsenic content but higher chromium content, in 1993-1994.
- Alternative preservation methods, such as chemical modification and heat treatment, have not yet been commercially used in Sweden.

If one should estimate the amount of active ingredients accumulated in treated wood today it is reasonable to assume that the figures shown for the period after 1970 represent a fairly good estimate. Thus, it is, e.g. approximately 8 000 tons arsenic, 6 000 tons of copper and chromium respectively.

In order to estimate the amounts of active ingredients in annual waste flows, figures like those presented in Table 4, presented on a yearly basis for the period 1991-1997, are required and not only figures on the total amounts of the different active ingredients used during the whole period. Although not shown here such figures are possible to calculate with the help of the production statistics available.

Acknowledgements

The authors gratefully acknowledge the Swedish Wood Preservation Institute for financial support of the project.

References

Anon. 1950-1972. Swedish Wood Preservation Committee: Wood preservation statistics for the years 1950-1972. (In Swedish).

Anon. 1973-1997. Swedish Wood Preservation Institute: Wood preservation statistics for the years 1973-1997. (In Swedish, English summary).

Anon. 1990. The National Chemicals Inspectorate's regulations on preservative-treated wood. Swedish National Chemicals Inspectorate Code of Statutes, KIFS 1990:10 (ISSN 0283-1937).

Anon. 1994. Träskyddsinstitutets miljöprojekt 1990-1994. Swedish Wood Preservation Institute, report no. 170. (In Swedish).

Jermer, J., Edlund, M.-L. and Nilsson, K. 1995. The implementation of restrictions on the use of arsenic and chromium based wood preservatives in Sweden. The International Research Group on Wood Preservation, Document No. IRG/WP 95-50062.

Tullin, C. And Jermer, J. 1998. Inventering och energiutvinning av träskyddsbehandlat virke i Sverige. Värmeforsk report no. 653. (In Swedish, English summary).